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GLOBAL SUPPLY CHAIN MANAGEMENT IN THE MANUFACTURING INDUSTRY

Configurations, improvement programs and performance

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Index

Tables list

Figures list

List of abbreviations used in the text

SC: Supply Chain

SCM: Supply Chain Management

GVC: Global Value Chain

Preface

This thesis reports the results of the research developed during a three year PhD Program in Economics and Technology Management at the Università degli Studi di Bergamo. The research focuses on supply chain management and how it is related to supply chain globalization choices with a specific reference to the manufacturing industry.

This work is actually part of a broader research project on global supply chains carried on by the University that brought over time to several publications (see the publications list below) to which I directly contributed. The project started in 2008 with some papers presented at conferences [1, 2] and published on international journals [3, 4]. The main results of these papers are reported in the literature review section of this thesis.

The results presented in this work are instead based on other papers developed in 2009 and 2010. These papers have been presented [5-6] or will be presented at international conferences [7, 8] or have already been published [9].

The work benefited also of two international collaborations. First of all the International Manufacturing Strategy Survey network that every four years gathers data on more than 600 companies from about 19 countries through a detailed questionnaire. Part of the results presented in this work is based on data collected in 2009 where the questionnaire was specifically updated with questions about global supply chain management.

Next, the work benefited of a research period of 5 months spent at the Center on Globalization, Governance and Competitiveness of the Duke University where I had the chance to learn and apply the so called Global Value Chain analysis. In this thesis, some results of a report written with Marcy Lowe and Gary Gereffi on the electric motor industry are presented [10].

Errors of fact or interpretation in this thesis remain exclusively with the author.

Publications list

1. Cagliano, R., Caniato, F., Golini, R., Kalchschmidt, M., 2008. Supply chain configurations in a global environment: a longitudinal perspective, 15th EurOMA Conference, Groningen (The Netherlands).
2. Caniato, F., Golini, R., Kalchschmidt, M., 2008. Supply chain integration in a global sourcing context, 18th Ipsera Conference, Wiesbaden (Germany).
3. Cagliano, R., Caniato, F., Golini, R., Kalchschmidt, M., Spina, G., 2008. Supply chain configurations in a global environment: A longitudinal perspective. Operations Management Research 1 (2), 86-94.
4. Golini, R., Kalchschmidt, M., 2010. Moderating the impact of global sourcing on inventories through supply chain management. International Journal of Production Economics doi:10.1016/j.ijpe.2010.06.011.
5. Caniato, F., Golini, R., Kalchschmidt, M., 2010. Global Supply Chain Configurations and Drivers, 17th EurOMA Conference, Porto (Portugal).
6. Caniato, F., Golini, R., Kalchschmidt, M., 2010. On supply chain improvement programs and performance improvement: the moderating effect of global supply chain configurations. Submitted to International Journal of Production Economics.

7. Caniato, F., Golini, R., Kalchschmidt, M., 2011. Global Supply Chain Strategies in Manufacturing: A Global Value Chain Perspective, forthcoming18th EurOMA Conference, Cambridge (London).
8. Golini, R., Kalchschmidt, M., 2011. Managing inventories in global sourcing contexts: a contingency perspective, forthcoming 20th IPSERA Conference, Maastricht (The Netherlands).
9. Golini, R., Kalchschmidt, M., 2010. Global Supply Chain Management and delivery performance: a contingent perspective, Rapid modeling and quick response - intersection of theory and practice. Springer, London, pp. 231-247.
10. Lowe, M., Golini, R., Gereffi, G., 2010. US Adoption of High-Efficiency Motors and Drives: Lessons Learned. Report prepared for the Environmental Defense Fund (EDF), February.

Executive Summary

Background

The opportunities for companies to operate on a global scale have significantly increased in the last decades, fostered by several factors like trade agreements, improvement in transportation and communication technologies. International manufacturing sources have been more and more sought out by managers, primarily to benefit from cost reduction, due to customs duty and trade concessions, low cost direct labor, capital subsidies and reduced logistics costs in foreign markets.

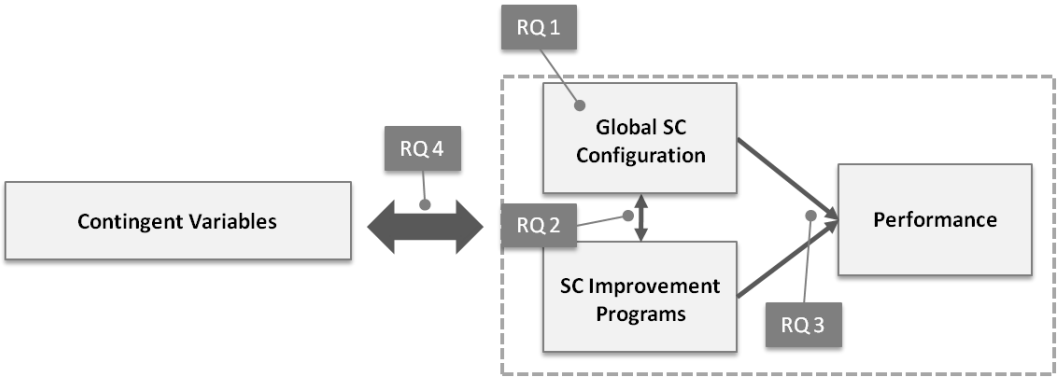
Exploiting such opportunities, the level of globalization of companies' supply chain (SC) has increased over time, in terms of global sourcing (i.e. buying from foreign countries), global manufacturing (i.e. producing in foreign countries) and global distribution (i.e. selling in foreign countries).

However, global SCs create several issues to the management, for instance geographical distance not only increases transportation costs, but also complicates decisions because of inventory cost tradeoffs due to increased lead-time in the SC. Companies can try to put in place some kind of collaboration or integration with their SC partners, but globalization makes it more difficult. For example, it is more difficult to perform just-in-time when suppliers are far away.

Objectives

Despite the relevance of the topic, literature does not provide many insights, especially at the plant level. Because of this, we aimed to fill these gaps taking the plant as unit of analysis. Figure A reports the research framework and the associated research questions.

Figure A - The research framework and the research questions investigated



First of all, we identified which are the recurrent global SC configurations in terms of global sourcing, manufacturing and distribution, answering to our first research question:

RQ 1: which are the main global SC configurations adopted by companies?

Then we investigated if these configurations were in relation with the adoption of different SC improvement programs, in order to answer to our second research question:

RQ 2: How configurations are related to different SC improvement programs?

Subsequently, we tested whether companies belonging to different configurations and adopting different SC improvement programs result in different performance. This was related to our third research question:

RQ 3: which is the performance achieved according to different configurations and SC improvement programs?

Finally, we analyzed how this model changes when considering some relevant contingencies like company size, product and market type. Our fourth research question, in fact, was:

RQ 4: what is the effect of contingent variables on the overall model?

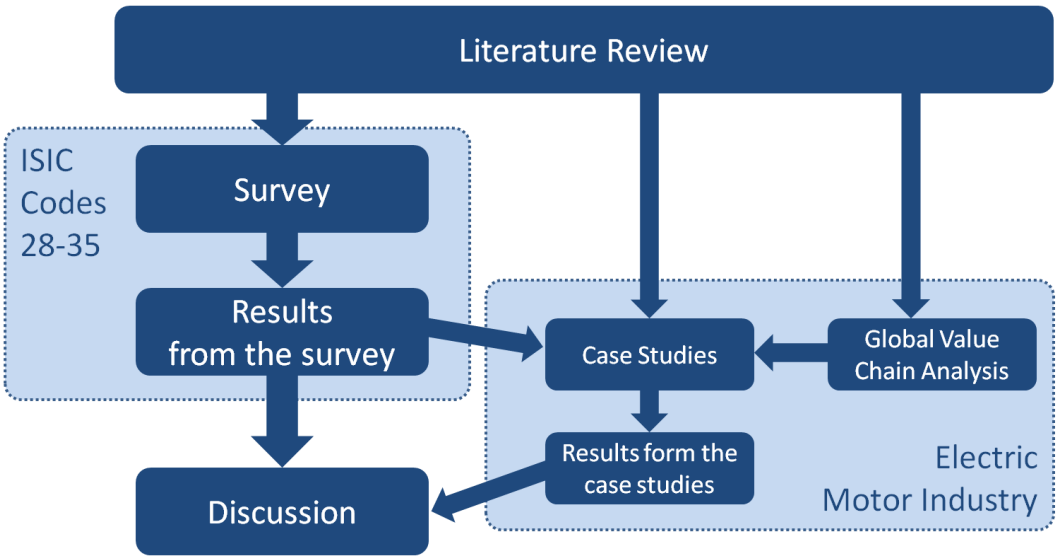
Methodology

We adopted a mixed methodology based on survey and case studies.

Given the rather developed state-of-art of research on global SCs, we have been able to investigate our research questions mainly through a survey. In particular we relied on the fifth edition of the International Manufacturing Strategy Survey (IMSS), an international research project focused on strategies put in place by companies in the assembly manufacturing industry. Data from 650 companies from 19 countries have been used for the purposes of this research.

Results obtained from the survey have been enriched by a set of case studies that helped in the interpretation and discussion. Specifically, eight Italian companies (6 manufacturers and 2 suppliers) belonging to the electric motor manufacturing industry have been interviewed. Case studies have been supported also by a Global Value Chain (GVC) analysis of the industry, helpful to identify the value chain stages, the key players and the relationships among them. The GVC analysis was developed during a visiting period at the Center on Globalization, Governance and Competitiveness of the Duke University (Durham, NC).

Figure B - Research methodology workflow



Results

The key results are hereafter organized according to the four research questions.

RQ 1: which are the main global SC configurations adopted by companies?

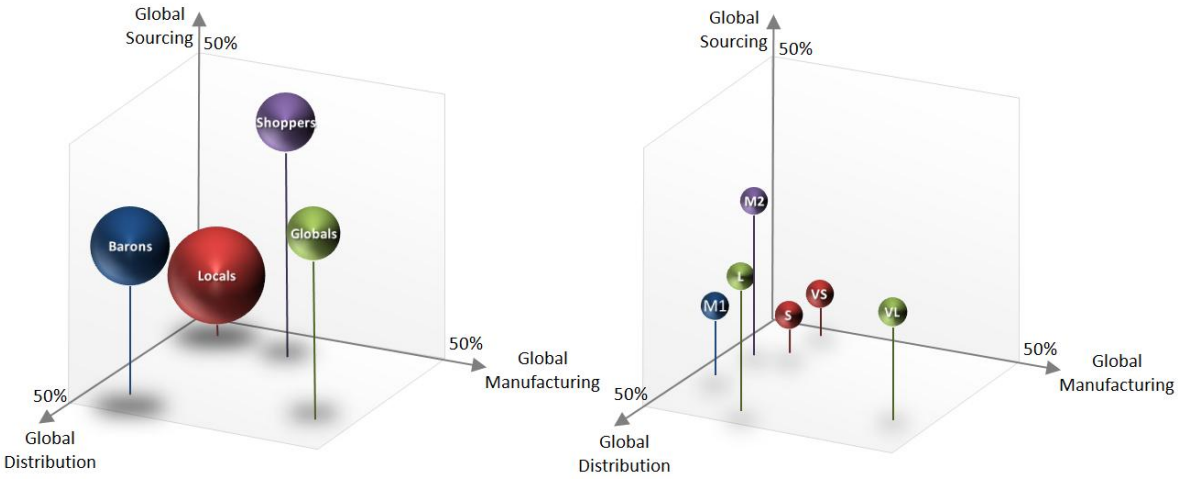
From the survey we identified 4 main configurations of global SC in terms of percentage of sourcing, manufacturing and sales outside the continent. These clusters have been labeled and defined as follows:

- Locals: local sourcing, manufacturing and distribution;
- Barons: local sourcing and manufacturing, global distribution;
- Shoppers: global sourcing, local manufacturing and distribution;
- Globals: global sourcing, manufacturing and distribution.

We have found that these clusters differ in terms of contingent variables, namely size, wealth of the country where the plant is located and localization advantages sought by the plant. We showed also that smaller firms are starting to globalize, at least in terms of sourcing. Finally, plant localization advantages have been seldom analyzed in relationship with global SC configurations, while they show some significant relationship.

By means of case studies we have shown how these four configurations can be a good synthetic representation, but other configurations can be identified especially when considering the country and not the continent as the threshold to define what is global and what is local. Moreover case studies helped in detailing possible alternatives in global sourcing, manufacturing and distribution (i.e. the role of intermediaries, sales units and global suppliers).

Figure C - Global SC clusters emerged from the survey (on the left) and case studies positioning (on the right)



RQ 2: How configurations are related to different SC improvement programs?

Here we considered the following SC improvement programs:

- Rethinking and restructuring the supply strategy, and the organization and management of supplier portfolio through e.g. tiered networks, bundled outsourcing, and supply base reduction;

- Implementing supplier development and vendor rating programs;
- Increasing the level of coordination of planning decisions and flow of goods with suppliers including dedicated investments (e.g. information systems, dedicated capacity/tools/ equipment, dedicated workforce);
- Rethinking and restructuring the distribution strategy in order to change the level of intermediation (e.g. using direct selling, demand aggregators, multi-echelon chains);
- Increasing the level of coordination of planning decisions and flow of goods with customers including dedicated investments (e.g. information systems, dedicated capacity/tools/ equipment, dedicated workforce);
- Implementing SC risk management practices including early warning system, effective contingency programs for possible SC disruptions.

What we found from the survey is that Locals, as a general tendency, invest less than the others; specifically, Locals invest less than Shoppers on supplier development and distribution strategy; Locals invest less than Barons in coordination with suppliers; Locals invest less than Globals in supplier development.

Moreover, through case studies and global value chain analysis, we confirmed these results and we highlighted that investments in the supply chain are strongly related to the company size (larger companies tend to invest more in the supply chain), type of market (industrial applications of the electric motors differ substantially from product applications of the motor), typology of suppliers (e.g. raw materials suppliers - being almost monopolist - limit the possibilities to perform supply chain integration).

RQ 3: which is the performance achieved according to different configurations and SC improvement programs?

Here we considered together the global SC configurations, SC improvement programs and the following performance indicators: flexibility, quality, delivery, cost, lead time, and inventory turnover.

Next, for each configuration and for the whole sample, we analyzed the relationship between SC improvement programs and performance, finding that:

- Locals show significant improvements in performance from both upstream (coordination with suppliers, supplier development) and downstream (distribution strategy) investments;
- Barons take significant advantage from only upstream programs (supply strategy and supplier development);
- Shoppers have significant performance improvements by using risk management related investments;
- Globals do not show any significant relationship. Under the light of the cases, this can depend on the many different configurations that Globals can have.

Interestingly we have a predominant effect of improvement programs in the local portions of SCs that can be justified by the major complexity of managing global SCs, which somehow reduces the benefits of improvement programs, or worse, discourages companies from investing in that direction.

We confirmed the results through the case studies and we found that the adopted global supply chain configuration is tightly connected to the companies' desired performance. In particular, interviewed companies - to sustain the competition from low cost countries - aim at high flexibility,

small batches, high customization and delivery speed and this pushes them in keeping a local supply base, a limited global manufacturing and a direct relation with their customers.

RQ 4: what is the effect of contingent variables on the overall model?

Given the complexity of the contingency analysis, we built two structural equation models: the first one focused on global sourcing and its effect on the inventory level; the second one focused on global distribution and its effect on the delivery performance. Next, we performed a multi-group analysis considering companies with different characteristics.

Concerning global sourcing, we found that companies can mitigate the negative effect of global sourcing on inventory level by investing in SCM, but this works only for larger companies, for companies with a limited number of suppliers, for companies characterized by ATO (assembly-to-order) and MTS (make-to-stock) production processes and when purchases are mainly constituted of raw materials.

Next, by means of the second model we found that companies can keep a good delivery performance, also in the case of global distribution, if they invest in SCM downstream. In particular, larger companies tend to invest more on the SC when global distribution increases; this is true also for companies operating in uncertain contexts. Finally, ATO and MTS companies can find it more difficult to keep delivery performance under control on a global scale.

Case studies helped in understanding that a connection exists between the strategic advantages provided by the plant and the clusters, but sometimes it is necessary to consider the whole network rather than a single plant. What we further observed from cases is quite aligned with these results. Basically, the global SC configuration explains only partially the choices in SCM and the performance achieved. In particular, the electric motor industry is characterized by being positioned upstream in the value chain, by a high incidence of raw material costs and direct work, production is mainly in purchase-to-order or make-to-order. Given these characteristics, besides the global SC configuration, company size, the degree of product customization and the performance pursued should be included in the analysis as relevant variables.

Conclusions

This work offers a new perspective on global supply chain management by identifying four configurations that are significant in explaining differences in SC improvement programs adoption and their effect on performance. It therefore extends results available in literature and we deem our results interesting also for practitioners, since the globalization of SCs is a challenge for most companies. Results provide some evidence of the different models of globalization that can and are adopted by firms, providing some hints on the characteristics of each of them, which can help managers to define their globalization strategy. Moreover, we show which investment in the SC improvement programs can be more beneficial to improve the performance for companies adopting different configurations.

Limitations and further developments of this work are mainly related to the extension of this study to industries other then the assembly manufacturing and to the analysis of the whole manufacturing networks of multinational companies.

Section A: Research Background

1 Introduction

Companies may not always find in their country of origin the necessary resources (e.g. raw materials, technology, competences and workforce) to perform competitively their processes. Because of that, to pursue an effective manufacturing strategy and to make their competitive processes more competitive, companies have often globalized their SCs (Dornier et al., 2008; Taylor, 1997).

The opportunities of investing on a global scale have significantly increased in the last decades fostered by several factors like trade agreements and improvement in transportation and communication technologies. International manufacturing sources have been more and more sought out by managers first of all to benefit from cost reduction, due to customs duty and trade concessions, low cost direct labor, capital subsidies, and reduced logistics costs in foreign markets (Buckley and Ghauri, 2004; Ferdows, 1997a). Other drivers lie in the exploitation of distribution channels, access overseas markets, and closeness to customers.

According to the (UNCTAD, 2010b), multinational companies have increased their international expansion into new markets with particular regard to emerging economies. The current and future challenges for these multinational companies are first of all the rise of international networks populated by many different actors. In the Nineties, the recurrent model was the "integrated international production" where multinational companies split and directly controlled their operations in different parts of the world. Overtime, however, other actors have been involved (e.g. suppliers, customers, institutions) generating the so called "integrated international networks". This happened contextually to the fact that companies always more preferred non-equity entry modes, such as partnerships with suppliers and customers (Giroud and Mirza, 2006).

Nevertheless, leading companies in the world remain multinational companies with headquarters usually in developed countries and many branches, both productive and commercial, around the world. As we will see in the literature review, many different models can be adopted by a company to design and manage its network. However there are many influencing variables, from the product and industry characteristics to the corporate strategy that can influence such decisions. Sometimes there are also path-dependency effects that lead a company to prefer one model rather than another. As reported by Berger (2006), companies operating in similar industries may adopt very different approaches: example in the electronic industry, for example, Intel keeps much of the production in-house, while Apple outsources almost everything.

Independently from the model adopted, the complexity of global SCs (e.g. new and more suppliers, variable exchange rates, changing local policies) has increased overtime and this can reduce firms' performance if they are not properly managed (Hülsmann and Grapp, 2006). Global SCs are in fact more difficult to manage than domestic SCs (Dornier et al., 2008; MacCarthy and Atthirawong, 2003). Geographical distances not only increase transportation costs, but complicate decisions because of inventory cost tradeoffs due to increased lead-time in the SC. Moreover different local cultures diminish the effectiveness of business processes. Similarly, infrastructural deficiencies in developing countries (e.g., transportation and telecommunications, inadequate worker skills, supplier availability, supplier quality) provide challenges normally not experienced in developed countries

(Meixell and Gargeya, 2005). Furthermore, global SCs carry specific risks such as variability and uncertainty in currency exchange rates, economic and political instability, and changes in the regulatory environment (Carter and Vickery, 1988, 1989; Dornier et al., 2008). Finally, SC corporate responsibility, i.e. suppliers control in respecting the environment, society and workers rights, can be more difficult to be managed in a global context (Mamic, 2005).

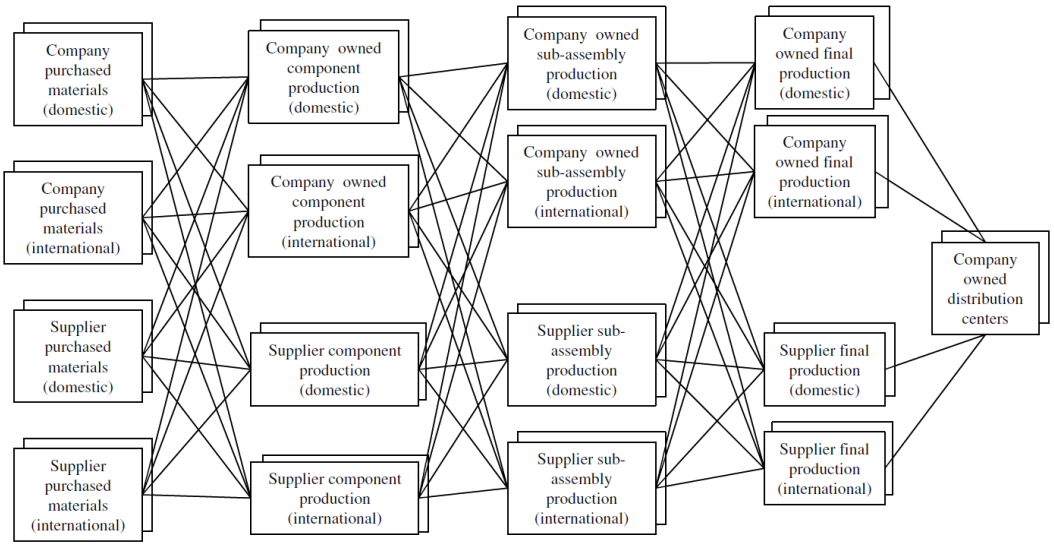
As a result, a growing academic interest has been devoted to the concept of *global SCM* (Prasad and Babbar, 2000).

Global SCs have been analyzed from different perspectives: products' global value chains (Gereffi et al., 2005), international networks (Chung et al., 2004) or - focusing on a company perspective - the coordination and management of sourcing, manufacturing and distribution activities on a global scale (Bello et al., 2004; Cohen and Mallik, 1997; MacCarthy and Atthirawong, 2003; Murray et al., 1995).

Taking this last perspective, literature developed in the past years focused on the different SC processes (namely, global sourcing, manufacturing and distribution) separately. Very few contributions actually took into account the SC as a whole (e.g. Rudberg and Olhager, 2003) analyzing at the same time management practices and performance achieved. Because of this, our work tries to fill this gap by considering the whole global SC and the management practices to achieve higher performance.

One of the problems is that the number of possible strategies is very broad and a conceptualization of global SC strategies is missing in literature. For example, a company may decide to purchase materials directly or through other suppliers on a domestic or international scale. Then the manufacturing of components, sub-assembly and final production can happen in owned factories or at suppliers' plants, again at a domestic or international scale (Figure 1.1). The number of possible combinations is already 256 without considering possible distribution alternatives.

Figure 1.1 - Alternative production locations in a global SC (Meixell and Gargeya, 2005).



The aim of this work is therefore to provide a conceptualization of SC configurations and then connect to these SC improvement programs and performance. In particular, in the literature review we will provide the theoretical background of our study; next, we will present the research

framework, the objectives and the methodology used (Section B); afterward, we will present the results obtained from the data analysis (Section C); next, we will present results obtained from the case studies (Section D); in the discussion (Section E), we will put together the results of the survey and of the cases; finally, in the conclusions (Section F), we will summarize the main findings and the contribution of this work.

The topic of global SCs, however, is not independent from the surrounding economical conditions that, in the last years, have been dramatically affected by the crisis and the role of new economical powers, China for first. Because of this, in the reminder of the Introduction we reported some relevant trends in terms of world trade and foreign direct investments. The first is a measure of the flows of goods among different countries. The second represents investments made by companies in order to control another company located out of the national boundaries.

1.1 Recent trends in the international trade

According to the WTO (e.g. 2009a, b) the world economy, both in terms of GDP and international trade, significantly slowed down in 2008 and 2009 because of the economical downturn. As a matter of fact, the financial crisis and the related credit shortage brought to an overall fall of asset prices, demand, production rates and resources to finance imports and exports. This crisis, started in the United States, spread first to the other developed countries and next to the developing ones.

Beside the financial, crisis there are other reasons underpinning the world trade flows reduction. First of all, demand appears to be more correlated among different countries than in the past. Thus, a downturn in one geographical region affects also the others. Next, the higher diffusion of global SCs increased the volatility in the total trade. As a matter of fact, products are always more manufactured in several different countries before reaching the final market. Thus, if a final market experiences a slowdown both imports and exports of all the involved countries will be negatively affected. Finally, a growing protectionism put in place by countries contributed to the reduction of the world trade (World Trade Organization, 2009b).

In 2009 China has been the leading exporter followed by Germany, United States and Japan. In the same year, the United States have been the leading importer followed by China, Germany and France (Table 1.1).

Table 1.1 - Merchandise trade: leading exporters and importers 2009 (World Trade Organization, 2009a)

	Exports (Bn)		**Imports (Bn)**
China	€ 1,202	United States	€ 1,605
Germany	€ 1,126	China	€ 1,006
United States	€ 1,056	Germany	€ 938
Japan	€ 581	France	€ 560
Netherlands	€ 498	Japan	€ 552
France	€ 485	United Kingdom	€ 482
Italy	€ 406	Netherlands	€ 445
Belgium	€ 370	Italy	€ 413
World	**€ 12,489**	**World**	**€ 12,588**

It is important to remark that, however, for the more developed regions (i.e. North America, Europe and Asia) the intra-regional trades are still the dominant ones. As shown in Table 1.2, almost one

third of the world total value ($ 15,717 bn) is traded inside Europe ($ 4,695 bn). Flows inside Asia follow ($ 2181.4 bn) and then inside North America ($ 1,014.5 bn).

Table 1.2 - Intra and inter-regional merchandise trade, 2008 (World Trade Organization, 2009a) - Data in billion dollars

	North America	South-Central America	Europe	CIS	Africa	Middle East	Asia	World
North America	1014.5	164.9	369.1	16.0	33.6	60.2	375.5	2035.7
South -Central America	169.2	158.6	121.3	9.0	16.8	11.9	100.6	599.7
Europe	475.4	96.4	4695.0	240.0	185.5	188.6	486.5	6446.6
CIS[1]	36.1	10.1	405.6	134.7	10.5	25.0	76.8	702.8
Africa	121.6	18.5	218.1	1.5	53.4	14.0	113.9	557.8
Middle East	116.5	6.9	125.5	7.2	36.6	122.1	568.9	1021.2
Asia	775.0	127.3	801.0	108.4	121.3	196.4	2181.4	4353.0
World	2708.0	583.0	6736.0	517.0	458.0	618.0	3903.0	15717.0

[1]Commonwealth of Independent States

In terms of goods categories (Table 1.3), fuels account by far for the largest part of the total trades ($ 2,862 bn) followed by office and telecom equipments ($ 1,561 bn), automotive products ($ 1234 bn), food and chemical products ($ 1,114 bn).

Table 1.3 - World Merchandise exports by product group, 2008 - Absolute Value and Annual percentage change (World Trade Organization, 2009a)

Product group	Total trades 2008 (bn $)
Fuels	2,862
Office and telecom equipment	1,561
Other chemicals	1,279
Automotive products	1,234
Food	1,114
Iron and steel	587
Pharmaceuticals	427
Integrated circuits	417
Clothing	362
Non-ferrous metals	360
Ores and other minerals	308
Personal and household goods	254
Raw materials	228

Another interesting trend is the growth of intra-firm exports. In the year 2000, more than 50% of the imports and about 35% of the exports in the United States were intra-firm trades. This demonstrates the increasing role of multinational companies that own multiple parts of the production done in different countries. Intra firms trade is higher among high-income countries, but the share of intra-firm trade with low-income countries is rising (Bernard et al., 2005).

However, according to UNCTAD (2010a) value chains are following a trend of fragmentation of the activities in different countries in order to exploit local advantages. In developing countries, access to natural resources (as oil, mining and agriculture products) and cheap labor are the main drivers. In Asia, the IT GVCs moved through India and the electronic GVCs through China, Taiwan, and Asian Southeast.

UNCTAD (UNCTAD, 2010a) also reports that value chains are dominated by some key players that control suppliers upstream and the access to the market downstream. They are the players with the ability to innovate, license, create brands. Small and medium suppliers, often depend on one or more of these key players so they are pushed by their customers to improve quality, delivery and follow the innovations. SMEs are at the same time in a difficult position as these key players, especially in the last years, tended to reduce the number of suppliers in order to manage their vast supplier base more efficiently.

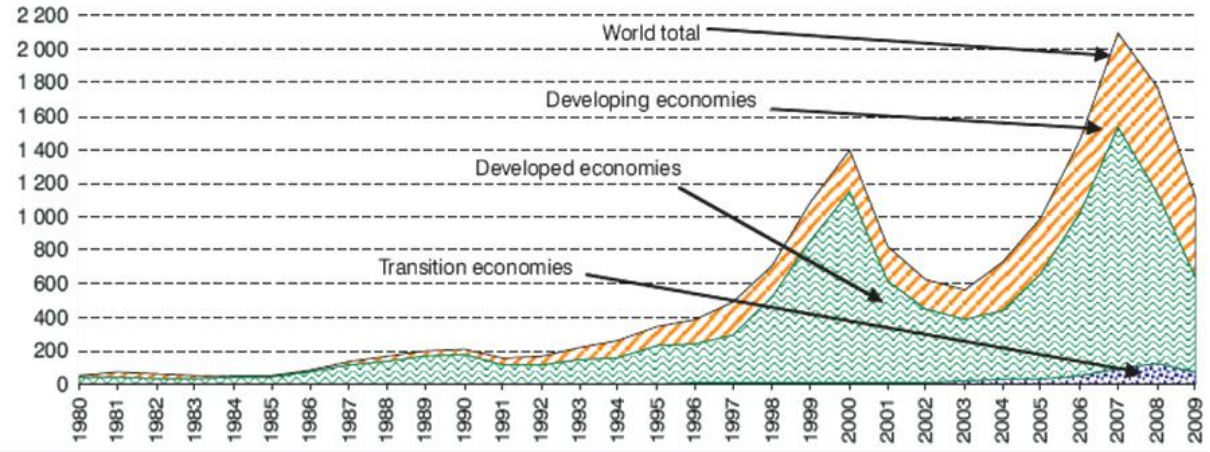
When taking a longitudinal perspective on GVCs, it is possible to identify strategic patterns put in place by companies. For example, in the fashion industry, brand owners outsourced overtime the whole production processes in order to focus on design, marketing and distribution activities. Nevertheless, thanks to their power they can control the upstream suppliers to a high degree (Humphrey, 2003). On the other side, some of these delocalized suppliers of finished products got bigger overtime improving at the same quality, innovation and the ability to talk with several customers thus increasing their bargaining power. As a consequence brand-owners sometimes went back to in-sourcing models (Berger, 2006).

1.2 International FDI

According to (UNCTAD, 2010b), FDI at the global level declined in 2008 and 2009 after the peak reached in 2007 (Figure 1.2). In the first half of the 2010, a modest recovery has been observed and cautious optimism is shown for the next years. Historically, largest share of investments inflows has been accounted by developed economies, however, in 2009, half of the global economic inflows were attracted by developing and transition economies. Moreover developing and transition economies generated one quarter of the global FDI outflows.

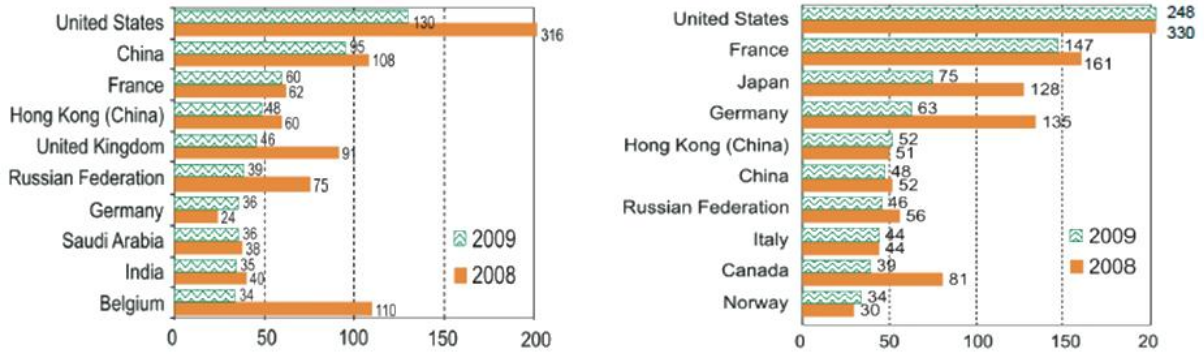
Of the total inflows, primary sector accounts for about 20%, manufacturing 25% and services for the remaining 55%. The share of services and primary sector continue to increase in spite of manufacturing activities.

Figure 1.2 - Global FDI inflows (UNCTAD, 2010b)



At the global level, United States are the first host and home economy; China is the second host and the sixth home, France the third host and the second home (Figure 1.3).

Figure 1.3 - Top 10 host economies of FDI (on the left) and top 10 home economies of FDI (on the right) (UNCTAD, 2010b). Values in bln $.



When investing across borders, companies may incur in several problems not experienced at the domestic level. According to the (World Bank Group, 2010) "*the benefits of FDI are particularly amplified in economies with good governance, well-functioning institutions, and transparent, predicable legal environments*".

First of all complete foreign ownership can be limited, varying sector to sector. On average, for light manufacturing and services (tourism, healthcare, retail), the shares owned by the investing companies are higher (up to 98%) while for utilities and transportations are lower (below 90%). Second, the establishment process is not always simple and transparent because of bureaucratic procedures and approval processes. Starting a business in China for a foreign company can take up to 100 days, almost three times more what is required to a domestic one. Moreover, information is not always easily available from abroad, for example electronically. Next, the access to industrial land can take time, especially in case of public land. Furthermore, there can be minimum capital requirements that can limit FDIs for smaller companies. Finally, some countries miss a legal framework for fair and efficient commercial disputes arbitration.

All these factors can make a country more or less open to FDIs. Worldwide, high-income OECD countries are the most open followed by Eastern Europe and Central Asia. On the other side South and East Asia and Pacific appear to be the most closed regions to foreign FDIs, followed by Latin America and Caribbean and Sub-Saharan Africa which perform slightly better (World Bank Group, 2010).

2 Literature Review

This work is positioned and aims at contributing to the theory mainly from the perspective of the Contingency Theory (Burns and Stalker, 1994; Fiedler, 1964). The underlying view here is that the optimal SC is contingent upon various internal and external constraints. This theory has been applied for many studies in the Operations Management and Manufacturing Strategy fields (Ho, 1996; Sousa and Voss, 2008), including the analysis of global SCs (e.g. Hughes et al., 1998). In particular, it has been studied how different company specific factors (e.g. company size, industrial sector) can affect the adoption of different global SC strategies. For instance, country specific factors may play an important role. Different countries show strong local requirements from the geographical, social and economical points of view (e.g. Redding and Venables, 2004). According to Schoenberger (1982), these factors can explain company success even better than adopted managerial models.

We will focus now on the specific literature providing the theoretical framework for this research. We start from a definition of SCM and we will move to the concept of global SCM, performance and influencing factors. In the end, we will provide some concepts about the GVC analysis that is an alternative approach to those used in Operations Management. However, we used such analysis to reinforce our case studies and therefore it is important to ground this methodology in the literature.

2.1 Supply chain management

As defined by Tan et al. (2001) "*Supply chain management encompasses materials/supply management from the supply of basic raw materials to final product (and possible recycling and re-use). SCM focuses on how firms utilise their suppliers' processes, technology and capability to enhance competitive advantage. It is a management philosophy that extends traditional intra-enterprise activities by bringing trading partners together with the common goal of optimisation and efficiency*".

However, it is clear how difficult can be to create such partnerships or optimize information and goods flows when companies are geographically distant or manufacturing networks are dispersed around the world (Dornier et al., 2008; MacCarthy and Atthirawong, 2003; Meixell and Gargeya, 2005). On the other side, many cases demonstrate that companies can get relevant competitive advantages leveraging effectively their global SCs (Berger, 2006).

Given this problem/opportunity, literature about global SCM significantly developed in the last decades (Prasad and Babbar, 2000). In particular, literature focused on different aspects of global SCM, namely:

- SC configurations: the degree of globalization of sourcing, manufacturing and distribution adopted by a company;
- SC improvement programs: tools and techniques put in place to manage global SCs;
- Drivers and strategies: leading to the adoption of different configurations or SC improvement programs;
- Performance: as an outcome of the adopted global SC strategy;
- Contingencies: internal and external factors that can affect the previous variables.

Before entering in the detail of these concepts, we introduce the literature about globalization strategies with a brief historical note. Next, we focus separately on global manufacturing, sourcing

and distribution management. Finally we report literature analyzing them jointly in terms of configurations, SC improvement programs, drivers, performance and contingencies.

2.2 Globalization strategies (brief historical note)

Theories about firms globalization (or "internationalization") and trade flows among countries date back to the Eighteenth century with the works of Adam Smith (The Wealth of Nations, 1766) and Ricardo (Principles of Political Economy and Taxation, 1817). However only in the 1960 with the work of Hymer (1960) a special attention was devoted to multinational companies and their investment strategies (Bartlett and Ghoshal, 1991). In the meanwhile, Vernon (1966) focused more on the firm level developing a theory linking multinational companies' behavior and the product lifecycle. Next, supported by the work of Williamson (1975) on the transaction costs, other authors (Buckley and Casson, 1976; Hennart, 1982; Rugman, 1981) analyzed with an even stronger focus on the firm, the internal processes of information transfer inside the company network.

One of the most famous theories is the one related to globalization strategic goals (e.g. Buckley and Casson, 1976). These are *market seeking*, *resource seeking*, *efficiency seeking* and *strategic assets seeking* strategies. Companies characterized by market seeking strategies aim to gain the *insider* advantages, such as a better adaptation of the product to the local market, control the market, overcome export barriers, exploit "made in" effects, follow strategic customers, disturb competitors in their local markets. Next, resource seeking strategies are implemented for acquiring resources that can be rare and specific or are delivered at better conditions, for instance in terms of price or quality. These resources can be raw materials, energy or other products, technical or managerial skills, low-cost labor force. Following, companies pursuing efficiency seeking strategies, look abroad for scale economies or better productive conditions (e.g. transport or communication infrastructures, market structures). Last, strategic assets seeking strategies aim to find abroad assets or capabilities to be acquired, complementary products, risk diversifying business.

Besides strategic management, the analysis of internationalization strategies has taken also other perspectives overtime and, as stated by Bartlett and Ghoshal (1991), *"the result of this sometimes confusing intersection, overlap and complementarity of work, is a field of great diversity and dynamism. Grounded in a wide range of disciplines and functional applications, yet willing to draw freely from each other's findings, researchers are creating eclectic and multi-disciplinary frameworks"*.

Among these different perspectives, one of the most recent is the Operations Management one, which highlighted the importance of considering the SC rather than the company individually. In particular, in the study of global SCs, contributions have taken different trajectories: some authors have analyzed global sourcing (e.g. Murray et al., 1995), i.e. the management of supplier relationships on a global perspective; other authors have considered the role of manufacturing in a global environment (e.g. MacCarthy and Atthirawong, 2003) thus analyzing how companies manage manufacturing activities distributed all over the world. Finally, other authors have also considered global distribution (e.g. Bello et al., 2004), thus how companies manage their sales and distribution channels globally. These contributions are better described in the following chapters.

2.3 Global sourcing

Global sourcing refers to the level of globalization of purchases. The analysis of international purchasing has been addressed according to different concepts, ranging from foreign sourcing, international sourcing, worldwide sourcing to global sourcing (Zeng, 2003). The definition of global sourcing can be very broad encompassing also the coordination of worldwide business units (Bozarth

et al., 1998; Monczka and Trent, 1991). A key distinction is the difference between "international" and "global" sourcing (Monczka and Trent, 1991). International sourcing means procuring from suppliers outside the firm's country of origin without a strong coordination among different purchasing business units. Global sourcing is instead a strategy that involves all the business units in terms of centralized decisions and worldwide integration of processes.

Usually different maturity stages in the globalization of the procurement process are identified (Bozarth et al., 1998; Nassimbeni and Sartor, 2007; Swamidass, 1993; Trent and Monczka, 2003). Bozarth et al. (1998) highlight four stages of global sourcing and these are related to different degrees of exchanged information with suppliers. In the last phase firms are distinguished by the development of global sourcing networks, with worldwide purchasing systems and coordination mechanisms.

Recent studies (Cagliano et al., 2008; Trent and Monczka, 2003) show that global sourcing - i.e. purchasing goods from outside the country - even if still relatively diffuse, is significantly growing in popularity. Cagliano et al. (2008), for example, provide evidence of global sourcing practice based on more than 600 companies in the assembly industry from 20 different countries. The authors report that the majority of the companies considered in their study (about 64% of the sample) do only 4% of their spending outside their continent. This limited rate of adoption may be due to several inhibiting factors, such as management experience or logistical costs. However, a significant number of companies are still looking for suppliers abroad: e.g., Cagliano et al. (2008) find that the overall sample used in their work displayed an average growth in purchases outside the continent of about 4% between 2001 and 2004.

This trend of growth has driven researchers to more thoroughly analyze the impacts of global sourcing on companies' processes and performance to determine the best ways to cope with it. In fact, recent studies have shown that global sourcing, especially from low-cost sources, makes it harder to manage the cost versus response trade-off (Lowson, 2003; Nair and Closs, 2006).

One clear effect is that longer lead times and less dependable deliveries from suppliers require companies - *ceteris paribus* - to maintain higher safety stocks to preserve the same service level. This has been confirmed at an aggregate level; in 2005, increased import ratios for U.S. manufacturing companies were reflected in additional costs of raw materials inventories (Han et al., 2008).

Another important point is why companies extend their relationships internationally and to what extent this practice contributes to increase their competitive advantage (Frear et al., 1992; Trent and Monczka, 2003; Womack and Jones, 1996). Bozarth et al. (2008) identify different motivating factors in global sourcing. Among these, lower procurement prices are typically considered the most important; foreign supplier markets can be also a source of technology, knowledge or higher-quality products. Taxation or currency advantages due to international agreements or exchange rate fluctuations are other important factors. Access to new markets, shorter product development processes and product life cycles, or even company image can be also motivating factors (Frear et al., 1992; Nassimbeni and Sartor, 2007). Global sourcing is, in fact, related not only to the procurement of low-price and standard products, but also to the need for high quality and technical components (Nassimbeni and Sartor, 2007).

There are several factors influencing the adoption of global sourcing. It is to a large extent dependent on the company, the sector in which it operates, the type of product purchased and the country where the foreign supplier is located (Quintens et al., 2005). For example, Nassimbeni and Sartor

(2007) report that in Italy, textiles/clothing and chemicals/pharmaceuticals are the sectors where global sourcing is more widely adopted.

2.4 Global manufacturing

There are several reasons why companies extend their manufacturing networks out the national borders. First of all, there can be competitive pressures (e.g. attractiveness of foreign markets and product innovation) or product and market standardization (i.e. customers have similar needs) that push and favor setting-up new plants abroad. Next, cost advantages have always been considered a major objective, but several companies have also invested due to the limited availability of specific resources locally, such as technologies. Furthermore, companies have invested abroad also to be closer to the final customer and to be capable to serve the market with responsiveness and specific services. Similarly to Buckley and Casson (1976), UNCTAD (2010b), classifies these drivers into: market-related factors (i.e. size of the market, growth of the local market, access to the regional market), resource-related factors (i.e. skilled labor, access to natural resources, access to capital market), efficiency seeking (i.e. cheap labor), quality of business environment (i.e. government effectiveness, incentives, stable investment environment) and other motivations (e.g. follow the leader).

Besides strategic drivers, authors focused on the plant localization decisions according to the minimization on certain cost functions related to taxes, custom duties, production and transportation costs (e.g. Aikens, 1985; DuBois et al., 1993; Schmenner, 1979). Taking a dynamic perspective, Ferdows (2009) indentified that a foreign plant might be rapidly opened and then closed seeking for the best locations in the world ("footloose" model). On the other side a plant might remain many years in place establishing strong connections with the suppliers ("rooted" model).

Once selected the location, when setting-up new plants, changes on manufacturing methods are needed when social structures are transferred across cultures and societies (Young, 1992). For example, the issues of transferring Japanese manufacturing management approaches to U.S. industries were more related to geographic and cultural factors rather than management approaches (Schoenberger, 1982). National culture significantly explains international operations management behaviors among similar manufacturing plants in the same industry located in different cultures. National culture may also create systematic differences regarding decision making (Pagell et al., 2005).

Also global manufacturing "structures" have been identified. About this, Egelhoff (1982) found four different configurations that correspond to different organizations and information flows. The first one is the *worldwide functional division structure* in which the activities performed in one function of every foreign branch are "copied" from the same division in the main plant. The headquarter sets also the strategies in a cross-functional perspective. The second one is the *international division structure,* where all the plants are coordinated by one main international division. The third one is the *geographical region structure* in which the market is divided into regions, each one of them has its main plant. Each main plant is internally organized with liaison roles for coordinating with the other plants. Last, the *worldwide production division structure* is identified. In this configuration the production is centralized in the main plant and subsidiaries have a more marketing-oriented role.

Next, coordination of the manufacturing network has been investigated (e.g. Bartlett and Ghoshal, 1991; Galbraith, 1990; Pontrandolfo, 1999). This stream of research studies the physical and information flows among the plants, in order to control and manage effectively the entire network.

For example companies need to overcome the problem of coordinating operations where interdependence exists among subsidiaries. Increasing interdependence is also significantly associated with greater communication among country-subsidiary managers and greater communication with a central manufacturing staff group (Mascarenhas, 1984).

More recently, the concept of "role of the plant" emerged. The seminal contribution is from Ferdows (1997b) followed up by Vereecke and Van Dierdonck (2002). The model relies on two dimensions. The first one is the primary strategic reason for establishing a foreign factory. A plant in a certain country can indeed provide a localization advantage such as low cost resources (labor, materials, energy, etc.), proximity to market, access to skills and technology. Vereecke and Van Dierdonck (2002) extended this model adding proximity to suppliers, socio-political and competition factors as relevant drivers in the localization choice. The other dimension is the level of site competence that can range from just producing the product as mandated by the headquarters to design the products and be a center of excellence for the entire network. Combining the two dimensions six roles can be identified: i.e. Offshore, Outpost, Server, Source, Contributor and Lead plants.

2.5 Global distribution

The globalization of distribution activities includes specific tasks such as the organization of worldwide efforts, the research of domestic and foreign markets, finding new partners and managing costs of the international transactions (Svensson, 2002). There can be many different advantages coming from marketing globalization: it can provide opportunities for growth and expansion or, in other cases, it is necessary for surviving in national markets against global competitor. Moreover, it allows achieving a concentration and coordination of marketing initiatives to find new markets, segments and niches (Dahringer and Mühlbacher, 1991; Keegan and Green, 2003; Lamont, 2002).

On the other side, when globalizing their distribution activities, companies face the problem that in the last twenty years customer service and quick response strategies have acquired higher importance in the competitive arena (Christopher et al., 2004; Hammond, 1991; Lowson, 1999; Lowson et al., 1999). To achieve higher responsiveness, sometimes called agility, companies can restructure their production processes, keep higher inventories or invest in SCM (Lee, 2004; Naylor et al., 1999). SCM in particular, i.e. sharing of information and coordinating processes with customers, is an effective way to enhance customer responsiveness without increasing the level of inventories thus minimizing the whole SC costs (Christopher, 1999; Frohlich and Westbrook, 2001).

However, when operating in a global environment, investments in SCM can be more difficult to be put in place and longer distances may negatively affect responsiveness, for example in terms of delivery lead times. Several authors stated that global SC by definition cannot be fast and seamless (Levy, 1997; Minner, 2003; Womack and Jones, 1996). "Lean" SCs usually require short distances to have frequent deliveries and lower inventories. Moreover cultural distances and possible lack of trust between companies can make longer the definition of agreements and the return of SCM investments (Levy, 1997). Moreover, longer distances may require use of intermediaries and make the number of actors in the value chain higher. This can increase the bullwhip effect especially for companies on the upstream part of the value chain (Lee et al., 1997).

All these conditions - from one side - amplify the negative effect of globalization on customer responsiveness and - from the other side - can hamper investments in increasing coordination of flows of goods and information with customers abroad. As a reaction, companies may be pushed to

achieve responsiveness through traditional methods such as make-to-stock production and higher inventories of finished products, rather than adopting a make-to-order production (Pyke and Cohen, 1990).

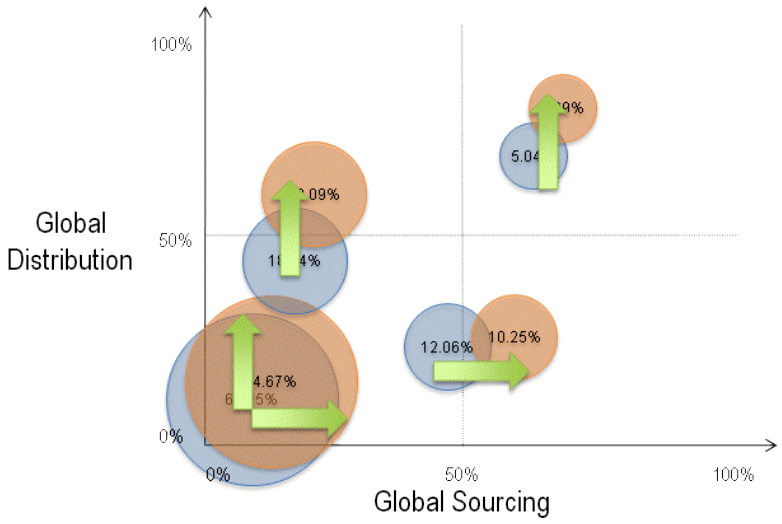
However there can be postponement - or leagile - strategies that can be effective for global distribution contexts (Aitken et al., 2002; Christopher, 2005; Goldsby et al., 2006; Naylor et al., 1999; Yang and Burns, 2003). Some authors also talk about global just-in-time or some specific SCM investments effective in global contexts (Gunasekaran and Ngai, 2005): for example, rationalizing their distribution strategy and reduce the level of intermediation and, by consequence, the bullwhip effect.

2.6 Global SC configurations

Even if a comprehensive framework is still missing, there are many evidences in literature about correlations among global sourcing, manufacturing and distribution. These processes are typically interrelated: companies, in order to support global distribution, need to invest in new foreign plants and manage suppliers on a global scale (Buckley and Ghauri, 2004); similarly, companies that purchase on a global scale, sometimes decide to invest in foreign manufacturing facilities so to have better control over the SC (Ferdows, 1997a). Bozarth et al. (1998) highlight four stages of global sourcing maturity where the last phase is distinguished by the development of global sourcing networks, with worldwide purchasing systems and coordination mechanisms. This implies that the company performing a mature global sourcing has grown to a multinational scale with several production facilities. Meixell and Gargeya (2005) report several models to optimize plant locations and distribution costs. Patterns of internationalization from a local to a global scale have been found also in manufacturing and distribution processes (Chetty and Holm, 2000; Shi and Gregory, 1998). Rudberga and Olhager (2003) merged the sourcing and distribution processes into the network perspective. Therefore they identified four clusters of companies according to the number of sites per organization and number of organizations in the network.

Finally, Cagliano et al. (2008) found out four clusters of companies performing global or local sourcing and distribution (Figure 2.1). This study highlights that there are groups of companies that have globalized either sourcing or distribution, not necessarily both of them.

Figure 2.1 - The four clusters identified in 2001 (blue) and 2005 (orange) by Cagliano et al. (2008). Arrows highlight the growing trend in globalization.



2.7 Global SC improvement programs

To implement and manage any global SC configuration, the plant may adopt some SC improvement programs. Improvement programs in SC are defined as those actions or investments undertaken by the company to improve its performance. Improvement programs can be internal (e.g. improving the organization, management or technology) or external (e.g. collaboration and coordination with other partners in the SC).

External SC improvement programs have been analyzed in literature in two main areas: information sharing and system coupling (e.g. Cagliano et al., 2003; Frohlich and Westbrook, 2001).

The first concept refers to the exchange of information about production plans, inventories, market demand, etc. This practice requires some standardization and integration of the Information Technology (IT) systems, but on average results are very beneficial for companies (e.g. Lee and Whang, 2000), for example to reduce the bullwhip effect (Lee et al., 1997). Information sharing has also been analyzed in the specific context of global SCs, concluding that it is vital for an effective flow of materials (Gunasekaran and Ngai, 2005; Lee and Whang, 2000) even though global IT integration may pose several key issues to the management (Ives and Jarvenpaa, 1991).

The second concept - system coupling - represents joint investments made by suppliers and customers to coordinate physical activities (e.g. just-in-time, vendor managed inventory, collaborative planning forecasting and replenishment, etc.) in order to achieve faster flows of products with less inventory levels (Power, 2005). Several authors analyzed system integration with suppliers in terms of just-in-time (JIT) practices (Gélinas and Jacob Jocelyn, 1996; González-Benito, 2002; Gunasekaran and Ngai, 2005). This is one of the most studied practices in global contexts (Babbar and Prasad, 1998). The motivation behind these studies is that typically JIT requires specific conditions - frequent and fast deliveries, small lots - that can be hardly found in global settings. Because of that, the key success factors are different from local to global JIT (e.g. higher investments in terms of communication and coordination) and however achievable results are limited (Das and Handfield, 1997; Vickery, 1989).

Besides JIT, other SC investments are typically used to manage global SCs. These are: the definition of a supply strategy and a purchasing organization, the creation of supplier development programs,

the introduction of vendor rating systems, the adoption of complex distribution systems, the coordination with customer and suppliers (e.g. Golini and Kalchschmidt, 2010b). Other global SC investments are related to reduction of risks like as fluctuating exchange rates, supply disruptions, strikes or political issues, lead time variability. These risks can be limited by using multiple supply sources and different distribution channels (Minner, 2003). Ensuring communication lines in crisis situations and joint development of continuity plans with customers and suppliers are other types of SC investments oriented to mitigating risk in global SCs (Craighead et al., 2007; Jüttner et al., 2003; Tang, 2006).

Moreover, Petersen et al. (2006) show that structures, processes, business capabilities, international language capabilities and top management commitment are critical to the effectiveness of a global SCM. This is in line with other authors such as Quintens et al. (2006), Zeng (2003) and Gelderman and Semeijn (2006).

Finally, other potentially interesting practices for global SCM are for example Continuous Replenishment Programs (CRP) or Vendor-Managed Inventory (VMI) (Meixell and Gargeya, 2005; Ovalle and Marquez, 2003), but so far their diffusion and impact have been little researched in relation to global sourcing.

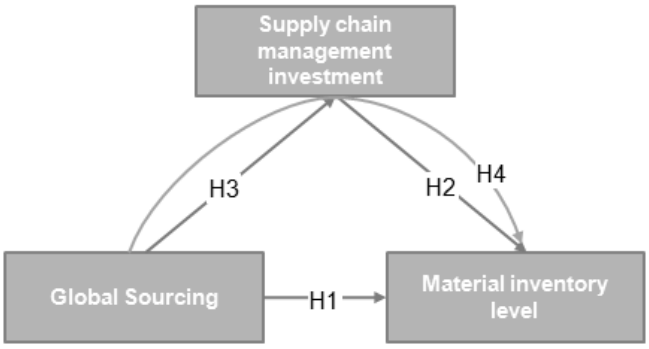
2.8 Performance

Several studies have failed to detect any significant impact of global SC on general business success (Kotabe and Omura, 1989; Murray et al., 1995; Steinle and Schiele, 2008). This may be due to several reasons. First of all, different companies may move globally for different purposes, e.g. cost reduction, market access, customers' proximity. This implies that if we do not consider why companies extend their boundaries abroad it may be very difficult to compare performance. A second reason is that different companies may have gained different results from the investments in globalization and companies may have also changed their global strategy according to the results achieved. Finally, this is partially due to the investments companies do in order to increase performance when globalization is pursued.

Some evidences come from Golini and Kalchschmidt (2009) that showed that companies who decide to adopt global sourcing can get good performance (in terms procurement lead time, manufacturing lead time, delivery speed, manufacturing conformance) also thanks to the adoption of SCM and eBusiness tools. On the other side, companies may decide to source locally with a strategic reason behind and again get good performance. Thanks to the closeness of the suppliers, these companies have the higher adoption of just-in-time. Finally, there are companies that source locally without a strategic intent, probably due to common practices. These are the companies that are less competitive, since they get performance significantly worse than the others.

In another work, the same authors (Golini and Kalchschmidt, 2010b) studied the direct relationships between global sourcing and SCM and the indirect effect of global sourcing on material inventory level (Figure 2.2). Results show that all the relationships are significant and, in particular, that the degree of globalization of sourcing tends to increase the material inventory level, but it can be fully compensated by higher investments in SC.

Figure 2.2 - The relationship among global sourcing, SCM and inventory performance (Golini and Kalchschmidt, 2010b)



2.9 Contingencies

2.9.1 Relevant contingencies for global sourcing

Starting from global sourcing, company size has been considered as a major influencing factor: smaller companies tend to be more reactive towards international purchasing, even if they are not always convinced of the real benefits of international purchasing (Leonidou, 1999; Quintens et al., 2005).

Next, product complexity is a relevant variable affecting sourcing decisions (Sharon and Eppinger, 2001). Product complexity can indeed have a twofold effect over sourcing globalization. The less complex the product is and the easier is to scout for and communicate with suppliers abroad (Perona and Miragliotta, 2004; Westhead et al., 2001). On the other side, when dealing with complex products (i.e. technologically intense) companies might be forced to look for suppliers abroad if they are not available at a local scale (Chung et al., 2004).

About production characteristics, we consider here the position of the decoupling point (Naylor et al., 1999; Olhager and Östlund, 1990). Companies operating in make-to-stock contexts can be more efficient in managing their material inventory and plan consignments also in global contexts. On the other side companies operating in make-to-order must be more reactive so either they are more integrated with suppliers or they have to keep higher inventory levels if they want to purchase globally (Gunasekaran and Ngai, 2005).

Finally, the number of suppliers and the type of product purchased represent relevant contingencies. Having many suppliers allows to keep suppliers in competition and avoid under-capacity issues, but this can reduce suppliers' responsiveness (Choi and Krause, 2006; Handfield et al., 2000). Moreover especially in global sourcing contexts, where the risk SC of disruption is higher, it might be necessary to keep some local suppliers to cope with emergencies. On the other side having few suppliers can allow to establish partnerships and SC integration programs more effectively (Choi and Krause, 2006).

For what concern the type of products purchased, raw materials show specific characteristics different from purchasing components and sub-systems. First of all, raw materials have a lower degree of customization and usually are supplied by large multinational companies, so creating partnerships with these companies can be difficult and not always necessary. Given the low information complexity and specificity together with highly capable suppliers, the relationship with raw material suppliers is usually arm-length and based on price (Gereffi et al., 2005). This is also

confirmed by Cagliano et al. (2003) who found that companies in the upstream part of the value chain tend to have a lower adoption of integration and eBusiness tools with suppliers.

2.9.2 Relevant contingencies for global distribution

Moving to global distribution, several contributions put in light the following factors (Fujita, 1995; Mollenkopf et al., 2010; Perona and Miragliotta, 2004; Zou and Cavusgil, 2002):

- Product and process complexity: the higher the complexity (number of components, technological level, number of production stages) the more difficult can be the communication and coordination with customers abroad;
- Uncertainty and innovation rate: the higher the uncertainty in the products and process the more difficult can be to establish long term partnerships with customers;
- Product differentiation: if competition is much based on price, rather than differentiation, internationalization can be more difficult;
- Life-cycle: the shorter the life-cycle the higher the willingness to reach many markets in order to amortize fixed costs;
- Position of the decoupling point: companies operating in make-to-stock may easier balance the negative effects of globalization on customer responsiveness through higher inventories. Similarly assembly-to-order companies may quickly produce a customized product keeping inventories of semi-finished products. However these strategies are not always viable if there is a high degree customization (engineer-to-order or make-to-order) or if inventories are costly (e.g. space occupation, obsolescence).

2.10 Global Value Chain analysis

The topic of global SC strategies has been studied also through the concept of the GVCs. Even if the GVC analysis has been developed in the economical and industrial trade literature (Gereffi et al., 2005), there are several studies using it to interpret phenomena in the SCM field (Abecassis-Moedas, 2006; Chiarvesio and Di Maria, 2009; Fleury, 1999). We describe here the theory related to GVC analysis, as we used this methodology to contextualize our case studies as explained later of this work.

"Global Value Chains (GVCs) cover a full range of interrelated productive activities performed by firms in different geographical locations to bring out a product or a service from conception to complete production and delivery to final consumers. The activities may involve concept, design, production, marketing, distribution, retailing and R&D functions, and may even include waste management and recycling" (UNCTAD, 2006).

As we have seen in the introduction, value chains are called "global" when the production and marketing activities are fragmented and dispersed in several countries.

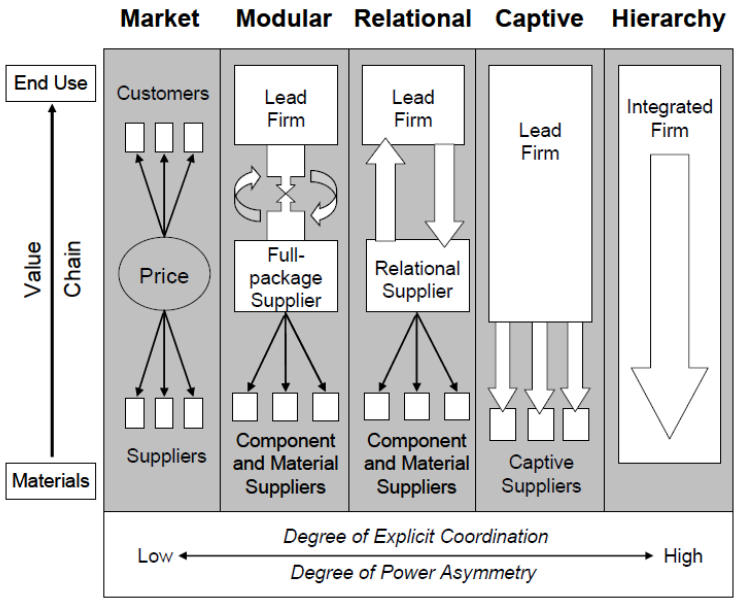
GVCs are an important unit of analysis not only to understand the industrial dynamics but also for understanding enterprise competitiveness (UNCTAD, 2006). In fact this methodology is used to map the value chain in terms of economic added activities (from raw materials to finished product), global material/components/product flows, relationships among players at different stages of the value chain and their evolution over time.

In particular 5 types of relationships among companies are identified. According to (Gereffi et al., 2005), from the lead firms perspective, these are:

- Market: when the product is standardized and there is enough availability of suppliers, the transaction is based on price without high collaboration or coordination costs (e.g. commodities). The switching cost for the lead firm to new suppliers is low.
- Modular: when the product is more complex, but made of modules or standardized components the need for collaboration is low thanks, for instance, to technical standards. In this case the buyer-supplier relationship can be slightly tighter, but still characterized by a low level of collaboration. The switching cost to new suppliers remains low.
- Relational: when products are complex or specifications cannot be codified but capable suppliers are available, lead firms can establish partnerships characterized by a high level of collaboration that can be regulated through contracts or informally. The switching cost to new suppliers for the lead firm is high, but also suppliers develop some dependency from the lead firm.
- Captive: when the companies face the previous situation of product complexity, but suppliers are not very capable, the lead firm will help suppliers, usually focused on specialized activities, to develop the necessary capabilities from the financial, managerial and design point of view. These suppliers have a strong dependency from the lead firm that represents their access to the market.
- Hierarchy: when products are complex and there are no suppliers available, the lead firm is constrained to vertically integrate and make the product/component in-house.

Figure 2.3 graphically represent these five typologies of relationship. Moving from market to hierarchy implies the increase of power asymmetry (as suppliers become more and more dependent from customers) and explicit coordination (i.e. the collaboration and quantity of transferred information).

Figure 2.3 - Typologies of relationship in the value chain (Gereffi et al., 2005)



Finally, the value chain is characterized by the position of the focal firm in the chain. According to Gereffi (Gereffi, 1999) value chains can have different "structures": a GVC can be in fact "buyer-driven", when the focal firms are in downstream stages (e.g. brand owners or retailers), or "producer-driven" when manufacturers have the control of the chain. For example, the automotive sector is producer-driven, while consumer goods industry is typically buyer-driven. These two

typologies have different characteristics in terms for example of drivers, core competences and barriers to entry, summarized in Figure 2.4.

Figure 2.4 - Main characteristics of the producer-driven or buyer-driven value chains (Gereffi, 1999)

	Producer-Driven Commodity Chains	Buyer-Driven Commodity Chains
Drivers of Global Commodity Chains	Industrial Capital	Commercial Capital
Core Competencies	Research & Development; Production	Design; Marketing
Barriers to Entry	Economies of Scale	Economies of Scope
Economic Sectors	Consumer Durables Intermediate Goods Capital Goods	Consumer Nondurables
Typical Industries	Automobiles; Computers; Aircraft	Apparel; Footwear; Toys
Ownership of Manufacturing Firms	Transnational Firms	Local Firms, predominantly in developing countries
Main Network Links	Investment-based	Trade-based
Predominant Network Structure	Vertical	Horizontal

Section B: Objectives and methodology

3 Research framework and objectives

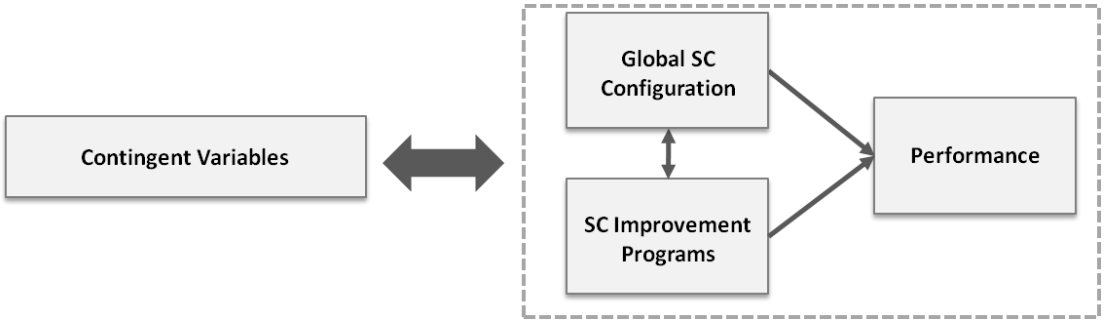
Global SCM is a rather complex research topic. As seen in literature, many different perspectives exist with several trade-offs among them.

Generally speaking we can divide literature about global SCs in the Operations Management field in two streams: contributions that analyze the manufacturing networks and contributions focused on the plant. The formers analyze multinational companies: their global sourcing, manufacturing and distribution strategies. The analysis usually considers these processes separately: global sourcing is related to decisions like centralization in the headquarter or decentralization in the local branches (e.g. Giunipero et al., 2005); global manufacturing deals with facility location (MacCarthy and Atthirawong, 2003) and how to coordinate global manufacturing networks (e.g. Egelhoff, 1982; Mascarenhas, 1984); global distribution is about how to configure the distribution network (e.g. Aikens, 1985).

On the other side there are works focused on the plant. As a matter of fact, managing a global SC is not only a strategic but also an operational issue (e.g. Handfield, 1994). Geographical distances increase transportation costs and lead times; cultural distances can increase coordination costs; there are higher risks of SC disruption, delays and qualitative issues (Dornier et al., 2008; MacCarthy and Atthirawong, 2003). These problems are worsened by the fact that establishing SC integration - aimed to overcome such issues - with partners far away is not easy. Despite all of these managerial issues, there are no models in literature that, taking a plant-based perspective, analyze the whole SC by considering jointly global sourcing, manufacturing and distribution and identifying which SC improvement program are worthier to get better performance.

Our aim is therefore to fill this gap through a model in which all the key elements are related among them. In particular we used the framework represented in Figure 3.1 as a basis for our research questions and analysis. As explained in the remainder, the elements on the framework and their relationships are tightly connected to literature, but they also highlight existing research gaps that we will try to fill.

Figure 3.1 - The research framework



There are evidences in literature about the existence of global SC configurations in terms of global sourcing (i.e. how far suppliers are), manufacturing (i.e. if other plants are involved in the production) and distribution (i.e. how far customers or markets are). However, these processes are typically interrelated. For example in order to support global distribution, companies might need to invest in new foreign plants and manage suppliers on a global scale (Buckley and Ghauri, 2004). Similarly companies often decide to invest in manufacturing facilities abroad in order to have better control over the SC (Ferdows, 1997b). Even if these processes are more and more studied jointly (Cagliano et al., 2008; Rudberg and Olhager, 2003) a conceptualization of global SC configurations is still missing. In particular we deem useful to identify some archetypical global SC configurations in terms of how much sourcing, manufacturing and distribution are globalized. In particular, in line with Cagliano et al. (2008), we expect symmetric and asymmetric configurations.

Because of that, the first research question we want to investigate is:

RQ 1: which are the main global SC configurations adopted by companies?

To implement and manage any global SC configuration, the plant may adopt some SC improvement programs. Improvement programs in SC are defined as those actions or investments undertaken by the company to improve its performance. Improvement programs can be internal (e.g. improving the organization, management or technology) or external (e.g. collaboration and coordination with other partners in the SC).

As we have seen in the literature review (2.7 - Global SC improvement programs), specifically in global contexts, one of the most analyzed practices is just-in-time (Babbar and Prasad, 1998), but also the definition of a supply strategy and a purchasing organization, the creation of supplier development programs, the introduction of vendor rating systems, the adoption of complex distribution systems, the coordination with customer and suppliers (Craighead et al., 2007; Golini and Kalchschmidt, 2010b; Jüttner et al., 2003; Tang, 2006). Other potentially interesting practices for global SCM are for example Continuous Replenishment Programs (CRP) or Vendor-Managed Inventory (VMI) (Meixell and Gargeya, 2005; Ovalle and Marquez, 2003), but so far their diffusion and impact have been little researched in relation to global SCs.

Since diverse SC improvement programs are implemented in global or local contexts, we expect a relationship between these and the global SC configurations previously identified. However, this relationship is hardly predictable given the high number of possible configurations and SC improvement programs available.

By consequence, the second research question we want to investigate is:

RQ 2: How configurations are related to different SC improvement programs?

As an outcome of the global SC configuration and improvement programs adopted, the plant can gain different results. For example, a company that sources, manufactures and distributes mainly locally can have different outcomes from investing in SC improvement programs from a company that operates globally - as it happens for just-in-time (Das and Handfield, 1997). In the literature, however, only few contributions (e.g. Handfield, 1994) provided evidence of this relationship on a complete set of performance - which, according to Kim and Arnold (1996), are cost, quality, time and flexibility. Even if these performance indicators are recognized by the literature to be highly impacted by globalization and SC decisions (Carter and Narasimhan, 1990; Christopher, 2000; Frear et al., 1992; Frohlich and Westbrook, 2001; Minner, 2003; Pyke and Cohen, 1990) they have been under investigated so far.

Because of that our aim is to study the impact of SC improvement programs on a complete set of performance according to the global SC configuration adopted. This aim is summarized in our third research question:

RQ 3: which is the performance achieved according to different configurations and SC improvement programs?

Given also the fact that our model is rooted into the contingency theory (Burns and Stalker, 1994; Fiedler, 1964; Sousa and Voss, 2008), it is essential to consider all those elements that can affect our results.

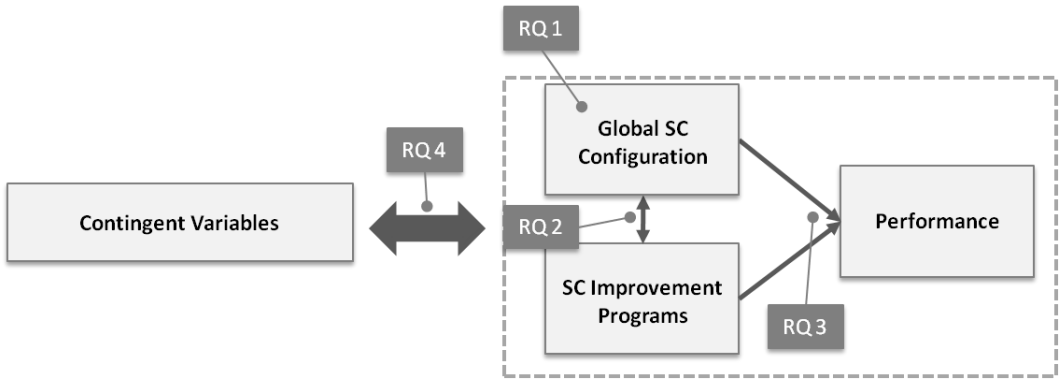
As seen in the literature review (Chapter 2.9 - Contingencies), the literature about global SCM has always considered some contingent variables like company size, degree of product differentiation, labor content, transportation cost, total volumes produced (Sweeney, 1994). However we have identified other contingencies that might be potentially relevant. First of all the role of plant, as defined by Ferdows (1997b), which might lead to different configurations or SC improvement programs. Next, other potentially relevant factors we want to analyze are product and process complexity, uncertainty and innovation rate, product differentiation, position of the decoupling point, type of procurement organization and purchased categories factors (e.g. Fujita, 1995; Mollenkopf et al., 2010; Perona and Miragliotta, 2004; Zou and Cavusgil, 2002).

Given this last objective, our fourth research question is:

RQ 4: what is the effect of contingent variables on the overall model?

Figure 3.2 locates the research questions over the research framework.

Figure 3.2 - Research questions over the research framework



4 Research strategy

As already seen, literature on globalization and SCM is rather developed even if several gaps still exist. In particular, authors focused on specific parts of the problem, for example global sourcing, manufacturing or distribution and there is a lack of studies analyzing the overall SC. As a consequence, our aim is to overcome such limitations identifying global SC configurations, putting them in relationship with SC improvement programs and performance and highlighting the effect of contingent variables.

Therefore this a theory testing/explanatory research, where the "*knowledge of a phenomenon has been articulated in a theoretical form using well-defined concepts, models and propositions"* (Forza, 2002). In this situation, the literature suggests the adoption of research tools such as surveys where "*data collection is carried out with the specific aim of testing the adequacy of the concepts developed in relation to the phenomenon, of hypothesized linkages among the concepts, and of the validity boundary of the models*" (Forza, 2002).

Therefore, we adopted the survey as the main research instrument to answer to our research questions. In particular, we took advantage from participating to an international survey project (namely IMSS - International Manufacturing Strategy Survey). More details on this project are provided in the following chapter.

However, surveys can have several limitations: for example questions can be misunderstood, self-reporting data can create biases, wording can affect the answers (Behling and Law, 2000; Podsakoff et al., 2003). Moreover globalization strategies can change significantly from industry to industry (e.g. Berger, 2006). Our survey is quite robust to these problems as the questions have been tested on multiple editions of the project and with companies too. Moreover the considered sample ranges among several industries (ISIC codes from 28 to 35).

Nevertheless, in order to enrich our results, we used the findings obtained with the survey to study some cases taken from a specific industry. We selected the electric motor industry as target because it is included in the survey sample (the corresponding ISIC code is 31) and it has good characteristics for the purposes of this study (we will discuss this choice in details afterwards). We tested our results in this industry through a set of case studies. Case studies have been one of the most powerful research methods in Operations Management, especially for new theories development (Voss et al., 2002). However case studies can be used, as in our case, also for testing, extending or refine a theory, especially when dealing with strategic and complex topics (Boyer and McDermott, 1999; Pagell and Krause, 1999).

Therefore, we adopted a mixed methodology (survey and case studies), which is often used in the literature to hedge the weaknesses of the different methodologies (Campbell and Fiske, 1998; Creswell, 2009; Jick, 1979). As a matter of fact, quantitative methods like surveys help in the results conceptualization and generalization, while case studies let researchers better understand the whys and connections with the environment surrounding the company (Creswell, 2009).

As shown in Table 4.1, from the survey we expect to answer the research questions by identifying significant relationships with SC improvement programs, performance and contingent variables. From the case studies, instead, we expect to verify if such configurations are meaningful and, about the relationship with the other variables, the whys and the connections with context.

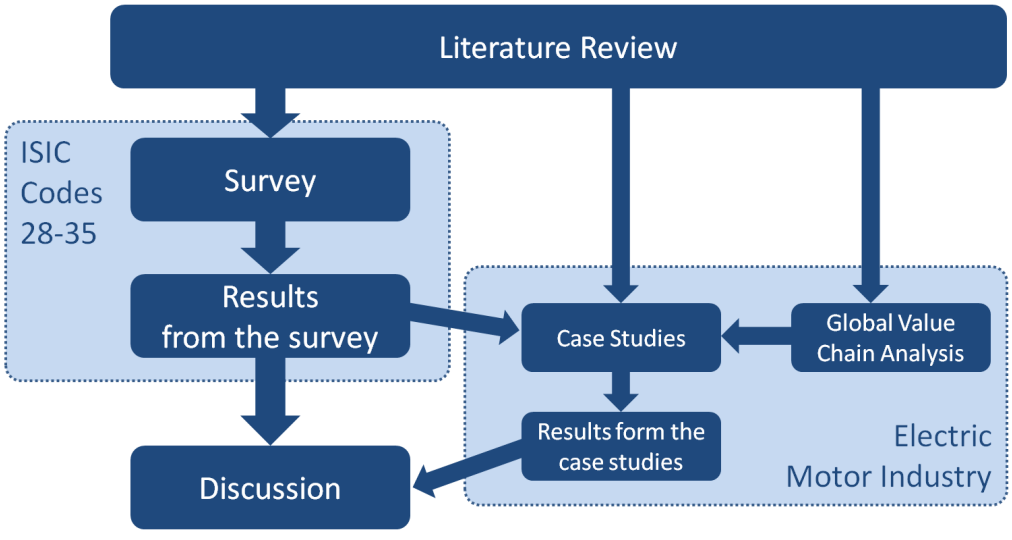
Table 4.1 - Research questions and results expected from the two applied methodologies

Research Question	Results from the survey	Results from the case studies
RQ 1: which are the main global SC configurations adopted by companies?	Identify configurations of global SC configurations and their characteristics	Check if the identified configurations hold on the considered cases and in which contexts they occur
RQ 2: how configurations are related to different SC improvement programs?	Verify if configurations significantly differ in terms of adoption of SC improvement programs	Identify if the results from the survey corresponds on cases and identify why different companies invest differently in SC improvement programs and the relation with the context
RQ 3: which is the performance achieved according to different configurations and SC improvement programs?	Verify if configurations get different performance from the same SC improvement programs.	Verify if the results from the survey correspond on the cases and understand why and what is the relationship with the context
RQ 4: what is the effect of contingent variables on the overall model?	Verify if the selected contingent variables affect the significance or the intensity of the relationships among the variables	Understand if other relevant contingency exist and why contingent variables affect the results in the way indentified by the survey

Moreover, to have an even clearer perspective on the environment in which our case studies operate, we performed a Global Value Chain (GVC) analysis on the electric motor industry. Even if the GVC analysis has been developed in the economical and industrial trade literature (Gereffi et al., 2005), there are several studies using it to interpret phenomena in the Operations Management field (Abecassis-Moedas, 2006; Chiarvesio and Di Maria, 2009; Fleury, 1999). GVC analysis in fact is helpful not only to identify the value added stages and key players in the entire chain, but also to establish the type of relationships among the players, the possible strategies in the value chain and the effect of policies and regulations (UNCTAD, 2006). The study on the electric motor GVC was conducted during a visiting period at the Center on Globalization Governance and Competitiveness of Duke University led by Prof. Gereffi and brought to a published report (Lowe et al., 2010).

We summarized our research strategy and workflow in Figure 4.1. Starting from the literature review we developed constructs and hypotheses for the survey, case studies and GVC analysis. Next, we performed the analysis based on the survey and we got the main results. These results have been used as an input for the case studies together with the insights got from the GVC analysis. Case studies brought to further results that support the final discussion.

Figure 4.1 - Research workflow



5 Survey

Survey research is one of the most diffused research techniques in Operations Management, SCM included (Craighead and Meredith, 2008; Forza, 2002; Van Der Vaart and Van Donk, 2008). It is usually used with well-defined and literature based constructs with different aims: exploratory, confirmatory and descriptive (Filippini, 1997; Pinsonneault and Kraemer, 1993).

In particular, we used the data from the fifth edition of the International Manufacturing Strategy Survey (IMSS 5) collected in 2009. This project, originally launched by London Business School and Chalmers University of Technology, studies manufacturing and SC strategies within the assembly industry (ISIC codes 28-35[1]) through a detailed questionnaire administered simultaneously in many countries by local research groups. Responses are gathered in a unique global database (refer to Lindberg et al., 1998 for further details).

The basic structure of the questionnaire remained the same over time. The first section of the questionnaire is related to the business unit, in order to gather general information (e.g. company size, industry, production network configuration, competitive strategy and business performance), while the other sections refer to the dominant activity of the plant focusing on manufacturing strategies, practices and performance. Dominant activity is defined as the most important activity, which is considered to best represent the plant itself. The plant is chosen as the unit of analysis in order to avoid problems related to business units with multiple plants operating in different ways (refer to the Appendix for the complete version of the questionnaire).

In the questionnaire as it is today, items and constructs are grounded in theory and experience of the participating researchers. Even if the basic structure of the questionnaire remained the same, at every edition old questions have been updated or removed and new questions have been added by the design team composed by a pool of international researchers. Specifically for the purposes of this research, some literature based items about globalization have been added. These items are described in the Results section as long as they are employed in the analysis.

After the design phase, to which I directly participated, the questionnaire is tested with some sample companies to check if the questions are clear to the respondents.

Following, the questionnaire is sent to the international partners who collect data for their own countries. In each country data are gathered in the native language as the questionnaire is translated using a back-translation procedure to check for consistency (Behling and Law, 2000).

Companies are usually selected from convenience samples or randomly from economic datasets. Then they are contacted, in the person of the operations, production or plant manager, asking for their interest in the research. If the respondent agrees, the questionnaire is sent out. Where is the case, after some weeks a reminder is sent. Questionnaires that are sent back are controlled for

[1] ISIC Code (Rev. 3.1): 28: Manufacture of fabricated metal products, except machinery and equipment; 29: Manufacture of machinery and equipment not classified elsewhere; 30: Manufacture of office, accounting, and computing machinery; 31: Manufacture of electrical machinery and apparatus not classified elsewhere; 32: Manufacture of radio, television, and communication equipment and apparatus; 33: Manufacture of medical, precision, and optical instruments, watches and clocks; 34: Manufacture of motor vehicles, trailers, and semi-trailers; 35: Manufacture of other transport equipment.

missing data which are handled case by case usually contacting the company back. Every country then controls the gathered data for late respondent bias on company size and industry.

In the last edition we got data from 650 companies from 19 countries with an overall response rate of 18.3% on the questionnaires sent (10.6% on the contacted companies).

Table 5.1 reports information in terms of country, company size and ISIC code for the overall sample.

Table 5.1 - Descriptive statistics in terms of (a) country, (b) size, (c) industrial sector (ISIC codes) for IMSS V data collected in 2009

(a)

Country	N	%	Country	N	%
Belgium	29	4.5	Japan	20	3.1
Brazil	37	5.7	Mexico	13	2.0
Canada	19	2.9	The Netherlands	50	7.7
China	59	9.1	Portugal	10	1.5
Denmark	18	2.8	Spain	40	6.2
Estonia	27	4.2	Switzerland	31	4.8
Germany	38	5.8	Taiwan	30	4.6
Hungary	70	10.8	United Kingdom	25	3.8
Ireland	5	0.8	USA	73	11.2
Italy	56	8.6	**Total**	**650**	**100.0**

(b)

Size*	N	%
Small	321	49.4
Medium	118	18.1
Large	211	32.5
Total	**650**	**100.0**

(c)

ISIC**	N	%
28	207	31.8
29	188	28.9
30	16	2.5
31	78	12.0
32	38	5.8
33	41	6.3
34	35	46
35	21	36
Total	**650**	**100.0**

* Size**:** Small: less than 250 employees, Medium: 251-500 employees, Large: over 501 employees

**ISIC Code (Rev. 3.1)	Industry description
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment not classified elsewhere
30	Manufacture of office, accounting, and computing machinery
31	Manufacture of electrical machinery and apparatus not classified elsewhere
32	Manufacture of radio, television, and communication equipment and apparatus
33	Manufacture of medical, precision, and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers, and semi-trailers
35	Manufacture of other transport equipment

6 Case studies

As explained before, we enriched the results obtained from the survey through a set of case studies. In particular, given the objective of testing, extending and refine a theory, we adopted a multiple-case study methodology (Voss et al., 2002).

We picked up cases only from one sector that is the electric motor manufacturing industry, so that the value chain (raw materials, suppliers, production phases, distribution channels, market requirements, business cycles) is similar for all the cases. Indentifying and fixing some common and relevant characteristics is in fact essential to correctly interpret the cases (Meredith, 1998). Focusing on one single industry, we could study the global SC strategies put in place by companies within the same context and discriminate what is due to the industry and what is due to the cases. On the

other side, this limits the possibility of results generalization. However, our aim was to try on the field and complement the results obtained from the survey.

We selected the electric motor industry for several reasons. First of all, as explained in the next chapter, it is a relevant industry at global and Italian scale for its economical value and impact of electric motors on national energy consumptions. Next, it belongs to one important sector of our database (ISIC code 31, 12% of the companies in the sample). Finally, it has a limited variability in the variables we were looking into. Electric motors can be in fact produced in different sizes with different target markets, but, as shown later, the upstream part of the SC (suppliers and the production process) remains quite similar allowing an effective comparison among the companies.

Before interviewing the companies, we performed a GVC analysis. Following the methodology suggested in the literature (Gereffi et al., 2005; UNCTAD, 2006) we identified the value chain structure and the key players. Results are presented in Chapter 11 (GVC analysis) together with the case studies results.

Next, we contacted a set of companies in the electric motors production value chain (Table 6.1). Six of them are motors producers, while two of them are suppliers of specific components. For anonymity sake, we labeled every motor manufacturer according to its size (e.g. VS: very small, S: small, etc.) and the two suppliers as Su1 and Su2.

Table 6.1 - Case studies set

Case	Size	Employees	Interviewed person(s)	Type of company
S	Small	7	Owner	Motor manufacturer
M1	Medium (1)	85	Managing Director, Controller	Motor manufacturer
M2	Medium (2)	100	President	Motor manufacturer
VS	Very Small	3	Owner	Motor manufacturer
VL	Very Large	700	Plant purchasing manager, buyer	Motor manufacturer
L	Large	550	Operations Director	Motor manufacturer
Su1	Large	511	Logistic director	Supplier
Su2	Small	25	Owner	Supplier

Following the practice described by Eisenhardt (1989) and Yin (2009) we selected cases according to different criteria looking for theoretical and literal replication. Literal replication is the expectation that similar cases will produce similar results, while theoretical replication is the expectation that cases will provide different results but for predictable reasons. In our case, we selected companies of different sizes, with different global SC configurations, producing motors with different characteristics.

We interviewed one or two people from the company with visibility on the SC activities. Two researchers participated to each interview and for the majority of the cases a plant visit followed and integrated the interview. An interview protocol (in Appendix) was followed in order to check whether all the relevant information was collected. Given the particular historical moment, we also asked questions about the impact of the crisis and of the new regulations on high efficiency electric motors.

The items in the protocol are partially aligned with those in the questionnaire (for instance, questions about SCM and globalization of the SC) and partially broader in order to better understand the context in which the company operates. We also asked to the interviewees if they confirmed or not the causal relationships identified through literature, GVC analysis and the survey. Moreover the

interviewees were free to give further information to avoid missing some relevant elements. We also interviewed two suppliers of components specialized in this industry and supplying many of the interviewed motors manufacturers. These interviews were particularly helpful in order to triangulate the information retrieved from the motors manufacturers about the relationships with their suppliers.

We decided to stop contacting new cases, when we had a good representativeness of different situations and the information added by each new case became marginal. Focusing on one specific sector and following the indications of Eisenhardt (1989) we concluded that 6 manufacturers plus 2 suppliers cases were a sufficient number.

Every interview was recorded and then transcript. After that the researchers coded with a cross verification the information collected. This has been an iterative process with the objective of refining the coding at every step and highlighting the most relevant information and the differences among cases. After that we contacted again the companies in order to fill out any possible missing information and we triangulated collected data through secondary sources (economical database and other publicly available information).

After the information coding process, we performed a inter- and a cross- case analysis. Focusing on one specific sector we could compare companies that deal with similar products in a similar value chain highlighting differences in terms of SC configurations, SCM and performance. We interpreted the results under the light of the information collected in the cases and the insights provided by the GVC analysis that helped to identify and marginalize the impact of the business environment.

In the next paragraphs we will substantiate why this industry is relevant, the process followed to perform the GVC analysis and finally some descriptive information about the interviewed companies.

6.1 Relevance of the electric motors industry

Note: results of this chapter are mainly taken from the report by Lowe, Golini and Gereffi (2010).

Electric motors employ a relevant share of the total generated electrical energy worldwide. For industrial applications (e.g. pumps and fans) this share is around 30 and 40% worldwide, around 70% for the European Union, 50% for China (de Almeida et al., 2008; McKane et al., 2008). It is also dependent on the process typology. Mining, oil and gas extraction, water supply, sewage and irrigation are particularly energy intensive employing 80% of their energy in motors. Process manufacturing (e.g. food, tobacco, textile, lumber and wood products, paper, printing, chemicals, petroleum refining, rubber and plastics products, concrete products) employ around 70% while discrete manufacturing (e.g. apparel, furniture and fixtures, fabricated metal products, industrial and commercial machinery and computer equipment, electronic and other electrical equipment, transportation equipment) are around 40%.

Typical applications for industrial electric motors are (U.S. DOE, 2002):

- Pumps (25% of motor system energy in manufacturing): for circulating water or other process fluids;
- Compressors (16%): for heating, ventilation and air conditioning (HVAC) and for pneumatic power tools;
- Fans (14%): for ventilation and exhaust systems;
- Refrigeration systems (7%): for food primarily, also for paper and metals processes.

Additional contexts for motor applications include the following broad umbrella categories:

- Material processing (22%): including mills, grinders, lathes;
- Material handling (12%): including belts, conveyors, elevators, cranes;
- Other applications (4%): including process heating such as ovens and kilns.

There are many different typologies of electric motors, but the so called three-phase squirrel-cage induction motors represent the majority of the market (de Almeida et al., 2008).

Even if the technology of electric motors is mature, in recent years the so called high efficiency motors entered in the market pushed by regulations set by governments (Lowe et al., 2010). The impact of this technology can be relevant considering that, according to an U.S. based study, In the United States it could save an estimated 62-104 billion kilowatt hours of electricity annually (Consortium for Energy Efficiency, 2009). This could lead to a cost savings of $3-5 billion and a reduction in CO_2 of about 15-26 million metric tons per year (the equivalent of the annual emissions from 4-7 coal-fired power plants or from 3-5 million passenger vehicles).

Electric motors constitute also a big market and have relevant international flows (UNComtrade, 2005[1]). In 2005, Germany, Mexico and United States have been the 3 larger exporters of electric motors (Italy is seventh with 602 million US$). United States and Germany are also the first two importers (Italy is fourth with 525 million US$). Focusing on Italy, that is the location where we interviewed companies, more than 60% of the exports are to Europe but there are significant exchanges also with the countries outside the continent (e.g. United States, China, Mexico).

In terms of imports, Italy has a very strong relationship with Germany that accounts for 36% of the total imports. However there are also significant exchanges with other European and non European countries (e.g. United States and China).

This preliminary analysis confirms that electric motors are a sector with a significant economical impact and a quite high degree of value chain globalization, also for Italy. Therefore it is reasonable to take it into account as a target sector for our case studies.

6.2 GVC analysis

Before interviewing cases we performed a GVC analysis in the electric motors industry. For the theoretical part please refer to Chapter 2.10 (Global Value Chain analysis).

Mapping a GVC involves a sequence of steps (UNCTAD, 2006) that we followed. First of all, an initial map of the SC is drawn considering the main activities and production processes. The information is collected from secondary sources, economical databases, interviews with industry experts and companies at different stages. Second, for each stage the connections between the different stages are traced. Third, key players and their location are identified. Fourth, the relationships among the players are identified (i.e. market, modular, relational, captive or hierarchy). Fifth, the value chain typology is identified (buyer-driven or producer-driven).

6.3 Sample of cases

As declared before, we interviewed six motor manufacturers and two suppliers. In the next chapters we will describe the companies belonging to both groups. In the results, however, we will focus only

[1] http://comtrade.un.org/ This web site provides access to information and data on International Merchandise Trade Statistics (IMTS) and the work of the International Merchandise Trade Statistics Section (IMTSS) of the United Nations Statistics Division (UNSD).

on motor manufacturers and we will keep suppliers' perspective only to better understand some patterns that emerged from the analysis.

6.3.1 Motor manufacturers

We provide here the general information about the motor manufacturers interviewed. Summary tables are reported in Table 6.2, Table 6.3, Table 6.4. Detailed information about companies' SCs is reported in after, in Chapters 12 and 0.

Case 1: Small motor manufacturer (S)

This is a small company of 7 employees founded in 2008 after a management buy-out and, despite this change, they were able to react to the crisis. The company sales are around € 400,000 with about 20,000 motors sold per year. Given their size, they have only one plant located in Northern Italy. They produce mainly small motors (unit price 30-40 €) for home automation (gates, doors), laboratory equipments, robots and construction tools. The product range is quite narrow made of two product families: standard AC motors (about 40% of the sales) and customized DC motors (60% of the sales). The degree of customization is relatively low, as their order winners are: quality, flexibility (especially in terms of small batches) and delivery speed. Their customers in fact go for them for small series or when they need urgent deliveries. Given the small size of their supply network and customers, they have been less struck by the crisis being able to compete through flexibility.

Case 2: Medium motor manufacturer (M1)

M1 is a medium size motor manufacturer founded it the Seventies, of about 90 employees with 3 production facilities in Italy. Their total sales have been around € 12 million in 2009 with more than 1.5 million motors produced in the same year. They have a broad product range, with motors ranging from 3 to 900 € even though the majority of the turnover is made of small motors for white goods, automotive and industrial applications. Products, especially for floor-care are quite standardized, while others have a slightly higher level of customization. Therefore their order winners are: quality, customer service and flexibility. The recent regulations about motor efficiency did not affect them much as these regulations are more related to big motors. For smaller motors, as the ones they make, power, rather than efficiency, is still the dominant performance. They strongly feel Chinese competition made harsher by the crisis. As an outcome of the crisis in the last years many customers started buying from China creating a market downshift that will probably never be recovered.

Case 3: medium motor manufacturer (M2)

M2 is a medium size motor manufacturer operating since the end of the Eighties. They have around 100 employees concentrated in one production plant in Northern Italy. They produce around 2 million motors per year generating € 20 millions of revenues. They are specialized in the market niche of medium and small refrigeration and conditioning systems (e.g. fan coils, bar fridges). In particular, they usually do not sell the motor stand alone, but the motor assembled with the fan and the hood. In this way they offer to their customer a subassembly ready to be integrated in the final product with a considerable higher selling price (about 3-4 times the price of the motor). Together with this product integration service, their key success factors lie in the flexibility, quality and delivery speed. Customers are in fact very sensitive to motor quality and reliability and they ask their

suppliers to have specific certifications. This higher margin and the leadership position in Europe helped to face the crisis.

Case 4: very small motor manufacturer (VS)

VS is a very interesting case of a very small producer of highly customized electric motors in small series. It is a company founded in the Sixties with its laboratories and assembly facility in the Northern Italy. In the company work stably only 3 persons that follow the design and prototype phases, while external help is asked to assemble the products. They produce around 300 motors per year for several different industries (e.g. textile, paper industry). They do not have a catalog, but every series is customized. Usually they serve Italian customers that appreciate innovation, flexibility and speed. The competition in last years is not only from China but also from Eastern Europe countries like Poland, Turkey, Romany.

Case 5: Very large motor manufacturer (VL)

This company is part of multinational group with several production facilities around the world (Europe, China, South Africa, South America). In Italy they employ more than 200 people to produce big motors for heavy industry and transportation applications. Their strengths are related to speed, quality, customization and pre- and post- sales services at a global scale. They globally produce a wide product range; however each plant has a specialization. For example the Italian plant manufactures low voltage motors, large machines and explosion-proof motors. All the motors they produce are tailored to customers' specification. Their market is moving more and more to Middle East, China and other emerging countries. The regulations on high efficiency motors, that are more expensive, are in contrast with the low cost countries competition. Especially for high-voltage industrial applications (e.g. cement factories) there is less concern for energy efficiency.

Case 6: Large motor manufacturer (L)

This company is one of the largest motors manufacturers in Italy, employing more than 500 people, making more than 100,000 motors per year with a turnover above € 110 millions. They have one main plant in Italy and they are setting up a new one in the Asian Southeast. They serve many different industries with a broad range of products. They are able from one side to keep low prices for standardized motors and on the other offer degree of customization for higher margin customized products. They also produce generators for hydroelectric power generation and cogeneration. The technology to produce generators is in fact similar to the one for motors. Even if they are a large company, globally they have around 4% of the market share. So, thank to some big contracts they were able to overcome successfully the crisis.

Table 6.2 - Case studies sample: general information

Case	Year of foundation	Total sales 2009 (K€)	Volumes (2009)	Employees (2009)	Production facilities	Certifications
S	2008	400	20,000	7	1 (Italy)	No certifications
M1	1972	12,000	1,500,000	85	3 (Italy)	ISO 9001:2000, UL, EN
M2	1989	20,000	2,000,000	100	1 (Italy)	VDE, UL
VS	1960	NA	200	3-6	1 (Italy)	No certifications
VL	1988	236,000	NA	700	10*	ISO 9001, ISO 14001, OHSAS 18001 (…)
L	1891	115,000	100,000	550	2 (Italy and Asian Southeast)	ISO 9001, ISO 14001 BS OHSAS 18001

* Europe; India; China; South Africa; South America

Table 6.3 - Case studies sample: product applications and markets

	Main Applications	Unit Price	Order winners
S	Home automation (automatic doors and gates), lab equipments, robots, construction tools (e.g. drills)	30-40€	Small batches, quality, flexibility, delivery speed
M1	White goods, automotive, fans, pumps	3-900€ (90% of sales is made on smaller motors)	Quality, customer service and flexibility
M2	Refrigeration and HVAC	6-35 € (for the motor),120€ for motor and the fan system	Flexibility, delivery speed, quality, product integration
VS	Several applications (textile, paper industry, etc.)	30-800€	Customization, flexibility, reactivity
VL	Several applications (e.g. transportation, cement factory, oil & gas)	NA	Speed, quality, customization, reliability, global presence, after sales
L	Several applications	30-300,000€	Price for standard products, customization for special products, after sales

Table 6.4 - Case studies sample: product typologies

	Motor Power Range (kW)	Product Range	Customization
S	Up to 0.5	Narrow product range. 2 product families: standard DC motors (about 40% of sales); customized AC motors (60% of sales)	DC motors are standard, AC motors are more customized.
M1	0.02 - 2.1	Wide product range with 6 product families (e.g. induction, brushless, special, permanent magnets)	Depending on the sector, e.g. in the floor care there are standard motors; in the small home appliances there is higher customization.
M2	Up to 0.6	Wide product range: different types of motors with different types of ventilation devices.	Motors are usually standardized, while fan systems are customized.
VS	0.03- 20	Wide product range	Motors are all highly customized
VL	20 – 45,000	Wide product range. The Italian plant manufactures low voltage motors, large machines and explosion-proof motors.	Motors are all highly customized
L	0.12 – 6,400	Wide product range: asynchronous motors in low, middle and high voltage, open drip proof, air or water cooled, high efficiency, explosion proof. They produce also generators for hydroelectric power generation and cogeneration.	50% standard, 50% customized

6.3.2 Suppliers

Supplier 1 (Su1) - Metal plates supply

The first case (Su1), supplies cut metal sheets that used to make the stator and the rotor. To make this product, big presses are required that must be saturated in order to return on the investment. For their clients is therefore economical to buy metal plates from them in order to avoid the investment especially when production volumes are low. The company acts also as an intermediary who buys steel, process it and in some cases keeps finished products to stock.

The company owns multiple plants in the same Italian region specialized in different processing or product sizes. They also own a plant in South America and one in Northern Africa opened to serve important customers' plants located there. The company usually produces in make-to-order. First of all products are customized and the company uses different dies for every customer. Next there can be different sizes, shapes and steel qualities for every customer so, it is practically impossible to produce on forecasts. However for habitual customers with whom they have yearly frame agreements, they sometimes anticipate production before getting the actual order.

The business is made complex by several factors. First of all the company is positioned quite upstream on the chain so the bullwhip effect - as defined by (Lee et al., 1997) - is particularly strong. Next a high inventory is required in order to have in home every steel quality. Purchasing-to-order is in fact not feasible as the steel requires around 3 months to be shipped from foundries. Furthermore the high capital invested in the machineries requires a high level of saturation that is made more critical by long set-up times (up to 1 turn) and customers requiring small batches. Finally, the automotive industry is particularly critical to serve because of certifications (e.g. ISO TS) that for example require that the production is fully made in the certified factory or at certified suppliers' place.

The good point of the business is that it only partially suffers the competition of low-cost countries. In fact they purchase the steel at the international market prices that is the same for players also in low-cost countries. Moreover for capital intensive business like theirs, the incidence of the workforce cost is relatively low.

Since the value added of the manufacturing process is low, it is critical to purchase the steel at the best conditions. The steel is purchased at global scale from the leading companies in the steel making industry through yearly frame agreements. Moreover the company can deliver stators and rotors already stacked, welded and baked according to the customer needs.

Finally, they highlighted a low level of supply integration between motor manufacturers and their suppliers. Only for a big customer in the automotive industry they have in place electronic exchange of information and just-in-time deliveries. This is possible thanks to frame agreements, dedicated production lines and inventory space.

Supplier 2 (Su2) - Permanent magnet supplier

Su2 provides its customers with permanent magnets made both of Ferrite and Neodymium (see Chapter 11.2.3 - Permanent magnets). They help their customers on the design phase and then they buy the finished product in China, mainly from a factory opened through a joint venture.

Since they have frame agreements with their customers, they can order bigger batches from China and then keep inventory (around 2 months of coverage) in Italy. This is anyway necessary as the lead

time to receive the products from China is around 3 months. In fact it takes 1 week to send the order, 3-4 weeks to produce it (the Chinese plant works in make-to-order) at 7-8 weeks for the shipment. In case of urgencies, they use the air transport with a lead time of around 2 months.

The main source of issues for their business is that prices of raw materials are very variable and, on average increasing because of China having a sort of monopoly. Other difficulties are related to the interaction with the Chinese plant for the linguistic and cultural differences and sometimes for a lack of transparency.

Interestingly, the crisis had a lighter effect since they are upstream suppliers serving customers that produce motors for several industries with a sort of compensation effect.

Section C: Survey Results

Results are organized in three sections. The first section (this one – form Chapter 7 to 10) reports the results obtained from the survey. The second section (the next one – from Chapter 11 to 0) reports the results obtained from the global value chain analysis and the case studies. Finally, in the section devoted to the Discussion (from Chapter 14 to19) we will compare the results obtained from both methodologies. Results from the survey (this section) are organized in chapters according to the research questions stated before. For each chapter, first the objectives and methodology used are explained, then the measures are presented and third the results.

7 Global SC configurations (RQ1)

Our first research question (i.e. *which are the main global SC configurations adopted by companies?*) deals with the existence of different global SC configurations that are at the core of our research framework (see Chapter 3 - Research framework and objectives). In order to identify such configurations, a two-step cluster analysis has been performed using global sourcing, manufacturing and sales as input variables. First, hierarchical cluster analysis, based on the method of linkage between groups and Ward distance, was used to identify the most suitable number of clusters and the cluster centroids. Afterwards, K-means clustering algorithm was used to iteratively assign each firm to a cluster (Ketchen and Shook, 1996). Through this procedure, four clusters were identified. Finally, we checked for significant differences among clusters trough parametric (i.e. ANOVA) and non-parametric (i.e. Kruskal-Wallis) tests on some descriptive variables, that are: company size, wealth country of origin, industry, investment in globalization, characteristics of the SC, SC integration, role of the plant.

A brief description of the measures follows.

7.1 Measures

Globalization of the SC

In order to identify configurations, we used as a measure the percentage of sourcing, manufacturing and sales outside the continent. For what concerns global manufacturing, this is higher than 0% only if there are other plants in other continents involved in the plant's dominant activity.

See as a reference question G1 in the questionnaire reported in Appendix.

Company size, wealth of the country of origin and industry

Company size is evaluated through the number of employees in the business unit. *See as a reference question A1 in the questionnaire reported in Appendix.*

Wealth of the country of origin is assessed in terms of Gross National Income per Capita (Atlas Method), taken from the World Bank Database 2009[1].

[1] http://data.worldbank.org/indicator

Industry is evaluated through the ISIC code the company reports on the cover page of the questionnaire. The ISIC codes range between 28 and 35.

Investment in SC globalization

Investments in SC globalization are evaluated on a 1-5 Likert scale asking the level of effort put to increase the degree of globalization in terms of production network (i.e. shifting production activities to off-shored plants), sourcing, sales and product development. *See as a reference question G3 in the questionnaire reported in Appendix.*

Characteristics of the SC

Questions about the characteristics of the SC are organized in several sets of questions.

A first set, is devoted to suppliers:

- Purchasing portfolio: percentage of the spending for raw materials, parts and components, subassemblies and systems;
- Number of suppliers (total and strategic);
- Suppliers selection criteria: 1-5 Likert scale on the importance of the following factors to select suppliers: lowest price bid; delivery performance (reliability, speed, flexibility); quality of products/services offered; logistical costs (transportation, storage and handling); ability to provide innovation and co-design; physical proximity to/within region (local sourcing); willingness to disclose cost/other information; evaluation of supplier potential (development programs or past performance record).

See as a reference questions SC1, SC2, SC3 in the questionnaire reported in Appendix.

A second set of questions is about customers. Customers' typology is identified by the percentage of manufacturers of subassemblies, finished products, wholesalers and distributors or end users (in percentage). Next the total number of customers is asked and the proportion of key/strategic ones.

See as a reference questions SC4 and SC5 in the questionnaire reported in Appendix.

SC integration

The level of SC integration, separately with suppliers and customers, is assessed on a 1-5 Likert scale measuring the level of adoption of the following practices: information sharing (share inventory level information; share production planning and demand forecast information; order tracking/tracing; agreements on delivery frequency), system coupling (dedicated capacity; vendor managed inventory or consignment stock; plan, forecast and replenish collaboratively; just-in-time replenishment; physical integration within the same plant).

Next the adoption of electronic tools supporting SC integration is asked. These tools are: scouting/ pre-qualify; auctions; RFx; data analysis; order management and tracking; contract and document management.

See as a reference questions SC7 and SC8 in the questionnaire reported in Appendix.

Role of the plant

Finally, we evaluated the role of the plant using the scale proposed by Ferdows (Ferdows, 1997b; Vereecke and Van Dierdonck, 2002). In the first question we asked which are the advantages provided by the location of the plant, each one measured on a Likert-scale from 1 to 5. These advantages are: proximity to suppliers; availability of low cost labor; availability of low cost material and/or energy sources; availability of skills and know-how; access to transportation & logistic facilities; proximity to customers; social and political factors (e.g. tax advantages, incentives, regulation); competition (e.g. to be close to competitors or to prevent them from settling in the area); company image (e.g. made in, social acceptance, reputation).

In the second question, we asked for the capabilities of the plant from 1 ("get products produced") to 5 ("be a center of excellence"). *See as a reference questions B6 and B7 in the questionnaire reported in Appendix.*

7.2 Results

Table 7.1 provides descriptive statistics for the global SC variables. On average companies have a degree of global sourcing and distribution higher than global manufacturing, even though standard deviation shows a relevant variability within the sample.

Table 7.1 - Descriptives of global SC variables

Variable	Minimum	Maximum	Average	Std. Deviation
Global Sourcing (%)	0	95	14.522	20.316
Global Manufacturing (%)	0	90	5.691	15.080
Global Sales (%)	0	96	16.296	21.380

These three variables are correlated among themselves (Table 7.2). In particular, there is a strong correlation of both global sourcing and global sales with global manufacturing, suggesting that when companies globalize either sourcing or sales they also tend to support this process by means of global manufacturing.

Table 7.2 - Correlations among global SC variables

	Global Sourcing	Global Manufacturing	Global Sales
Global Sourcing	1.000	0.437	0.263
Global Manufacturing	0.437	1.000	0.389
Global Sales	0.263	0.389	1.000
All correlations are significant at the 0.01 level (2-tailed).			

Next we performed a cluster analysis based on these variables. Each cluster obtained in this way represents a different global SC configuration, since different levels of both global sourcing, manufacturing and sales characterize it.

The hierarchical cluster analysis suggested four as the number of clusters. These have been labeled and defined as follows:

- Locals: local sourcing, manufacturing and distribution;
- Barons: local sourcing and manufacturing, global distribution;
- Shoppers: global sourcing, local manufacturing and distribution;
- Globals: global sourcing, manufacturing and distribution.

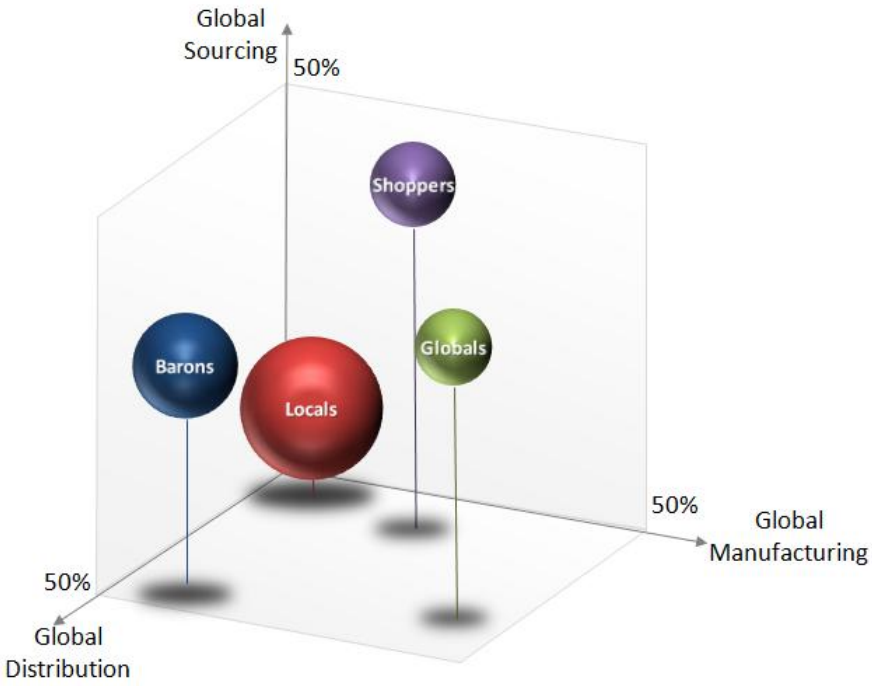
Table 7.3 provides the description of the identified clusters and Figure 7.1 a graphical representation of the clusters centroids.

Table 7.3 - Global SC configurations clusters means and descriptive statistics.

	Locals	Shoppers	Globals	Barons	Sample Average	Wilks Lambda[1]
Global Sourcing	5.48	56.79	49.43	12.77	13.96	0.298
Global Manufacturing	1.42	6.60	55.43	5.49	5.73	0.324
Global Sales	5.45	9.34	48.70	48.40	15.98	0.273
Total Number	350	47	30	93	520	

[1]Wilks' Lambda is significant with $p < 0.001$

Figure 7.1 - Global SC configurations clusters centroids (size of the bubble is proportional to the number of companies in the cluster)



First of all we notice that a vast amount of companies in our sample tend to stay completely local (Locals represent more than 67% of the sample) and only 6% of the sample show a real global SC (Globals). We can also find companies - i.e. Shoppers, representing 9% of the sample - that have a high level of global sourcing, thus managing purchases from different areas of the world while their manufacturing and distribution processes are locally focused. In the end, we have the Barons (18% of the sample) that source and manufacture locally, but they distribute in different countries outside their continent.

Wilks' Lambda provides evidence that the three variables contribute similarly to the clusters' definition. However, among the considered variables we can notice that global sourcing and global distribution are those that characterize the most the identified configurations. In fact Shoppers are those companies that leverage only on global sourcing, Barons focus on global distribution and Globals put emphasis on both, contrary to what Locals do. Global manufacturing is not much adopted by most of the configurations except for Globals: as a matter of fact we can highlight that the relevant use of global manufacturing is a specific characteristic of Globals compared to the other configurations.

After having identified the configurations we looked for differences among them as reported in the following chapters.

7.2.1 Company size, wealth of the country of origin and industry

First of all we performed an ANOVA considering the following contingent variables:

- Company size, measured by the number of employees of the business unit;
- Gross National Income (GNI) of the country where the respondent plant is located.

Post-hoc tests were also performed based on Scheffè post-hoc test in order to identify the mutual differences among the configurations. Results are shown in Table 7.4.

Table 7.4 - ANOVA results for differences among configurations on contingent variables. For each configuration the average value and the number of the configurations that are significantly different are reported.

	Locals (1)	Shoppers (2)	Barons (3)	Globals (4)	Sample Average	ANOVA Sig.
Size	546	693	717	1,106	612	0.020
	4	-	-	1		
GNI per capita (US$)	29,999	34,676	40,831	38,393	32,693	0.000
	3	-	1	-		

The global SC configurations emerged from the analysis show significant differences in terms of the two contingent variables considered namely company size and country GNI.

As far as size is concerned, Globals are significantly larger than Locals, in line with other contributions (Chetty and Holm, 2000; Shi and Gregory, 1998). It is not surprising that Globals are larger; however it is interesting that Shoppers, i.e. companies that do only global sourcing, are similar to Locals. Also Barons are not significantly different from Locals, therefore we can conclude that today also smaller firms can globalize their SCs, although partially.

As far as GNI is concerned, we observe an interesting result: Locals are on average located in lower GNI per capita countries, i.e. in emerging countries, while Barons show the highest average GNI per capita. On the one hand, we can conclude that Locals are more suited to emerging countries, since they have no strong reasons or needs to go global, but, at the same time, they may lack expertise and resources. On the other hand, Barons are those firms with a strong root in a rich country, who are able to sell globally thank to their unique products, technology and brands. We could expect Globals to belong to the richest countries; however we should remind that our respondents are from single plants, which can be plants of a Global firm located in an emerging country. Therefore it is not surprising that they are not significantly different from other groups.

In order to check for any industry effect, we cross-tabulated configurations with the ISIC codes (Table 7.2).

Table 7.5 - Distribution of the configurations per ISIC code

ISIC Code[1]	Locals	Barons	Shoppers	Globals	Total
28	140	19	8	4	171
29	105	33	9	7	154
30	5	5	1	1	12
31	31	13	11	4	59
32	13	2	10	4	29
33	14	10	3	7	34
34	28	5	3	1	37
35	21	5	1	2	29
Total	357	92	46	30	525
Pearson Chi-Square: Value: 84,759, df: 21, sig. = .000					

Considering configurations' numerousness and the a-priori distribution of the ISIC codes, we can observe that:

- Locals are quite uniformly distributed;
- Barons: have more than expected observations on ISIC 30 and 33;
- Shoppers: have more than expected observations on ISIC 31 and 32;
- Globals: have more than expected observations on ISIC 32 and 33.

Even if it is difficult to provide an exhaustive interpretation, we can observe that ISIC codes 28 and 29 (machinery manufacturing) are equally distributed among sectors. This could be related to the fact that suppliers and markets are spread around the world, so companies can decide whether to have a global or local SC. On the contrary, Shoppers are in higher number in sectors 31 and 32 which involve electronic components. Usually these components are manufactured in the Far East countries, so this could explain why companies in these sectors tend to buy more globally then the others.

Because of these dishomogeneities, we can hypothesize a correlation among ISIC codes and configurations that is confirmed by the chi-square statistic (sig. 0.000).

7.2.2 Investments in SC globalization

Next, we tested differences among configurations on the investments in globalization made in the last three years through an ANOVA and then Scheffè test for differences (Table 7.6). We can observe that every investment is related to significant differences among configurations. In particular:

- Production network globalization: Locals less than everyone else; Barons and Shoppers less than Globals;

[1] ISIC Code (Rev. 3.1): 28: Manufacture of fabricated metal products, except machinery and equipment; 29: Manufacture of machinery and equipment not classified elsewhere; 30: Manufacture of office, accounting, and computing machinery; 31: Manufacture of electrical machinery and apparatus not classified elsewhere; 32: Manufacture of radio, television, and communication equipment and apparatus; 33: Manufacture of medical, precision, and optical instruments, watches and clocks; 34: Manufacture of motor vehicles, trailers, and semi-trailers; 35: Manufacture of other transport equipment.

- Global sourcing: Locals and Barons less than Shoppers and Globals;
- Global distribution: Locals less than Barons and Globals, Shoppers less than Barons;
- Global product design: Locals less than Shoppers.

The results obtained first of all confirm the reliability of our configurations. Locals invested in globalization less than the others, while Globals the most in manufacturing, sourcing and sales. Next, Shoppers invested more in global sourcing and Barons more in global distribution. Shoppers are also those who invested more in product design globalization probably because they need to customize the product for the different markets they serve around the world.

Table 7.6 - Differences among configurations on the last three years investments in globalization (1-5 Likert scale). For each configuration the average value and the number of the configurations that are significantly different are reported. Blue bars are proportional to the average values reported in the same cell.

Variable	Anova Sig.	Locals (1)	Barons (2)	Shoppers (3)	Globals (4)	Total
Production network	0.000	1.73 2;3;4	2.47 1;4	2.33 2;4	3.55 1;2;3	2.02
Sourcing	0.000	2.65 3;4	2.99 3;4	3.67 1;2	3.76 1;2	2.87
Sales	0.000	2.88 2;4	3.84 1;3	3.13	3.59 1	3.11
Product Design	0.000	2.29 3	2.62	3.27 1	2.79	2.46

7.2.3 Characteristics of the SC

Next we checked for differences on SC characteristics.

Starting from the suppliers, we did not find any significant difference on suppliers' selection criteria. It is quite surprising not to find for example differences between Shoppers and Barons about supplier proximity or cost or deliveries. This means that companies in every configuration evaluate suppliers according to different criteria.

On the contrary, we found some significant differences on suppliers' typologies and the total number of suppliers (Table 7.7). Given the non-normal distribution of these variables we used non-parametric tests (Kruskal-Wallis and Mann-Whitney U for pair wise comparisons). Locals tend to have a higher share of raw materials suppliers than Barons and Shoppers (and Shoppers less than Barons). Shoppers and Barons, instead, have a higher share of parts/components and subassemblies/systems suppliers than Locals. Finally, Shoppers have a higher share of subassemblies/systems suppliers than Locals and Barons (and Barons more than locals). We can conclude that, in terms of supply, Locals are located more upstream followed by Barons and then Shoppers are more downstream. Globals, instead, do not show any particular characteristic.

We also found that Barons have a significantly higher number of suppliers than Locals, while no other significant differences were identified in terms of average suppliers per item (10.51 is the sample average) and total number of key suppliers (31.14 is the sample average).

Table 7.7 - Differences among configurations on the last three years on suppliers typologies and number of suppliers. For each configuration the average value and the number of the configurations that are significantly different are reported. Red bars are proportional to the average values reported in % and yellow for those in total number of suppliers.

Variable	Kruskal-Wallis Sig.	Locals (1)	Barons (2)	Shoppers (3)	Globals (4)	Total
Raw materials suppliers %	0.000	58.60 2;3	49.21 1;3	37.61 1;2	47.23	54.65
Parts/components suppliers %	0.000	33.69 2;3	44.44 1	55.85 1	40.73	37.80
Subassemblies/systems suppliers %	0.008	14.38 2;3	18.10 1;3	20.61 1;2	19.67	15.83
Total number of suppliers	0.001	221.24 2	336.23 1	215.79	404.00	251.54
Average Suppliers per item	0.380	6.69	20.62	14.82	19.22	10.51
Number of key suppliers	0.258	32.99	26.60	26.62	28.68	31.14

Looking downstream, we found only one difference in terms of customer typologies, i.e. Locals have a lower share of subassembly customers than Barons (Table 7.8). Therefore, for what concern the downstream part of the supply chain, we cannot infer that our clusters are positioned differently along the supply chain. Also the number of customers (total and key customers) is equal among groups. Companies in the sample have on average 340 customers in total and 37 key customers.

Table 7.8 - Differences among configurations on the last three years on customers typologies and number of customers. For each configuration the average value and the number of the configurations that are significantly different are reported. Red bars are proportional to the average values reported in % and yellow for those in total number of customers.

Variable	Kruskal-Wallis Sig.	Locals (1)	Barons (2)	Shoppers (3)	Globals (4)	Total
Subassembly customers %	0.011	23.01 2	32.81 1	20.00	34.80	24.71
Finished products customer %	0.753	41.71	44.19	41.43	41.67	42.11
Distributors %	0.220	37.86	38.94	54.64	30.75	38.94
End Users %	0.156	36.71	42.20	36.07	46.35	38.03
Number of customers	0.064	329.61	486.67	235.65	228.08	340.29
Number of key customers	0.500	37.56	37.44	31.78	37.04	36.97

7.2.4 SC integration

Furthermore, we analyzed differences on adoption of SCM practices with suppliers and customers. Most of the practices (i.e. sharing inventory level information, production planning, order tracking/tracing, delivery frequency, dedicated capacity, VMI, CPFR, physical integration) and the eBusiness tools (scouting, auctions, RFx, order management, contract management) adoption do not show any significant difference. This means that also Locals considerably adopt these tools.

The only differences found are reported in Table 7.9. Shoppers adopt more than Barons the agreements on delivery frequency and Barons have the lowest adoption of data analysis tools with customers. On the other side Barons adopt more than Locals just-in-time (and they have the highest average value). Finally, Globals adopt more than Locals and Barons data analysis with suppliers.

Table 7.9 - Differences among configurations on the adoption of SC integration tools (1-5 Likert scale). For each configuration the average value and the number of the configurations that are significantly different are reported. Blue bars are proportional to the average values reported in the same cell.

Variable	Anova Sig.	Locals (1)	Barons (2)	Shoppers (3)	Globals (4)	Total
Agreements on delivery frequencey with customers	0.025	3.63	3.30 2	3.98 3	3.66	3.60
Data analysis with customers	0.018	3.10 2	2.70 1;3;4	3.30 2	3.30 2	3.06
Just-in-time with suppliers	0.005	2.44 2	2.98 1	2.72	2.50	2.56
Data analysis with suppliers	0.049	2.99 4	2.86 4	3.26	3.45 1;2	3.02

7.2.5 Role of the plant

We also performed an ANOVA on the localization advantages, derived from Ferdows (1997b) and Vereecke and Van Dierdonck (2002), and measured on a Likert scale from 1 (Not important) to 5 (Highly important). Results show that the configurations are characterized by a limited number of differences. In particular, Globals do not seem to have any significant difference compared to the other configurations. Some differences can be found between Barons and Locals regarding the proximity to customers and the access to low cost labor that are more important for Locals. Barons show some difference also compared to Shoppers, regarding social and political factors that are considered more important by the latter ones.

Table 7.10 - ANOVA results for differences among configurations on localization advantages (1-5 Likert scale). For each configuration the average value and the number of the configurations that are significantly different are reported. Green bars are proportional to the average values reported in the same cell.

	ANOVA	Locals (1)	Barons (2)	Shoppers (3)	Globals (4)	Sample Average
Skills and know-how	0.063	3.36	3.53	3.66	3.73	3.45
Proximity to customers	0.012	2.90 3	3.00 -	2.43 1	2.90 -	2.827
Proximity to suppliers	0.816	2.70	2.55	2.75	2.73	2.698
Low cost labor	0.001	2.81 3	2.81 -	2.28 1	3.00 -	2.729
Low cost materials	0.105	2.61	2.55	2.40	3.03	2.592
Transportation / logistics	0.065	3.37	2.94	3.26	3.30	3.31
Social / political factors	0.025	2.56 -	3.06 3	2.43 2	2.77 -	2.594
Competition	0.977	2.29	2.21	2.30	2.30	2.285
Company image	0.608	3.13	3.38	3.19	3.13	3.165

Finally, we cross tabulated configurations with possible plant capabilities. The chi-square statistic (sig. 0.231) did not identify any correlation among the two dimensions. Results are however reported in Table 7.11. We can therefore conclude that while different configurations can be associated to different localization advantages of the plant, they are not related to the capabilities of the plant.

Table 7.11 - Distribution of the configurations per plant capabilities

	Locals	Barons	Shoppers	Globals	Total
NA	26	3	2	0	**31**
To get the products produced	96	25	9	7	**137**
Internal capabilities	112	23	13	9	**157**
Develop also for other plants	40	17	5	5	**67**
To develop for the company	41	7	6	2	**56**
To be a center of excellence	42	17	11	7	**77**
Total	**357**	**92**	**46**	**30**	**525**

8 Global SC configurations and SC improvement programs (RQ2)

The second research question (i.e. *How configurations are related to different SC improvement programs?*) is about the relationship, presented in the framework, between the configurations previously identified and the adoption of improvement programs in the SC. Since diverse SC improvement programs are implemented in global or local contexts, we want to verify if configurations significantly differ in terms of adoption of SC improvement programs. We simply checked this through an ANOVA analysis together with a Scheffè post-hoc test to identify configurations that significantly differ.

8.1 Measures

For what concerns SC improvement programs, we used 6 items that refer to improvement programs upstream, downstream and for risk management. These items are literature-based (e.g. Frohlich and Westbrook, 2001; Jüttner et al., 2003; Tang, 2006) - see Chapter 2.7. Items are measured on a 1-5 Likert-like scale (where 1 corresponds to *no effort in the last three years* and 5 to *high effort in the last three years*) referring to the level of investment on that program in the last three years.

See as a reference question SC9 in the questionnaire reported in Appendix.

As reported in Table 8.1, we notice a rather low level of adoption on average (mostly below 3) for all programs; however standard deviation is quite high, meaning that relevant differences exist within the sample. Considering average values, we notice slightly higher levels of adoption of upstream improvement programs, and, in particular, of supplier development. On the contrary, distribution strategy has on average the lowest level of adoption.

Table 8.1 - SC improvement programs items

Area	Name	Item description	Sample Average	Standard Deviation
Upstream	Supply strategy	Rethinking and restructuring supply strategy and the organization and management of supplier portfolio through e.g. tiered networks, bundled outsourcing, and supply base reduction	2.93	1.108
	Supplier development	Implementing supplier development and vendor rating programs	3.05	1.148
	Coordination w/ suppliers	Increasing the level of coordination of planning decisions and flow of goods with suppliers including dedicated investments (e.g. information systems, dedicated capacity/tools/ equipment, dedicated workforce)	2.80	1.087
Downstream	Distribution strategy	Rethinking and restructuring distribution strategy in order to change the level of intermediation (e.g. using direct selling, demand aggregators, multi-echelon chains)	2.39	1.172
	Coordination w/ customers	Increasing the level of coordination of planning decisions and flow of goods with customers including dedicated investments (e.g. information systems, dedicated capacity/tools/ equipment, dedicated workforce)	2.68	1.155
Risk management	Risk management	Implementing SC risk management practices including early warning system, effective contingency programs for possible SC disruptions	2.72	1.171

8.2 Results

The results of the ANOVA analysis (Table 8.2) show that, among clusters, there are only few differences on SC improvement programs. The only significant differences regard Locals that as a general tendency invest less than the others; specifically, Locals invest less than Shoppers on supplier development and distribution strategy; Locals invest less than Barons on coordination with suppliers; Locals invest less than Globals on supplier development.

Table 8.2 - Variables values for each configurations. In brackets configuration that are significantly different according to Scheffè post-hoc test (ANOVA sig. < 0.05)

	Local (1)	Barons (2)	Shoppers (3)	Global (4)	Sample Average
Supply strategy	2.89	3.02	2.98	3.17	2.93
Supplier development	2.94 ***(3,4)***	3.13	3.43 ***(1)***	3.55 ***(1)***	3.05
Coordination w/ Suppliers	2.70 ***(2)***	3.06 ***(1)***	2.89	3.10	2.80
Distribution strategy	2.28 ***(3)***	2.42	2.82 ***(1)***	2.83	2.39
Coordination w/ Customers	2.65	2.66	2.93	2.76	2.68
Risk management	2.61	2.91	3.04	2.86	2.72

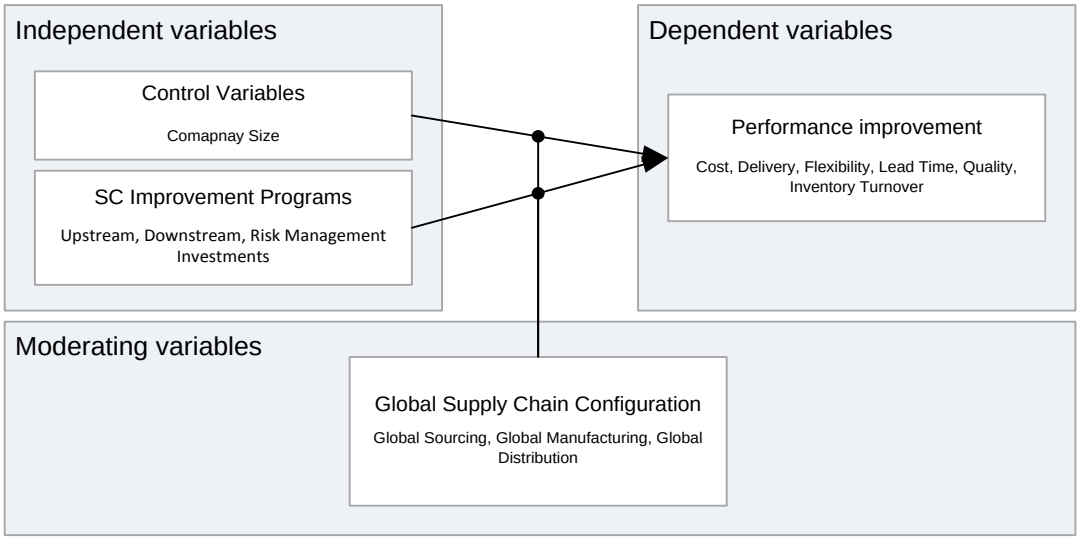
9 Configurations, SC improvement programs and performance (RQ3)

Our third research question (i.e. *which is the performance achieved according to different configurations and SC improvement program?*) aims to test whether companies belonging to different configurations achieve different performances according to the SC improvement programs adopted.

In order to verify this, we build a regression model represented in Figure 9.1.

The dependent variables are the performance improvement, thus we have several models, one for each performance improvement (namely, cost, delivery, flexibility, lead time, quality, inventory turnover). As independent variables we consider SC improvement programs. As defined in the previously (Table 8.1), these can range among upstream (i.e. with suppliers), downstream (i.e. with customers) and risk management improvement programs. We also controlled for company size, which is generally considered a relevant contingent variable affecting both global SC configuration and SC improvement programs (Cagliano et al., 2008; Carter and Narasimhan, 1990; Quintens et al., 2005; Scully and Fawcett). Respect to this model, global SC configurations (as defined in Table 7.3) act as a moderator variable (Baron and Kenny, 1986). Different configurations (e.g. Locals versus Globals) may, in fact, experience different effects (positive, negative or null) of a SC improvement program on a particular performance.

Figure 9.1 - RQ3 research model



We calculated the regression coefficients (for each performance improvement) through a hierarchical linear regression model. In the first step, only company size was inserted as a control variable. In the second step we inserted SC improvement programs through a stepwise procedure. We adopted the stepwise approach given the high correlation among independent variables. Basically, the stepwise method enters one variable at a time, selecting the most significant ones and continuing until no more significant variables are found. In this way the number of variables in the model is minimized together with the risk of multicollinearity.

We run this procedure first on the overall sample and then within each of the four configurations. In this way we got 30 regression models (one for each performance and each configuration plus the overall model). Each step of the procedure has been controlled for multicollinearity by checking the variance inflation factor (VIF) of the independent variables. R-square change was also taken into consideration in order to evaluate whether or not the new model had more explanatory power than the previous: R-square change is always significant. VIF is always lower than 2.2, and the cut-off point is usually between 5 and 10 (Hair et al., 1998; Menard, 2002; Neter et al., 1989). Therefore, multicollinearity is not considered as an issue for any of our models.

Before running the regression, we performed some preliminary analyses reported after in the results. These are an ANOVA analysis to highlight possible differences of performance improvements among the configurations and a correlation analysis of the variables in the model.

9.1 Measures

Global SC configurations were taken from the results of the RQ1 (Table 7.3) while SC improvement programs are the same of those shown in the RQ2 results (Table 8.1). Company size is measured as the number of employees of the business unit. Performance improvements need instead some further explanation.

We considered 11 items measured on a 1-5 Likert-like scale (where 1 corresponds to *deteriorated more than 5% in the last three years* and 5 *improved more than 25% in the last three years*) asking for the improvement of that performance in the last three years. *See as a reference question B10 in the questionnaire reported in Appendix.*

The items were grouped into 6 constructs through exploratory factor analysis: flexibility, quality, delivery, cost, lead time, inventory turnover (Table 9.1). The validity and reliability of such constructs was assessed by the total variance explained (83.02%), the factor loadings, always higher than 0.6, and the Cronbach's alpha, always higher than 0.7 (Nunnally et al., 1967). We acknowledge that using 6 factors does not optimize the parsimony in terms of number of variables, in fact the lower eigenvalue is only 0.542. However, compared to other more parsimonious models, this model allowed the highest interpretability of the constructs.

Table 9.1 - Performance improvement factor analaysis

	Factor					
Item	Flexibility	Quality	Delivery	Cost	Lead time	Inventory turnover
Volume flexibility	0.841					
Mix flexibility	0.838					
Manufacturing conformance		0.865				
Product quality		0.820				
Delivery reliability			0.809			
Delivery speed			0.774			
Procurement costs				0.807		
Unit Manufacturing cost				0.806		
Procurement lead time					0.808	
Manufacturing lead time					0.676	
Inventory turnover						0.914
Cronbach's Alpha	0.808	0.735	0.827	0.796	0.711	-
Eigenvalue > 0.542; Explained Variance 83.02%; Loadings below 0.4 are not shown						

9.2 Results

Before testing the model we performed some preliminary analyses on the sample. The results of the ANOVA analysis (Table 9.2) show that there are no differences on the performance improvement.

Table 9.2 - Variables values for each configurations. No significant differences found.

	Local (1)	Barons (2)	Shoppers (3)	Global (4)	Sample Average
Flexibility	3.35	3.23	3.61	3.32	3.35
Cost	2.81	2.80	2.98	2.86	2.83
Quality	3.29	3.10	3.44	3.40	3.27
Delivery	3.29	3.20	3.49	3.21	3.29
Manufacturing Lead Time	2.90	2.86	2.99	2.86	2.90
Inventory Turnover	2.93	2.91	2.96	2.96	2.93

Next we performed a correlation analysis among the variables (Table 9.3). What emerges is that there is a strong correlation among and within dependent and independent variables. Only size looks rather uncorrelated from the dependent variables.

Table 9.3 - Correlation among the variables (sig. < 0.01; * sig < 0.05)**

	Dependent variables						Independent and control variables						
	Flexibility	Cost	Quality	Delivery	Lead time	Inventory turnover	Size	Supply strategy	Supplier development	Coordination w/ suppliers	Distribution strategy	Coordination w/ customers	Risk management
Flexibility	1	.444**	.478**	.541**	.512**	.373**	-.067	.221**	.280**	.253**	.213**	.191**	.193**
Cost	.444**	1	.472**	.483**	.557**	.424**	-.002	.145**	.239**	.242**	.242**	.205**	.210**
Quality	.478**	.472**	1	.566**	.464**	.381**	-.042	.107*	.240**	.176**	.195**	.119**	.176**
Delivery	.541**	.483**	.566**	1	.610**	.456**	-.001	.201**	.217**	.270**	.287**	.255**	.188**
Lead time	.512**	.557**	.464**	.610**	1	.446**	.008	.220**	.200**	.234**	.271**	.229**	.204**
Inventory turnover	.373**	.424**	.381**	.456**	.446**	1	-.009	.176**	.194**	.168**	.227**	.164**	.144**
Size	-.067	-.002	-.042	-.001	.008	-.009	1	.101*	.112*	.109*	.122**	.075	.106*
Supply strategy	.221**	.145**	.107*	.201**	.220**	.176**	.101*	1	.556**	.503**	.367**	.347**	.423**
Supplier development	.280**	.239**	.240**	.217**	.200**	.194**	.112*	.556**	1	.548**	.382**	.392**	.468**
Coordination w/ Suppl.	.253**	.242**	.176**	.270**	.234**	.168**	.109*	.503**	.548**	1	.475**	.568**	.484**
Distribution strategy	.213**	.242**	.195**	.287**	.271**	.227**	.122**	.367**	.382**	.475**	1	.576**	.481**
Coordination w/ Cust.	.191**	.205**	.119**	.255**	.229**	.164**	.075	.347**	.392**	.568**	.576**	1	.520**
Risk management	.193**	.210**	.176**	.188**	.204**	.144**	.106*	.423**	.468**	.484**	.481**	.520**	1

The overall results of regression analyses are represented in Table 9.4. This table provides standard estimates for the different regression models. Globals were not inserted as they did not show any significant relationship.

Table 9.4 - Results of the regression analysis for the overall model and the single configurations. Only significant coefficients are displayed. Configurations not showing significant coefficients were removed case by case (p < 0.01; * p < 0.05)**

	Size	Supply strategy	Supplier development	Coordination with Suppliers	Coordination with customers	Distribution strategy	Risk management
Cost							
Overall			0.190**			0.173**	
Locals				0.176**		0.155*	
Barons			0.278*				
Shoppers				0.487**			
Delivery							
Overall				0.170**		0.218**	
Locals				0.204**		0.185**	
Barons		0.259*					
Shoppers							0.632**
Flexibility							
Overall			0.249**			0.14**	
Locals	-0.122*		0.219**	0.181**			
Shoppers				0.566**			
Lead Time							
Overall		0.145**				0.227**	
Locals				0.173**		0.227**	
Barons		0.284**					
Shoppers							0.441**
Quality							
Overall			0.193**			0.134**	
Locals			0.185**				
Barons		0.278*					
Shoppers							0.458**
Inventory Turnover							
Overall			0.127*			0.188**	
Locals						0.246**	
Barons		0.334**					
Shoppers							0.537**

First of all we can take into account the results for the overall sample. Quite interestingly coordination with customers and risk management are not significant in any relationship. This result indicates that, when considering all companies together, these SC improvement programs do not show any significant impact on performance improvement.

Other improvement programs instead, in particular, distribution strategy and supplier development, have an impact on almost all performance measures, indicating the pervasive effect of these investments, which provide benefits on a wide range of performance dimensions.

The other improvement programs considered have differentiated effects. In particular, supply strategy significantly impacts only on lead time performance, suggesting that rethinking the supply strategy has a positive impact on procurement and manufacturing lead time for example due to the reduction of the supply base and the introduction of bundle outsourcing policies. Similarly, the coordination with suppliers impacts on delivery performance. This is due from one side to the relevance of purchasing activities on the operations of the companies involved in this study, thus any delay on the supply side may have a strong impact of the demand side (in our sample the cost for direct materials and parts accounts on average for 53% of total manufacturing costs). From another point of view, literature shows that proper coordination with suppliers can impact significantly on the responsiveness of the whole SC (Lee and Whang, 2000).

When we consider results within the different configurations, we can see that results change rather significantly. Only a few results are still valid, specifically size and coordination with customers are confirmed to be not significant at all within any of the configurations. Coordination with customers is a rather neglected program, but still one could expect a relationship with delivery performance.

Interestingly, the significant relationships previously identified for the overall sample, are not always valid for all configurations. Besides, some relationships that were not significant for the whole sample become significant when considering single configurations. This result can be interpreted as a confirmation that the global SC configuration indeed has a moderating effect between SC improvement programs and performance improvement.

Distribution strategy, which had a pervasive impact for the overall sample, still shows a significant impact on several performances, but only for Locals, while no impact is found for the other configurations. This result is due to the size of the Locals, which counts for two-thirds of the overall sample, therefore investments in distribution strategy can actually be considered as beneficial only for companies with a local SC. One could argue that companies in other configurations, in particular, Barons and Globals who sell globally, have already invested in distribution in the past, and therefore they are not showing significant outcomes now.

We can also see that also other programs seem to be effective only in some configurations. Supply strategy has a pervasive impact for Barons, showing impacts on several performance improvement dimensions: delivery, quality, lead time and inventory turnover. This result provides evidence that for Barons, having mainly a local approach to purchasing, any investment in how supply is managed has a strong effect in terms of overall performance. Thus any investment on the supply side has a leverage effect also on the demand side, also due to the direct impact that a responsive SC upstream can have on downstream performance. Given their local supply base, Barons obtain significant improvement in cost performance by investing in supplier development programs. This program, differently from the previous, appears to be focused on a single performance.

Risk management program instead has a pervasive effect on performance (delivery, quality, lead time and inventory turnover) for Shoppers. This relates to the fact that Shoppers have a much dispersed supply network, thus any investment aimed to improve the SC resiliency limits the impact and probability of SC disruptions with strong benefits on companies performance. Shoppers also obtain relevant benefits, in terms of both cost and flexibility, through coordination with suppliers. This is also clearly related to better exploit their global supply base; it is interesting to notice that coordination with suppliers can help in improving flexibility also with suppliers who are far away.

Locals are characterized mainly by the strong impact of investments on suppliers (supplier development and coordination) and distribution strategy on several performance dimensions. This is due to the fact that Locals have to manage a simpler and shorter SC, since they do not purchase and sell much abroad. Thus they can capitalize a stronger impact of any investment done in these areas compared to what happens to the other configurations. This result is particularly interesting if we also consider that Locals invest significantly less than the other configurations on supplier development, on the coordination with suppliers and on the distribution strategy.

Quite surprisingly, Globals show no significant relationship between improvement programs and performance, this may be due to the fact that these firms have already invested a lot on improving their SC in the past and/or their performance are already good. However, also the limited number of firms belonging to this configuration in our sample may partly explain the absence of significant relationships.

10 The effect of contingent variables (RQ4)

We have seen in the results chapter for RQ1 how some contingent variables (e.g. size, country) differ among configurations. The aim our fourth research question (i.e. *RQ 4: what is the effect of contingent variables on the overall model?*) is to focus on the effect of contingencies on the relationship between SC improvement programs and performance according to different global SC configurations. Given the complexity of the analysis we decided to split our analysis in two, the first one looks only upstream (i.e. to global sourcing) and the other one downstream (i.e. global distribution). Moreover we focused on specific critical performance in the context of globalization: material inventory level for upstream analysis and delivery performance for the downstream one.

In terms of methodology, first of all we built two structural equation models, one for global sourcing and one for global distribution. Then we split our sample in two for the identified contingencies (e.g. small and large companies, high complexity and low complexity products). After that, we checked if the models hold for the different groups. Finally, we checked for differences between groups.

A note. The model for global sourcing and the one for global distribution report results of two different papers (Golini and Kalchschmidt, 2010a, 2011). In particular, the model for global sourcing, had the objective of replicate and extend a previous work (Golini and Kalchschmidt, 2010b). Because of that the models and methodologies show some differences.

10.1 Global Sourcing

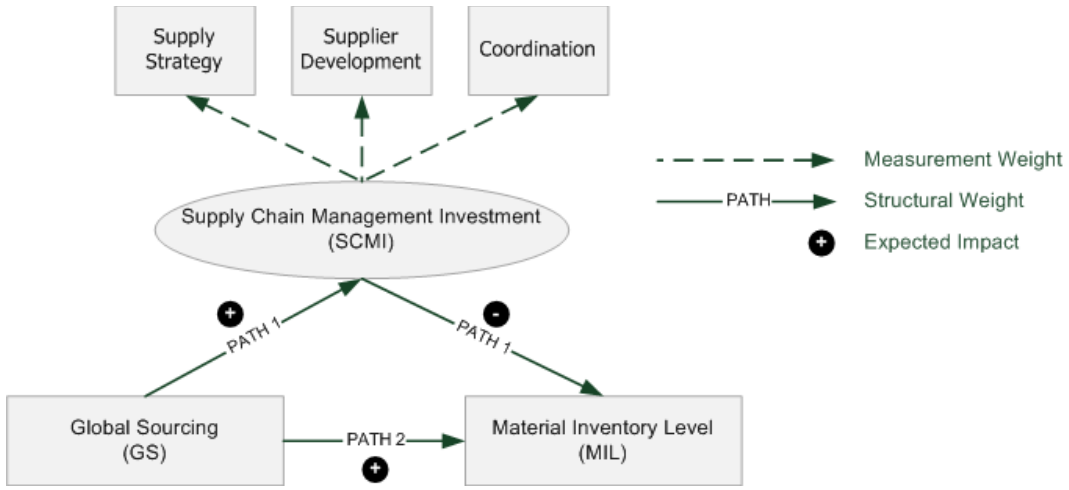
When investing in global SCs, one of the problems addressed is how to keep the inventories low. This is particularly critical as longer distances increase the consignment lead times and variability, so companies might have to keep higher material inventories to keep the production running, as

confirmed by several studies about global sourcing (Han et al., 2008; Stratton and Warburton, 2006). In this literature stream, Golini and Kalchschmidt (2010b) provided evidence that in the manufacturing industry it is possible to almost fully moderate the negative impact of global sourcing on material inventory level through SCM investments. However, one limitation of this study is that it does not provide insights for companies having different characteristics, for example in terms of size or type of production. Moreover the model was based on data collected through a survey during 2005 and things might have changed in recent years given the speed of the globalization phenomenon. Because of that, we replicated that model with data from the same survey but collected during 2009. Moreover, we tested whether the model holds for different groups defined on the basis of those contingencies that, according to literature, could affect the considered variables and their relationships (i.e. company size, product complexity, type of production, type of purchases and number of suppliers).

In terms of methodology, we built a structural equation model (Figure 10.1) that replicates the one by Golini and Kalchschmidt (2010b).

From left to right we can identify two paths from Global Sourcing (GS) to Material Inventory Level (MLI). Following Path 2, GS should increase the MIL (direct effect). Following Path 1, GS should positively affect SCM Investment (SCMI) that in turn should reduce MIL (indirect effect). As detailed afterward, SCMI is a latent variable based on three SC improvement programs, namely Supply Strategy, Supplier development and Coordination.

Figure 10.1 - Structural model. Squares are observed variables, ovals latent variables. +/- is the expected impact of one variable on the other. Thin and dotted arrows represent measurement weights (factors) while bold arrows are structural weights.



First of all, we tested this model for the overall sample to check whether the hypothesized relationships are verified and which the total effect of GS on MIL is, considering the joint effect along the two paths. Next we defined groups of companies facing different contingent contexts in terms of size, type of production, type of purchases, product complexity and number of suppliers. After that, we assessed the impact of contingencies on the model variables (GS, MIL, Supply Strategy, Supplier development, Coordination) by measuring differences between groups through an independent sample Mann-Whitney test (a non-parametric two independent samples test). Finally, we performed a multiple group analysis on the model to assess differences between groups in the structural weights (i.e. the linkages among the variables). We adopted a procedure similar to that one described in

Arbuckle (2005), Cook et al. (2006), Tausch (2007). The procedure consists of the following four steps:

1. Configural equivalence: check if the model holds when the groups are considered separately, i.e. to establish whether the factor structure and the model are valid for the different groups. To do this, no constrain is set among groups.
2. Measurement equivalence: check if factor loadings are invariant among groups, i.e. establish whether groups perceive factors in the same way. To do this, an equality constrains is set on the measurement weights of different groups (see Figure 10.1).
3. If the previous steps have a positive outcome, we analyzed differences among structural weights (see Figure 10.1) keeping the equality constraints among measurement weights. In this way we could assess differences among groups on the relationships (structural weights) among variables.

10.1.1 Measures

To measure the extent of the globalization of sourcing activities, we used the same measure of RQ1 (Table 7.1), i.e. percentage of purchases outside the region where the plant was based.

Since we were interested in the impact of global sourcing on inventories, we took into consideration the raw material and components inventory levels. We measured material inventory level (MIL) in terms of days of production (on average) that are carried in the raw material/components inventory. *See as a reference question PC3 in the questionnaire reported in Appendix.*

To measure SCM investments (SCMI), we defined a latent variable based on the three upstream items used already for RQ2 (Table 8.1):

- Supply strategy: rethinking and restructuring supply strategy and the organization and management of supplier portfolio through e.g. tiered networks, bundled outsourcing, and supply base reduction;
- Supplier development: implementing supplier development and vendor rating programs;
- Coordination: increasing the level of coordination of planning decisions and flow of goods with suppliers including dedicated investments (e.g. information systems, dedicated capacity/tools/ equipment, dedicated workforce).

Next, we split our sample on the basis of different contingent variables:

- Size was measured by means on the total number of employees and companies were divided according to whether they were SME (Group 1 - less than 250 employees) or large companies (Group 2 - more than 250 employees).
- The type of production was evaluated by means of the percentage of orders managed according to either an ETO or MTO or ATO or MTS production system. If the orders managed in ETO or MTO were more than 50% we assigned that company to Group 1 while if the orders in ATO or MTS were the majority we assigned that company to Group 2.
- For what concerns product complexity, we defined a new variable as the mean of four 1-5 Likert-scale based items: type of product design (modular or integrated); type of product (component or finished product); number of parts/components (few or many); number of production phases (few or many). Summing these items together was justifiable as the factor's Cronbach's alpha is equal to 0.72. By averaging these items we obtained a new variable ranging from 1 to 5 and we set 3.5 as a threshold discriminating low (Group 1) from

high (Group 2) complexity products. We set 3.5 as a threshold in order to have Group 1 with more 200 companies given the statistical analysis performed after.

- About the type of purchases, we put in Group 1 companies purchasing raw materials for more than 50% of their spending and in Group 2 all the others (i.e. they spend more than 50% for parts/components, subassemblies/systems).
- Finally, we defined 100 as the threshold number of suppliers to separate Group 1 and Group 2. This threshold was decided from one side because of the statistical purposes and from the other because 100 can be considered a high number of suppliers for a supplier base (Christy and Grout, 1994; Goffin et al., 1997). In this way we can identify in Group 2 those who do actually have a very broad supplier base.

Table 10.1 summarizes the defined groups' characteristics.

Table 10.1 - Groups definition for the different contingent factors (in brackets the number of companies for each group)

	Group 1	Group 2
Size	Number of employees < 250 (255)	Number of employees >=250 (284)
Product complexity	<3.5 (203)	>=3.5 (343)
Type of production	Production mainly based on ETO or MTO (351)	Production mainly based on ATO or MTS (179)
Type of purchases	Raw materials are more than 50% of the total purchases (280)	Parts/components, subassemblies/systems are more than 50% of the total purchases (247)
Number of suppliers	<100 (233)	>=100 (253)

10.1.2 Results

As detailed at the beginning of this chapter, first of all we run the model by considering the whole sample and we found that the model holds (Table 10.2 provides a summary of the model fit). Differently to what was done in Golini and Kalchschmidt (2010b), since variables are non-normal, we validated results through Bollen-Stine p-value based on a 2000 iterations bootstrap procedure.

Table 10.2 - Model fit statistics for the overall model

	chi-square	df	p-value	Bollen-Stine p-value	NFI	RMSEA	CFI
Default model	5.053	4	0.282	0.348	0.989	0.022	0.998

NFI: Normed Fit Index (good above 0.95)
RMSEA: Root Mean Squared Error of Approximation (good below 0.05)
CFI: Comparative fit index: close to 1 means very good fit

In Table 10.3 we can see that the factor loadings have positive and high factor scores (i.e. greater than 0.5) and that all the structural weights are all significant over 5% of confidence. In particular, the hypothesized relationships turned out to be confirmed: GS is associated to higher MIL by a standard

estimate of 0.097 (direct effect). However GS is related to a higher adoption of SCMI by 0.162 that in turn lowers MIL by - 0.137 (indirect effect).

Table 10.3 - Estimates of the overall model

Relationship			Estimate	Std. Estimate	P
GS	→	MIL	.145	.097	.025
GS	→	SCMI	.006	.162	.000
SCMI	→	MIL	-5.501	-.137	.005
SCMI	→	Coordination	1.000	.712	-
SCMI	→	Supply strategy	.943	.668	.000
SCMI	→	Supplier development	1.147	.798	.000

In conclusion, thanks to the moderation effect of SCMI, the total effect of GS on MLI is 0.075 (while the direct was 0.097). These results confirm those obtained in Golini and Kalchschmidt (2010b).

Table 10.4 provides a direct comparison of direct and indirect effects in the two works.

Table 10.4 - Direct, indirect and total effect of global sourcing on material inventory level in (Golini and Kalchschmidt, 2010b) and this research

	Standardized Estimate (Golini and Kalchschmidt, 2010b)	Standardized Estimate (this research)
Direct effect	0.094	0.097
Indirect effect	-0.026	-0.025
Total effect	**0.068**	**0.075**

After the overall model assessment, we measured the impact of contingencies on the model variables (GS, MIL, Supply Strategy, Supplier development, Coordination) by measuring differences between groups through an independent sample Mann-Whitney test (the equivalent of a t-test for non parametric data). Results are reported in Table 10.5.

Table 10.5 - Average values for different groups for the main model variables (values in bold identify a significant difference between groups with sig. < 0.05 assessed by a Mann-Whitney test).

Variable	Size		Type of production		Type of purchases		Product Complexity		Number of suppliers	
Group	1	2	1	2	1	2	1	2	1	2
MIL	26.63	28.57	28.28	26.83	27.95	27.98	26.46	28.15	26.32	28.66
GS	**11.02**	**17.99**	**12.79**	**16.59**	**11.75**	**20.76**	**11.06**	**16.82**	**12.70**	**16.03**
Supply Strategy	**2.80**	**3.13**	**2.86**	**3.14**	2.92	3.11	2.88	3.05	2.91	3.11
Suppl. development	**2.67**	**3.35**	**2.89**	**3.19**	**2.93**	**3.22**	**2.74**	**3.21**	**2.87**	**3.24**
Coordination	**2.59**	**3.02**	**2.71**	**2.92**	2.77	2.90	**2.67**	**2.89**	2.73	2.91

We can see that MIL is never significantly different among groups while the level of GS and the adoption of supplier development are always higher for each group 2. Specifically, our sample shows that companies adopting global sourcing the most are typically larger companies, adopting ATO/MTS production systems, copying with relevant costs of purchasing, high product complexity and with

several suppliers. Among SCM investments, the adoption of supply strategy is higher for larger companies and ATO/MTS companies. Supplier development is always higher for group 2 cases while coordination is higher for larger companies, ATO/MTS companies and when a higher product complexity is faced.

After that, we assessed configural and measurement equivalence. As we can see from Table 10.6, models used to assess equivalence, have always (i.e. for any contingency variable considered) a good fit that tends to increase when constraining measurement weights. This result is confirmed also by a bootstrap analysis (Bollen-Stine p-value) to overcome possible non-normality issues. By means of a chi-square test, we assessed that the increase in the fit is significant, meaning that considering measurement weights to be identical among groups improves the fit of the model. In conclusion the model and the factors hold for different groups for all the contingencies and we moved to analyze differences in the structural weights.

Table 10.6 - Configural and measurement equivalence models fit.

	chi-square	df	p-value	Bollen-Stine p-value	RMSEA	NFI	CFI
Product Complexity							
Configural equivalence	5.993	8	.648	.692	.000	.987	1.000
Measurement equivalence	6.896	10	.735	.782	.000	.985	1.000
Size							
Configural equivalence	8.696	8	.369	.452	.000	.980	.998
Measurement equivalence	8.893	10	.542	.608	.000	.979	1.000
Number of Suppliers							
Configural equivalence	7.935	8	.440	.514	.000	.980	1.000
Measurement equivalence	9.986	10	.442	.505	.000	.975	1.000
Type of production							
Configural equivalence	7.542	8	.479	.584	.000	.984	1.000
Measurement equivalence	8.838	10	.548	.635	.000	.981	1.000
Type of purchases							
Configural equivalence	7.357	8	.499	.595	.000	.984	1.000
Measurement equivalence	9.793	10	.459	.575	.000	.978	1.000

Using the models constrained on the measurement weights to be identical, we finally compared regression coefficients between groups (Table 10.7).

Table 10.7 - Standardized structural weights for the overall model and the different groups (in bold the regression coefficients with sig. < .05 are highlighted)

		GS → MIL		GS →SCMI		SCMI →MIL	
		Std. Est.	Sig.	Std. Est.	Sig.	Std. Est.	Sig.
Overall model		**.097**	**.025**	**.162**	**.000**	**-.137**	**.005**
Product Complexity	Group 1	.069	.325	.095	.253	**-.209**	**.013**
	Group 2	.100	.066	**.156**	**.010**	-.110	.070
Size	Group 1	.004	.952	.088	.216	-.126	.080
	Group 2	**.153**	**.009**	**.135**	**.047**	**-.169**	**.013**
Number of suppliers	Group 1	**.131**	**.044**	**.149**	**.041**	**-.214**	**.004**
	Group 2	.103	.102	.078	.282	-.115	.116
Type of production	Group 1	.078	.146	.088	.141	-.043	.474
	Group 2	**.164**	**.031**	**.268**	**.002**	**-.318**	**.000**
Type of purchases	Group 1	**.167**	**.005**	**.152**	**.024**	**-.197**	**.003**
	Group 2	.041	.519	.124	.090	-.082	.268

As we can see, the estimates are always significant only for:

- large companies (size - group 2);
- companies with less than 100 suppliers (number of suppliers - group 1);
- ATO/MTS companies (production - group 2);
- High raw materials share purchasers (type of purchases - group 1).

We can notice that for these groups the structural weights are higher than those calculated for the overall sample, meaning that GS has a stronger negative impact on MIL, but GS induces a higher adoption of SCMI and that SCMI has an higher potential in reducing MIL (for ATO/MTS companies in particular).

For the other cases, relationships are never significant, meaning that it is not possible to relate GS to a higher adoption of SCMI or to higher MIL. Looking at complexity we find that relationships are only partially confirmed for both groups. Low complexity companies (group 1) have a positive reduction of their MIL thanks to SCMI, but global sourcing is not related to these variables. High complexity companies instead tend to have higher SCMI caused by higher GS but the impact on MIL is not significant.

10.2 Global Distribution

The contingency analysis of the impact of global distribution on delivery performance is very similar to the one just presented for global sourcing, but we focus now on the downstream part of the supply chain and on the delivery performance.

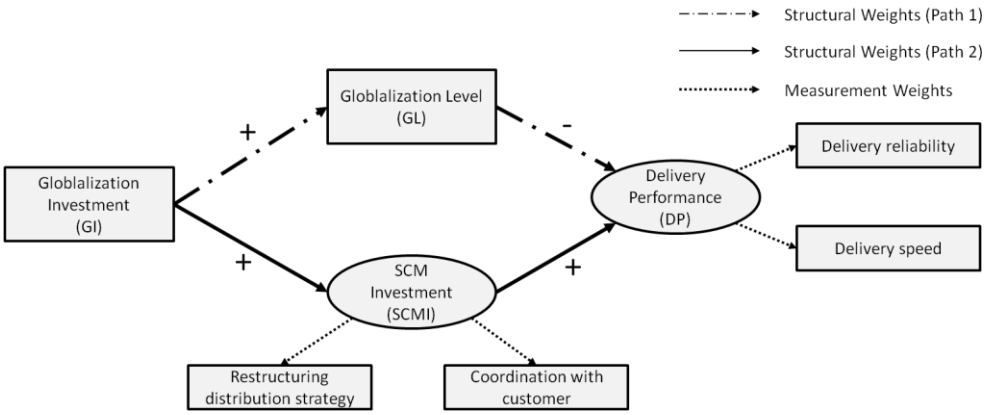
Figure 10.2 provides a description of the theoretical model under investigation.

From left to right we can identify two paths from globalization investment to delivery performance. They both start from Globalization Investment (GI) that is the effort companies have put in the last three years to globalize sales and distribution.

Following Path 1 we find Globalization Level (GL) that measures the percentage of sales outside the continent where the plant is based. We expect a positive relationship between these two variables (GI and GL). Finally, we have Delivery performance (DP). This is another latent variable measured by the increase/decrease of the delivery speed and reliability in the last three years. We expect a negative relationship among GL and DP as the higher the level of globalization the worse the expected delivery performance.

Following Path 2 we start from GI and then we find is SCM Investment (SCMI) that is the effort put in the last three years for SCM investments. This is a latent variable measured by two items (restructuring distribution strategy and coordination with customers). We expect a positive relationship with GI, as the investment in globalization usually needs SCM investments as a support. Finally, SCMI should have a positive impact on DP.

Figure 10.2 - Structural model. Squares are observed variables, ovals latent variables. +/- is the expected impact of one variable on the other. Thin and dotted arrows represent measurement weights (factors) while bold arrows are structural weights (along two paths).



In terms of methodology, we built a structural equation model based on Figure 10.2. We run the model by considering the whole sample and checking if the model holds and if the hypothesized relationships are correct. After this, we performed a multiple group analysis to assess if the model holds for the single groups in terms of configural and measurement equivalence. We finally compared regression coefficients between groups and the total effect of globalization investment (GI) on delivery performance (DP) as the contribution of Path 1 and Path 2 for the default and the models considering contingencies.

As a preliminary analysis we also assessed the impact of contingencies on the main model variables (GI, GL, SCMI, DP) by measuring differences between groups through an independent sample t-test.

10.2.1 Measures

In order to measure the extent of globalization of sales, we used the percentage of sales outside the continent where the plant was based already used before (Table 7.3).

Since we were interested in the impact of global distribution on delivery performance, we designed a latent variable based on the increase of delivery speed and delivery reliability in the last three years (Cronbach's alpha 0.791). These variables were measured on a 1-5 Likert scale where 1 represents deterioration and 5 represents significant improvement. Cronbach's alpha is 0.750 (higher than 0.6) claiming that reliability is guaranteed. Factor loads are equal to 0.894 (above 0.6). *See as a reference question B10 in the questionnaire reported in Appendix.*

In order to measure SCM investments (i.e. improvement programs) we defined a latent variable based on two downstream items already used for RQ2 (Table 8.1):

- Rethinking and restructuring distribution strategy in order to change the level of intermediation (e.g. using direct selling, demand aggregators, multi-echelon chains;
- Increasing the level of coordination of planning decisions and flow of goods with customers including dedicated investments (e.g. information systems, dedicated capacity/tools/ equipment, dedicated workforce);

We considered five contingency variables: size; product and production complexity; market and process uncertainty; position of the decoupling point; position in the SC. In particular, for each

contingency we defined specific measures based on the IMSS questionnaire and defined two groups for each contingency (Table 10.8).

Table 10.8 - Groups definition for the different contingent factors

	Group 1	**Group 2**
Size	Small *Below 250 employees*	Large *Above 250 employees*
Product and production complexity	Simple *Complexity index* <= 3*	Complex *Complexity index* > 3*
Market and process uncertainty	Stable *Uncertainty index** <=3*	Uncertain *Uncertainty index** > 3*
Decoupling point	ETO/MTO *Production mainly based on Engineer or Make to order*	ATO/MTS *Production mainly based on Assembly to order or Make to stock*
Position in the SC	Upstream *Customers are mainly other manufacturers*	Downstream *Customers are mainly distributors or end users*

*Based on an average of the following 1-5 Likert-scale based items: Type of product design (modular or integrated), Type of product (component or finished product), Number of parts/components, Number of production phases (Cronbach's alpha = 0.72, Factor loads above 0.56).
** Based on an average of the following 1-5 Likert-scale based items: change rate in logistic processes and production processes, products obsolescence rate, frequency of new product introduction (Cronbach's alpha = 0.65, Factor loads above 0.6).

10.2.2 Results

First of all we assessed the impact of contingencies on the main model variables (GI, GL, SCMI, DP) by measuring differences between groups through an independent sample t-test (Table 10.9).

Table 10.9 - Average values for different groups for the main model variables (values in bold identify a significant difference among groups with sig. < 0.05).

Variable	Sample average	Size		Complexity		Uncertainty		Decoupling point		SC position	
		Small	Large	Simple	Complex	Stable	Uncert.	ETO /MTO	ATO /MTS	Upstr.	Downstr.
GI	3.1	**2.9**	**3.3**	3.1	3.2	**3.0**	**3.3**	**3.0**	**3.3**	3.1	3.1
GL	15.9	**12.2**	**19.6**	**13.1**	**18.3**	16.1	15.6	14.8	17.8	15.4	16.3
SCMI	2.5	**2.3**	**2.7**	2.4	2.6	**2.2**	**2.9**	2.5	2.6	2.5	2.5
DP	3.3	3.2	3.3	3.3	3.3	**3.1**	**3.4**	3.2	3.3	3.3	3.2

We can see that several differences can be found when the different contingency variables are considered. The only exception is SC position that is not associated to any difference.

Next we built a structural equation model based on Figure 10.2. We run the model by considering the whole sample and we found that the model holds (Table 10.10) and that the hypothesized relationships are correct (Table 10.12).

Table 10.10 - Model fit statistics for the overall model

	chi-square	**df**	**p**	**NFI***	**RMSEA****
Default model	7.11	6	0.311	0.989	0.020

*NFI: Normed Fit Index (good above 0.95)
**RMSEA: Root Mean Squared Error of Approximation (good below 0.05)

Next, we performed a multiple group analysis on the original model to assess differences between groups in the structural weights - the linkages among the main variables. We adopted a procedure similar to that one described in Arbuckle (2005), Cook (2006), Tausch (2007). First of all we had to check whether the latent factor structure holds for Group 1 and Group 2 for the each contingent factor. To do this we run our model using separately data of Group 1 and Group 2, but keeping an equality constrain on measurement weights and intercepts between the two groups. We repeated the procedure for the different contingency factors checking models fit (see Table 10.11). The fit is always good except for SC position model that is rejected (even if NFI and RMSEA are acceptable). This means that for all the other models, measurements (or factors) for different groups hold.

Table 10.11 - Model fit for models considering contingencies (these models are constrained on measurement weights and intercepts).

	chi-square	Df	p	NFI*	RMSEA**
Size	17.07	18	0.518	0.978	0.000
Complexity	13.98	18	0.730	0.985	0.000
Uncertainty	23.85	18	0.160	0.977	0.026
Decoupling point	19.99	18	0.334	0.974	0.016
SC position	35.31	18	0.009	0.983	0.046

*NFI: Normed Fit Index (good above 0.95)
**RMSEA: Root Mean Squared Error of Approximation (good below 0.05)

Using the constrained models we finally compared regression coefficients between groups using critical ratio to establish significant differences. Table 10.12 summarizes theses results, for reader's convenience we reported also the average values already shown in Table 10.9.

Table 10.12 - Averages and standardized regression coefficients for the two paths for the default and the contingent models (values in gray are not different from the default model; values in italic are different from the default model, values in bold identify a significant difference among groups).

		Path 1					Path 2				
Model	**Group**	**GI**	**→**	**GL**	**→**	**DP**	**GI**	**→**	**SCMI**	**→**	**DP**
Default model		3.1	0.338**	15.9	-0.177**	3.3	3.1	0.326**	2.5	0.518*	3.3
Size	Small	**2.9**	0.318**	**12.2**	*-0.138*	3.2	**2.9**	**0.237***	**2.3**	0.614*	3.2
	Large	**3.3**	0.323**	**19.6**	-0.202*	3.3	**3.3**	**0.367****	**2.7**	0.468*	3.3
Complexity	Complex	3.1	0.324**	**13.1**	-0.228**	3.3	3.1	0.306**	2.4	0.616*	3.3
	Simple	3.2	0.347**	**18.3**	*-0.089*	3.3	3.2	0.373**	2.6	0.374*	3.3
Uncertainty	Uncertain	**3.0**	0.354**	16.1	-0.198*	**3.1**	**3.0**	**0.425****	**2.2**	0.566**	**3.1**
	Stable	**3.3**	0.34**	15.6	-0.163*	**3.4**	**3.3**	***0.207***	**2.9**	*0.459*	**3.4**
Decoupling point	ATO/MTS	**3.0**	0.35**	14.8	**-0.332****	3.2	**3.0**	0.412**	2.5	**0.700****	3.2
	ETO/MTO	**3.3**	0.347**	17.8	***-0.11***	3.3	**3.3**	0.315**	2.6	**0.459***	3.3
SC position	Upstream	3.1	0.254**	15.4	*-0.093*	3.3	3.1	0.356**	2.5	0.527*	3.3
	Downstream	3.1	0.389**	16.3	-0.247**	3.2	3.1	0.34**	2.5	0.555*	3.2

GI: Investment in globalization of sales; GL: level of globalization of sales; DP: Delivery Performance; SCMI: investments in SC.
**: sig. < 0.01
*: sig. < 0.05

Finally, we analyzed the total effect of globalization investment (GI) on delivery performance (DP) as the contribution of Path 1 and Path 2 for the default and the models considering contingencies (Table 10.13).

Table 10.13 - Total standardized effect of globalization investment on delivery performance.

Model	Group	Total effect of GI on DP
Default		0.109
Size	Small	0.107
	Large	0.102
Complexity	Complex	0.109
	Simple	0.115
Uncertainty	Uncertain	0.039
	Stable	0.170
Decoupling point	ATO/MTS	0.106
	ETO/MTO	0.172
SC position	Upstream	0.164
	Downstream	0.093

Looking at the previous tables we can draw several results.

First of all we can see that the default model is significant, both in terms of fit and significance of the relationships: investments in global sales increase the level of globalization that is associated with worse delivery performance (Path 1). On the other side these investments trigger investments in SC that make delivery performance better (Path 2). Since the impact of SCM on delivery performance is stronger than the globalization one, the total effect of investment in globalization on delivery performance is positive. Thus, overall, companies that have invested in the globalization of distribution and sales still have a competitive delivery performance.

These relationships, however, are influenced by some of the specific contingencies we considered.

Size seems to have a significant impact. First of all larger companies tend to invest more in globalization (GI) and SCM thus they have a higher level globalization (GL). Moreover for larger companies the relationship between GI and SCM is stronger than for smaller ones. Interestingly however there is no evidence that for smaller companies globalization level (GL) affects delivery performance (DP): the relationship between GL and DP is not significant when smaller companies are taken into account. When larger companies are considered, on the contrary, the impact on DP is significantly higher than the average (-2.020). Because of that for small and large companies the total effect of GI on DP is similar.

Complexity seems to affect only the globalization level. The higher the complexity the lower is the degree of globalization. Another interesting effect is that companies dealing with low complexity do not have a significant linkage between GL and DP and the linkage between SCMI and DP is below average. On the other side a high complexity context implies a stronger negative effect of GL on DP, but a higher effectiveness of SCMI on DP. We can summarize these findings by saying that companies operating in a more complex environment suffer more from globalization, but they do not invest more in SCM than the others partially because their investment appears to be more effective.

Because of that the total effect of GI on DP is almost the same for companies characterized by high and low complexity.

Uncertainty plays a significant role as well. First of all, companies operating in stable environments tend to invest more in globalization and SCM and they are able get more improvements in the delivery performance. However the globalization level is not higher compared to companies that operate in uncertain contexts: this probably means that these companies have started to globalize only recently compared to companies that face a more uncertain environment. Moreover for these companies Path 2 does not hold: there is no linkage between GI, SCMI and DP. It seems that companies operating in a stable environment do not need to moderate the negative impact of globalization through SCM and their investments are not aimed to delivery performance improvement. In fact if we look at the total effect, these companies can reach higher delivery performance even with higher level of globalization. On the other side, companies in uncertain environments tend to invest more in SCM when they globalize and their investment is quite effective. Nevertheless the improvement in the delivery performance is very marginal.

Also the position of the decoupling point has a significant role. Companies adopting ETO/MTO models tend to invest more in globalization and their level of globalization is slightly higher (even if not significantly). However globalization does not affect the delivery performance but they invest anyway in SCM thus improving their delivery performance. Because of that, when globalizing they are able to significantly improve their performance compared to the rest of the cases (Table 10.13). On the other side ATO/MTS companies show a strong negative effect of globalization on performance. Because of that their SCM investment is focused on delivery performance improvement and that is why the linkage is so strong (0.700). Thanks to this they are able to moderate the negative effect of globalization and keep performance aligned with the rest of the sample (Table 10.13).

Finally, SC position does not contribute much, it seems only that upstream companies have no negative effect from globalization and because of that they are able to have higher delivery performance even when they globalize.

Section D: Case studies results

11 GVC analysis

Note: results of this chapter are mainly taken from the report by Lowe, Golini and Gereffi (2010).

Results from the survey provided several useful insights, identifying configurations of global SC and how these are related to different companies' characteristics, investments in SC and performance achieved. Nevertheless some gaps remain. First of all, how much configurations are comprehensive of all the possible situations. Next, why different companies invest differently in on SC improvement programs and what is the relation of such decisions with the context. Because of that, as explained in the Methodology chapter, a case study analysis has been performed.

In particular, cases have been selected among companies operating in the electric motors industry. Since case studies have, among others, the aim to better understand the relationship between companies choices and the context we decided to get a clear understanding of the entire industry from raw materials to markets. Because of that, we run a preliminary GVC analysis useful to better understand this industry, identify the key players, their localization and mutual relationships. The analysis was made during a research period abroad at the Center on Globalization, Governance and Competitiveness of the Duke University and the results were reported in a report by Lowe, Golini and Gereffi (2010).

11.1 Overview of value chain

This section will describe the overall structure of the value chain, which consists of four main stages: materials & components, manufacturing & assembly, system integration & installation (optional), industrial users (see Figure 11.1). Also important is a fifth category, supporting institutions, which includes government and private organizations that have a significant impact on various stages of the chain.

Figure 11.1 - Electric motor value chain - Adapted from Lowe et al. (2010)

Electric motors are complex products assembled from a number of raw materials and subcomponents. Moving from left to right across the value chain, manufacturers perform sub-assembly, final assembly and testing of the stator, rotor, shaft and cooling fan. Especially for larger motors (100+ hp), many of the assembly phases such as insulation or wiring require significant manual work and a high degree of accuracy and skill.

After testing, the motor manufacturer may sell the product directly to two typologies of industrial users.

From one side we have those who use the motor for *process applications*, meaning that the motor is used to run machineries involved in the production process. Usually these users are divided in two sub-categories: manufacturing industries (e.g. electronic, automotive) and process industries (e.g. textile, glass, cement). They are distinguished for the different applications they make of the motors.

On the other side we have those who use the motor for *product applications*, meaning that the motor is part of the final product made by the customers. Examples of products are: controlling motors for automobiles, gardening equipments, drills, white goods.

Motor manufacturers can sell directly or indirectly their product to the users.

For process applications usually the motor manufacturer sells the motor to a system integrator or an equipment manufacturer (often a contractor building a plant for a customer). In either case, the system integrator puts together the following final elements:

- Drive system: a plastic box or metal cabinet containing electrical components such as circuits and relays, along with a user interface (display and buttons) and the plugs for the control system. The drive is fundamental, since it governs the starting phase and protects the motor from electric shocks. Today the drive system's function is increasingly performed by variable speed systems;
- Control system: a network made of central computers, computer-run devices, sensors, human interfaces and software to control the industrial process;
- Application: the equipment that is run by the motor; in manufacturing, the primary applications are pumps, fans, compressors and blowers.

For replacement motors instead, usually the motor manufacturers directly sells to the customer to substitute the old motor in his plant.

We will now have a deeper look into the different stages of the value chain.

11.2 Materials & components

The two main raw materials important to the manufacture of electric motors are electrical steel and copper. Copper is used mainly in the form of wire, incorporated into the windings. Iron and steel are used to make castings (for the frame) and plates (for the rotor and the stator). Other relevant materials are aluminum and permanent magnets. Finally, relevant motor components include the shaft and spare parts such as nuts, bolts, and screws, bearings, and insulating material.

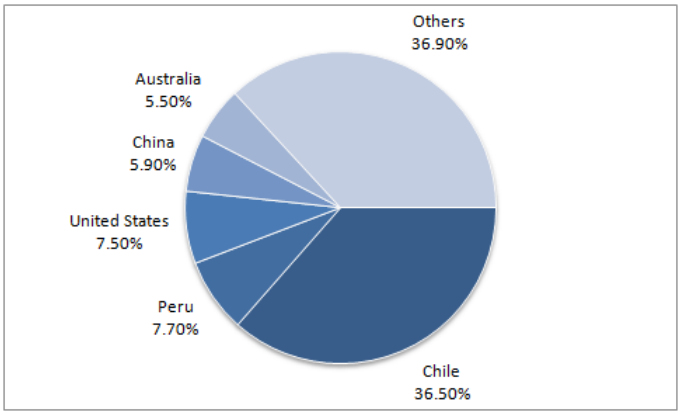
11.2.1 Electrical steel

Electrical steel plays an important role in motor efficiency, helping to reduce core losses. Chemically it is an iron alloy that may have from zero to 6.5% silicon and sometimes an addition of manganese and aluminum. It can be difficult to obtain high-quality electrical steel. Producers of electrical steel are relatively few, and they are concentrated in the United States, Europe and Japan. Relevant firms include ARMCO, ATI Allegheny Ludlum, British Steel Corporation, ThyssenKrupp, Kawasaki Steel, and Nippon Steel.

11.2.2 Copper and copper wire

The global copper market shows a high degree of concentration. The five leading export countries account for about 60% of the world total of 14 million tons per year. Chile clearly dominates, with 36.5% of the total market (see Figure 11.2). Next are Peru (7.7%), the United States (7.5%), China (5.9%), and Australia (5.5%). All other countries combined account for the remaining 36.9% (Freedonia, 2009).

Figure 11.2 - World Copper Mine Production, 2007 - (Lowe et al., 2010) based on (Freedonia, 2008)



Since late 2005, the copper market has experienced extreme price volatility. In the 17 months between January 2005 and May 2006, the price of a ton of copper tripled, from $3,000 to nearly $9,000 (see Figure 11.3). By early 2007, the price had dropped to around $5,000, only to return to $9,000 one year later, and fall back below $3,000 by the end of that year.

Figure 11.3 - Copper prices on London Metal Exchange, 2004-2009

China, a large producer and consumer of copper, exerts an increasingly strong influence on the market. India is another fast-growing consumer. Overall increases in the price of copper over the past five years have stimulated the development of new technologies, along with efforts to fully exploit new and existing reserves. In the United States, the world's third largest producer, several large, integrated companies dominate the competitive landscape, extracting and processing copper and other metals. The Earth's total endowment of copper is vast, yet only a fraction is economically viable with current extraction technologies. Over the past 50 years, copper extraction has increased at an average rate of 4% per year. Even under generous assumptions regarding advances in technology and rates of consumption, several forecasts estimate future availability at only 25 to 60 years (Brown, 2006). Copper recycling is a viable option for extending copper supplies, since recycled copper is nearly indistinguishable from primary copper (INMET, 2009). Today recycled copper represents 41% of total copper in use globally (European Copper Institute, 2007).

Copper magnet wire firms include Superior Essex, Elektrisola, Phelps Dodge Magnet Wire, Rea Magnet Wire, Alconex, and Nexans. Since copper is a crucial material in all motors, it represents a potential pinch point in the value chain, particularly for high-efficiency motors, which require on average 25% more copper. Companies have the option of salvaging copper from motors that are no

longer in use. This can be labor intensive, but given the increasing reliance on copper and the volatility of copper prices, recycling may become a more attractive option (Black, 2009; Copper.org, 1998).

11.2.3 Permanent magnets

In some electric motors, copper can be replaced with permanent magnets that allow higher power and efficiency, smaller size and less usage (e.g. brushless motors). On the other side they are more costly and their application is limited to smaller sized motors.

Permanent magnets can be made of ferrite or neodymium.

Ferrite is drawn from steel mills scraps, so there is globally high availability of this material. However it requires a lot of energy and work to be produced so overtime the production moved to China in order to exploit costs advantages.

Neodymium costs more and it is more powerful than ferrite and the production is again localized in China. In fact, despite neodymium caves exist also in other countries, China is the only country that overtime invested in extraction and production facilities.

Because of this situation, China has the global leadership in the permanent magnets supply.

11.3 Manufacturing and assembly

11.3.1 Drive manufacturers

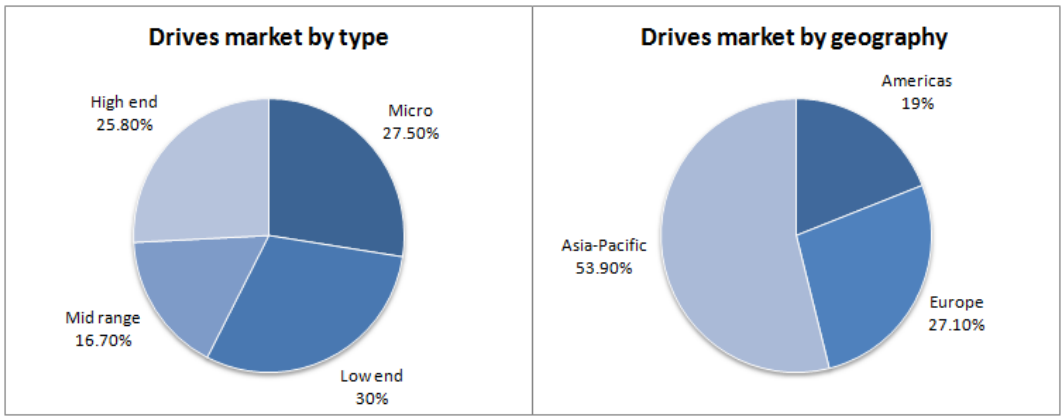
A drive is a system that controls the motor by modifying the input current in terms of voltage and frequency. Since AC electric motors are commonly used in industrial applications, this analysis focuses on drives specifically designed for AC motors. Lead manufacturers include ABB, Mitsubishi Electric, Rockwell Automation, and Siemens.

Most manufacturers of AC drives are electric and electronic component manufacturers. These players are numerous, but dominated by the above-mentioned lead firms. Characteristics of the market include the following (Datamonitor, 2009b):

- Equal bargaining power between component suppliers and manufacturers;
- Exploitation of global market opportunities by large multinational companies;
- High standardization and low product differentiation.

In 2008 the global market for drives reached a value of $9.8 billion, after an average annual growth rate of 7.5% in the period 2004-2008. Figure 11.4 depicts the world drive market by type and by geography. By type, the market is segmented according to power range: micro drives (up to 4 kW), low end (5 - 40 kW), mid range (41 - 200 kW) and high end (201+ kW). Low-end drives have the largest market share (30%), and mid-range drives have the lowest share (16.7%). The Asia-Pacific region dominates the market with a 53.9% share, followed by Europe (27.1%) and the Americas (19%).

Figure 11.4 - World drives market by type and geography (Lowe et al., 2010) based on (Datamonitor, 2009b)



11.3.2 Motor manufacturers

Market analyses often consider electric motors together with generators. The two products perform very different functions—generators convert mechanical energy into electricity, while motors convert electrical energy into mechanical power—however, they share many of the same suppliers, production phases, main players, and competitive landscape. The U.S. market for motors and generators is valued at $15 billion.

The market for motors and generators has the following characteristics (Freedonia, 2009):

- Large number of manufacturers, ranging from small niche producers to OEMs and large multinationals that often perform assembly and installation;
- High competition due to a mature market and lack of a large replacement aftermarket (products have a long average life compared to other industrial equipment);
- Medium-high standardization of products;
- Increasing presence of foreign-based, lower-cost suppliers. Competition is somewhat lower in the integral motors segment, comprising a few multinational companies along with numerous small, private niche firms.

Although the market for electric motors and generators is considered mature, it is undergoing the following changes (Freedonia, 2009):

- The commoditization of electronic components allows motor manufacturers to make in-house drive systems and sell a complete package of motor and drive;
- NEMA Premium and similar standards push companies to make high-efficiency motors;
- Rising energy prices stimulate the adoption of new, high-cost materials such as permanent magnets, formerly used only for specialized applications.

11.4 System integrators and equipment manufacturers

System integrators couple the motor and drive with the application. They also interface the motor/drive system with the client's control system. Integrator firms include not only equipment manufacturers, but also construction and engineering companies that specialize in industrial buildings.

Both categories are considered mature and fragmented, with many firms of varying sizes and degrees of influence. Lead firms include Bechtel Group, Redi Services, MAN AG, and IHI Corporation.

The industry shows the following characteristics (Datamonitor, 2009c):

- Competition due to low differentiation, high fixed costs, and high R&D costs;
- Price volatility of raw materials.

In the category of construction and engineering firms, the industry is characterized by the following (Datamonitor, 2009a):

- Competitive tendering to win contracts;
- Presence of norms and regulations;
- Numerous sub-contractors;
- Temporary project structures.

11.5 Results of the GVC analysis

In the literature (see Chapter 2.10- Global Value Chain analysis), two main types of GVC have been identified according to the position of lead firms (Gereffi, 1999):

- Producer-driven: when the lead firms are manufacturers;
- Buyer-driven: when the lead firms are retailers.

In the electric motors value chain, we can find a twofold situation (see Figure 11.5).

Industrial users that buy motors for process applications are supplied by manufacturers or system integrators and they employ the motors in their production processes. In this case, the lead position is held by these last players (motors manufacturers and system integrators), as the industrial user's core business is making products with the machineries and not building machineries. For this category of industrial users, the motor is part of a capital expenditure that happens only when there is the need of a new facility construction or a motor replacement occurs. Because of that we can categorize this as a producer-driven value chain.

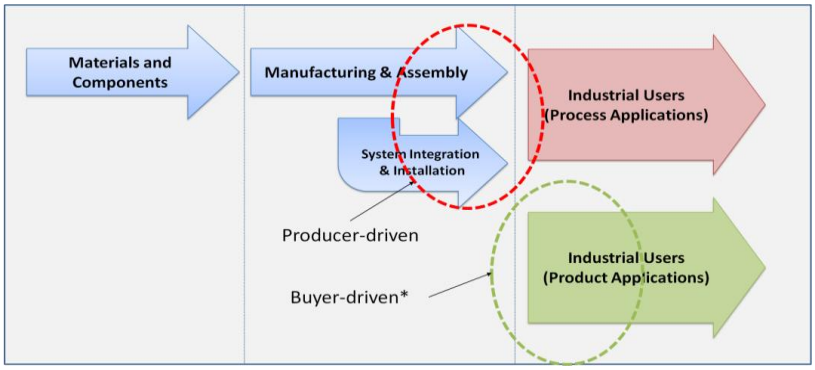
On the contrary, when the industrial users realize products with the motors inside them (e.g. drills), usually they are in the lead position. In fact, this type of users is represented by big branded companies that have the access to the market. The motor is no more a capital expenditure, but a component bought on regular basis from a supplier base. Because of that we can categorize this as a buyer-driven value chain.

Along the value chain, different types of relationships can be established by players according to power asymmetry and the degree of explicit coordination (see Chapter 2.10 - Global Value Chain analysis). These relationships push companies to a higher or lower degree of inter-firm collaboration (Figure 11.6).

The lowest degree of collaboration lies in the relationship between materials suppliers and manufacturers. A medium degree of collaboration marks relationships in most of the value chain, while the highest collaboration occurs between system integrators and industrial users in process applications and between motor manufacturers and industrial users for product applications.

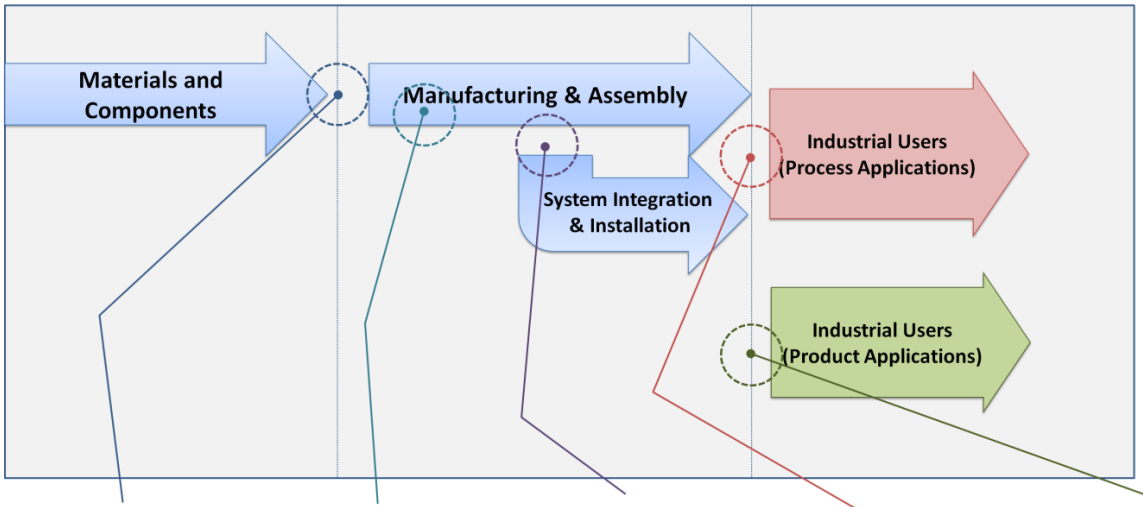
Further details and explanations are provided in Figure 11.6.

Figure 11.5 - Role of lead firms in electric motors value chain and in manufactured products value chain - adapted from Lowe et al. (2010)



* In this case buyers are not retailers but manufactuers of goods who use the motor in their product

Figure 11.6 - Governance structures and relationships between key players in the electric motor value chain - adapted from Lowe et al. (2010)



Low collaboration, standardized relationships (MARKET)

Electric motors rely heavily on key raw materials, yet this demand is only a small percentage of the raw material suppliers' total market.

Copper wire is purchased in bulk at market prices. Metal castings can be customized, but they are still a very standardized product. Collaboration can happen in logistics.

Medium to high collaboration (CAPTIVE / HIERARCHY)

Large, integrated motor manufacturers can either make the entire motor or use captive suppliers to outsource less core activities, such as certain sub-assembly phases.

Medium collaboration (RELATIONAL/MODULAR)

Electric motors account for a small to medium share of the value of products the system integrators sell. Motors have a medium impact on the integrated products' quality.

For standard applications such as a fan, the motor manufacturer and the system integrator will have low collaboration. For a special purpose application, collaboration will be higher.

Low collaboration (MODULAR/RELATIONAL)

When industrial users purchase an electric motor directly from the manufacturer, it is usually for a replacement. Since motors have largely standardized characteristics, the degree of collaboration is low.

On the other side, when the industrial user purchases a new equipment the degree of collaboration with the system integrator is usually higher.

Medium to high collaboration (RELATIONAL)

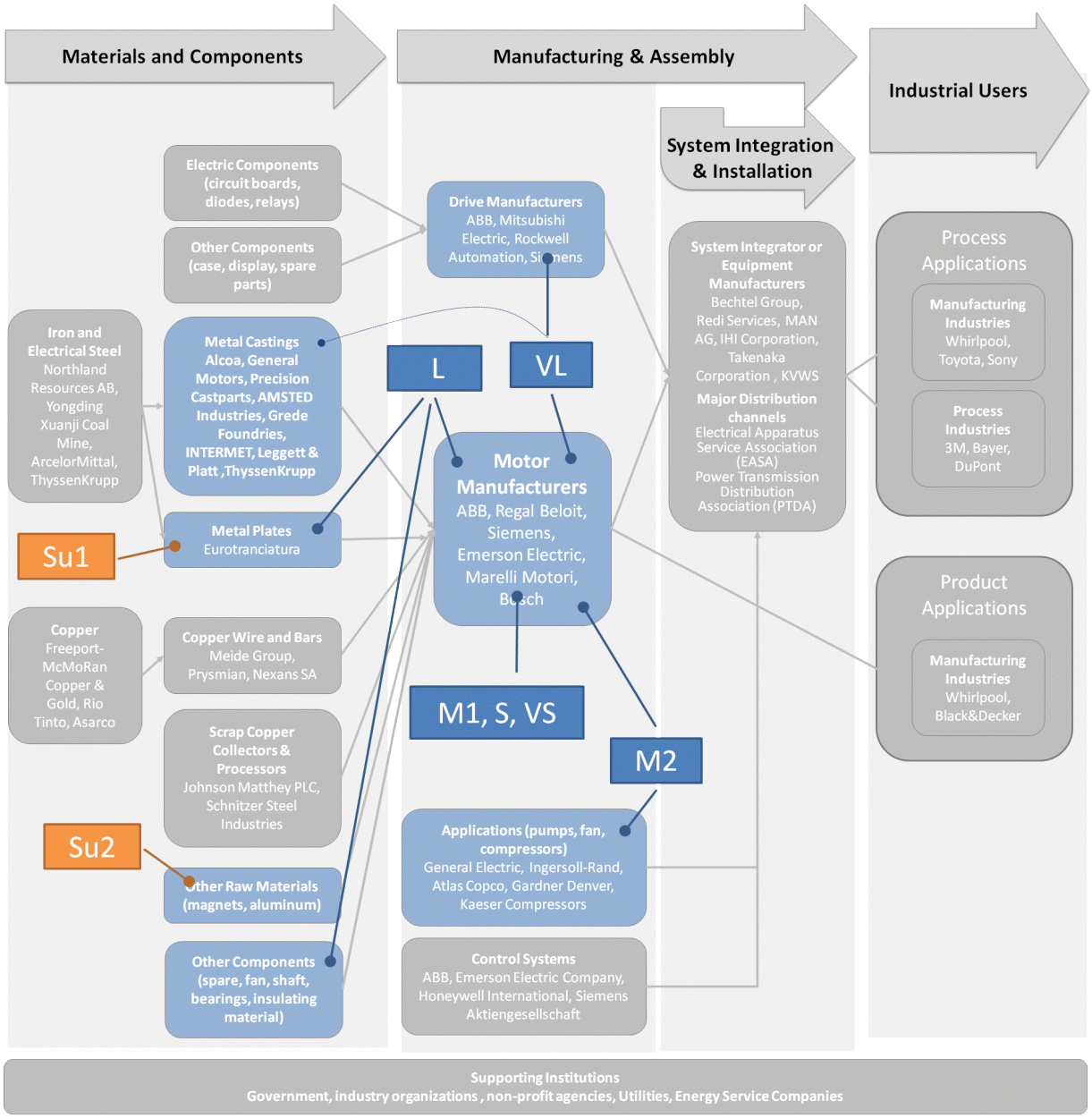
For industrial users of motors in product applications, motors are a key part of their product. Thus, relationships with motor providers are usually very collaborative during the product design and operational phases.

12 Positioning the cases over the GVC

As a second step, we positioned the interviewed companies over the GVC identified (Figure 12.1). This step was helpful in order to define the boundaries of the value added activities performed by the different companies. They somewhat differentiate each others. Besides motors, VL makes also drives and castings in an off-shored plant. L is vertically integrated upstream since they make in-house metal plates from steel coils and shafts. M2 assembles the motor with the fan and hood system. Finally, M1, S, and VS are purely motors manufacturers.

As explained before, we also interviewed two suppliers (Su1 and Su2) to in order to have their perspective on the relationship with electric motor manufacturers. The first one (Su1) is a supplier of metal plates and pre-assembled rotors and stators. Su2 instead provides permanent magnets importing them from China. We positioned them in the GVC as well.

Figure 12.1 - Positioning of the cases over the GVC



12.1 Sourcing

As a second step we analyzed the sourcing strategies of the motor manufacturers for the different product categories (Table 12.1) and the purchasing organization and strategy (Table 12.1).

12.1.1 Purchasing categories description

We will start from copper and steel that represent the main source of expenses. According to L, copper and steel account for about 50% of the direct material spending.

Copper is bought by S and VS from domestic resellers who buy copper from abroad. M1 and M2 buy raw copper on the London Metal Exchange Market in order to get the best price. Then the copper is sent to suppliers who process and ship it to the company. VL and L directly negotiate with global suppliers and they set frame agreements with them. Moreover they hedge the price fluctuations through financial investments in derivates.

Steel is bought already in form of cut metal plates by M1, S and VS from domestic suppliers. M1, M2 and VL, instead, buy steel from global suppliers who ship the raw material directly to local suppliers who cut it. Usually this processing is customized and it needs dies owned by the motor manufacturer. Because of that, it easier for companies to manage the relationship with local suppliers. Differently from the others, L buys steel coils from domestic resellers who procure steel from China, but then they produce internally the metal plates.

Metal castings, that is the following expense category, are purchased at the European scale by S. Usually these products need some processing, that in case of S is done by specialized local suppliers. L and VL instead buy them on a global scale, even from China and India. This is quite interesting given the fact that these are heavy and bulky components, but apparently shipping them is still economically viable. For VL, the driver to select domestic suppliers for this component is when they are highly customized. For this category, companies do not use financial hedging as the price is only partially related to raw materials as there is significant content of manual work.

The shaft is a critical component for the quality of the finished motor and it has a medium incidence on the total cost of the motor. Shafts are also potential production bottlenecks. In fact shafts are often customized (in size, shape, connections) so they are usually ordered to suppliers after having received the order from the customer. Moreover shafts are hooked up to the rotor in the early phases of the manufacturing process. Because of that, companies usually keep some stock of standard shafts and they look for fast suppliers for customized ones. M1, M2 and VL buy shafts from local or domestic suppliers so they can communicate their needs more easily and have a higher reactivity from the suppliers. For the same reasons, L preferred to make shafts in-house.

Bearings are still a critical component for the quality of the finished product, but they are much more standardized. Companies usually keep stocks of bearings and they buy them mainly from China or from European specialists. Since VL uses bearings also in products other than motors, it can enjoy strong economies of scale signing frame agreements with global suppliers. Only VS buys bearings from an Italian supplier.

Winding the motor or the rotor is a relatively simple process, but is critical for the quality of the motor. Defective windings not only reduce the efficiency of the motor, but in many cases they compromise the functionality of the entire motor. Moreover, windings are one of the first production phases done, so they constitute a potential production bottleneck. Because of that almost

all the companies make this process internally or at local suppliers' sites, so they can better control the quality and have the necessary flexibility and reactivity.

For what concerns permanent magnets, we saw before (see Chapter 11.2.3 - Permanent magnets) that China is the leading supplier country. As a matter of fact, companies who use permanent magnets, either they directly procure them from China (M1, VL) or from domestic resellers (VS) that in turn buy them in China.

Other non critical materials (e.g. screws, bolts) are purchased from local suppliers by S, VS and M2, while M1, VL and L prefer global suppliers.

Finally, we investigated whether some companies resell some motors made by other suppliers. This is a practice that only M2 and VS follow in case the demand exceeds the internal production capacity. Interestingly VS is able to buy customized motors from China through an intermediary. M2 instead buys motors from an Italian supplier or from China. However, as M2 told us, usually the qualitative level of Chinese manufacturers is lower, so this has to be decided together with the customer.

12.1.2 Purchasing organization and strategy

Moving to the purchasing organization and strategy (Table 12.2), only VL and L have a structured purchasing department, while, in the other cases, purchasing is managed more or less directly by the production manager. In particular, VL, being a multinational company, has a centralized purchasing department with commodity manager specialized on the different categories. At the plant level only the purchases specific for that plant needs are fully managed.

About suppliers' selection, all the companies give high importance to the quality granted by suppliers. In fact European motor manufacturers usually differentiate themselves for the higher quality of their products compared to the Chinese ones. However especially for more standardized products, the price made by the supplier plays an important role in the supplier selection. S and M1 give high importance also to physical proximity and the possibility of long-term relationships in order to achieve higher flexibility in the chain. For M2 and L delivery dependability of suppliers is particularly important.

About the number of suppliers, only VL expressed the commitment to reduce the supplier base to few strategic suppliers, while all the others rely on their traditional supplier base made, on average, of 50 key suppliers.

About the localization of suppliers, S and VS buy everything from local suppliers or through domestic intermediaries. M1 shows a higher degree of globalization, as around 80% of suppliers are still Italian, but the remaining 20% are Chinese. For M2 more than the 50% of the purchases is international. VL has still a low degree of global sourcing (around 20%), but the target is to reach 50% of global sourcing in the next years. Of course this requires a standardization of the needs at company level in order to exploit global frame agreements. They also keep some local backup suppliers. Finally, L has the higher degree of globalization with already 50% of the purchases from outside the country.

About the information exchanged, S and M1 tend to have long term relationships with their suppliers, mainly to face together demand uncertainty. However little extra information is exchanged (e.g. forecasts, production plans). For S and VS this relationship is informal, while M1 uses frame agreements of 3, 6 or 12 months with prices sometimes indexed to the raw materials market prices. VL and L are instead more structured. Besides frame agreements, VL exchanges 3, 6 and 12 months

forecasts with its key suppliers. For big orders, they also monitor the progress at the supplier's place. L has also put in place an electronic kanban system with its suppliers, so that they have visibility on the future needs of the company and they can consign weekly in just-in-time.

About inventories, usually companies keep a stock of standard parts (mainly spare parts, standard shafts) especially when components come oversea. Thanks to the kanban system, L reduced these inventories by 30%.

Table 12.1 - Suppliers mapping

	S	M1	M2	VS	VL	L
Copper	Pure copper wire is bought from an Italian reseller that buys it in Sweden	Copper is bought at the London Metal Exchange and it is directly sent to be wiredrawn to suppliers	Copper is bought at the London Metal Exchange and it is directly sent to be wiredrawn to suppliers.	Copper wire is bought from domestic suppliers	Global frame agreements with the major suppliers. Financial hedging for on price fluctuations.	Copper accounts for 25% of the spending. Copper is bought from 3-4 suppliers in South America, than is shipped to local suppliers for the processing. Financial hedging for price fluctuations.
Steel and metal plates	Metal plates bought from a domestic supplier	Metal plates bought from a domestic supplier	Steel directly bought globally from foundries. Then is cut by a local supplier to make plates.	Metal plates bought from a domestic supplier	Steel is bought directly from global suppliers (e.g. China and Russia) through global agreements. Then is cut by a local supplier to make plates.	Steel accounts for 24% of the total spending. They have 6 suppliers, 4 fixed and 2 in case of need. They buy from Italian resellers who buy from China. Plates are made internally.
Metal castings (frames, shields)	European suppliers for castings and local suppliers for metal processing.	NA	Local suppliers	Local suppliers	Castings are bought in India, China and finished by a Finnish or a Czech supplier. Another supplier is located in Poland. These purchases are out of corporate agreements so they are less economical. For highly customized supplies, they rely on domestic foundries.	15-20% of the purchases. Suppliers are located in Italy, Czech Republic, China. Beside raw material, castings have other mechanical processing. Because of that there is more work content and higher possibilities to negotiate on price. No financial hedging on these purchases.
Shaft	NA	Made by an external local supplier on provided specifications.	2-3 local suppliers providing good quality shafts at reasonable prices.	Local suppliers	Purchased from an Italian dealer, but a commodity manager will soon directly manage this purchasing category	Made internally
Bearings	Many suppliers available, but usually purchased from China	Purchased from China	Bought from GNK (England based)	Italian Supplier	Frame agreements with global players (SKF, NSK, NKE). Design is supplier side, they buy from catalog.	Chinese suppliers and SKF (Germany)

	S	M1	M2	VS	VL	L
Windings	Mainly internally or from small local suppliers	Mainly internally or from small local suppliers	Internal (70%) or external small local suppliers	Specialized German suppliers	Mainly internally	Mainly internally
Permanent magnets	From a reseller that procures magnets in China	From Chinese suppliers	NA	From a reseller that procure magnets in China	From China	NA
Other non critical materials (e.g. screws, bolts)	Local suppliers	From Chinese suppliers	Domestic suppliers	4-5 local suppliers	Global suppliers	Global suppliers
Finished motors	No procurement of finished motors	No procurement of finished motors	1000-2000 motors per year are purchased from an Italian company when the motor required exceeds the size deliverable internally. 20-30000 motors are purchased from China.	Some motors are purchased from China on company design through an intermediary.	No procurement of finished motors	No procurement of finished motors

Table 12.2 - Purchasing organization and strategy

	S	M1	M2	VS	VL	L
Purchasing organization	Purchasing managed by the production manager	Purchasing managed by the production manager	Purchasing managed by the production manager	Purchasing managed by the production manager	Corporate purchasing department with commodity managers specialized on the different categories (scouting suppliers, negotiation,…). Local purchasing responsibility only for those goods specific for the plant.	Purchasing department
Selection criteria	Physical proximity, quality, price, possibility of long-term relationships	Physical proximity, quality, price, possibility of partnership	Quality, price, deliveries	Quality, price, deliveries, flexibility	Quality, price	Quality, price, deliveries
Number of suppliers	50	200	NA	NA	27 but the objective is to lower to 6	200 suppliers but 50 are the most important
Localization	80% is regional, the remaining 20% is bought from intermediaries operating in China, Switzerland and Germany (resins and coatings).	75-80% are Italian, the remaining 20-25% are Chinese	Almost 100% is sourced locally	Almost 100% sourced locally or through intermediaries. Some components are purchased from Germany.	20% are global, but the target is move to 50%. Local backup suppliers	50% Italian, 50% foreign (Germany, Czech Republic, Turkey, Romania, UK, South America, China)
Type of relationship and exchange of information	Long term relationships but little collaboration or exchange of information.	Frame agreements of 3, 6 or 12 months. Prices can be fixed or related to raw materials stock prices.	-	Long term relationships, little collaboration or exchange of information. Suppliers with long term relationships are more willing to be flexible and supportive in case of emergencies.	Exchange of 3, 6 and 12 months forecasts. For big orders there is a progress monitoring.	Yearly frame agreements, electronic kanban system.
Inventories	Stock of standard components and shafts to cover one month ahead of the production.	Stock of components from China, but being standard there is no risk of obsolescence	Stock of standard components	NA	Stock of materials when possible to reduce lead times	Reduction of about 30% of the inventories thanks to the electronic Kanban.

12.2 Manufacturing

Information about the manufacturing network is synthesized in Table 12.3.

Only VL has an actual global manufacturing in place, while L will have it from 2011 through a new plant in Asian Southeast. The other cases either they have only one plant (S, M2, VS) or they have multiple, but in Italy. This is the case of M1 that has three facilities in Northern Italy.

VL has a complex structure as there are some plants providing components (e.g. the plant in India provides castings) and then other plants (e.g. Europe and China) specialized in different product families. These last plants have also the product design responsibility. For L the situation will be simpler. The delocalized plant in Asian Southeast will basically have only production duties of standardized motors, while the product design and the manufacturing of special motors will remain in Italy. Finally, M1 has three plants that are specialized in different processing, so when needed motors are moved from one plant to the other. All the companies operate mainly in make-to-order or purchase-to-order. In case of small and standardized motors a part of the production is in make-to-stock based on forecasts.

Table 12.3 - Manufacturing characteristics

Case	Production facilities	Production Facility Roles	Type of production
S	1 in Italy	-	90% MTO/PTO, 10% on MTS forecast
M1	3 in Italy in a 7 km radius	Specialization in different processing	100% MTO/PTO
M2	1 in Italy	-	90% MTO/PTO, 10% are MTS
VS	1 in Italy	-	Mainly MTO/PTO, some ATO
VL	4 in Europe, 1 in India, 3 in China, 1 in South Africa and 1 in South America.	Only plants in Italy, Finland and China have responsibilities on R&D.	100% MTO
L	1 in Italy and 1 Asian Southeast (from 2011)	The plant in Asian Southeast will have only production duties.	20% MTS, 70% MTO/PTO, 10% ETO

12.3 Sales and distribution

As reported in Table 12.4, the smaller companies in our sample (VS, S, M1 and M2) have the majority of their sales in Italy and the remaining part inside Europe. Only L and VL sell globally. Respect to the value chain previously identified, S, M1, M2 and VS sell to industrial users for product applications while VL and L to system integrators through their sales units.

The number of customers ranges from about 40 to more than 100, even if L and VL could not provide the exact number as the sales units manage the relationship with the customers. Especially smaller companies (S, M1) make the majority of their turnover with few big customers.

The minimum lead time to fulfill the received order is one week for L, three weeks for VS, four weeks for M1, M2 and S and, given the size of the motors produced, twelve weeks for VL. Lead times however increase by 50% on average when the company operates in purchase-to-order and materials come from oversea.

Table 12.4 - Customers localiztion and lead time performance

	Localization	Type of clients	Number and size	Lead time
S	74% Italy, 16% Europe	Product manufacturers	39 customers (the first 15 make 90% of the sales)	4 weeks
M1	50% Italy, 50% Europe	Product manufacturers	80 customers (the first 10 make 80% of the sales)	4-6 weeks (8-10 if materials come from China)
M2	70% Italy, 30% abroad (mainly Europe)	Product manufacturers	NA	4-5 weeks
VS	Almost 100% in Italy, foreign markets are closed by the need of certifications	Product manufacturers	More than 100	3 weeks
VL	About 50% global	Sales units to system integrators	NA	12 weeks in MTO Up to 20 weeks in PTO
L	30% Italy, 70% global	Sales units to system integrators	80% through 5 sales units, where everyone has about 100 customers	1 week in MTS, 12-16 weeks in MTO

Relatively to the information exchanged with customers (Table 12.5), we analyzed separately the case of joint new product development (co-design) and operational information exchange (e.g. orders, production progress). Starting from co-design, we observed different situations. VS usually performs little co-design with their customers. S builds the motor on customer specifications, but they usually design in-house the electrical part. M1 has sometimes a more intense co-design process when the customer wants to optimize costs or performance. VL, that realizes one-of-a-kind motors, has a strong level of co-design with customer through sales units.

These evidences are aligned with the "relational" type of relationship identified for these players in Figure 11.6.

On the contrary, about operational information exchange, smaller companies (VS, S, M1, M2), but also VL, do not exchange much information with customers other than the order information and some tracking of the production progress. Only L uses an eCommerce portal for exchanging information with customers.

Table 12.5 - Codesign and information exchange with customers

	Co-design information exchange	Operational information exchange
S	For fully customized motors: the customers design the mechanical part, they design the electrical part. For partially customized motors they start from the catalogue.	No formal frame agreements, but informal information exchange. Order tracking for main customers.
M1	Usually they design on customer specs. Some joint design projects brought to higher advantages in terms of costs and performance. Development and prototyping costs are charged to the customer according also to the order size.	No particular information exchange
M2	Strong co-design for the design of the motor and fan system.	No particular information exchange
VS	Little co-design	No particular information exchange
VL	High level of co-design, mediated by the selling unit	Production progress
L	Co-design with new customers mediated by sales units. Habitual customers tend to ask always the same type of motor with the same customizations, so there is no more need to co-design.	Use of an eCommerce portal for exchanging information.

13 Case studies analysis

Afterwards, we performed a within- and a cross- case analysis and some interesting patterns emerged. First of all there is an effect of the GVC both in terms of the industry structure, position of the companies and type of market on the global SC decisions. Next, we have identified the following elements as relevant in explaining differences in the global SCs: company size and type of purchases.

13.1 Industry structure

Since all the cases belong to the electric motor manufacturing industry they are constrained to some industry characteristics. About the sourcing, the main raw materials or components to be purchased (i.e. copper wire, steel and castings) are always the same available at few global suppliers. Since these suppliers are not usually specialized in the electric motor industry the possibilities to have sort of SC collaborations is limited especially for smaller companies. Moreover, shipments of these materials are constrained to long deliveries, usually 3 months.

This is in line with the findings of the global value chain analysis that identified a "market" relationship with raw materials suppliers (Figure 11.6).

For raw materials, some companies (e.g. S and VS) rely on local intermediaries that are more flexible, but the counterpart is that materials are more expensive. More degrees of freedom are left on the other components like shafts and spare materials that, when possible, are purchased in China and kept in stock. Also the production process is quite similar for the whole set of cases, with similar organization (usually purchase-to-order or make-to-order), limited automation and a strong content of work.

A tighter and sometimes a controlling relationship exist, instead, between motor manufacturers and their suppliers of customized components or outsourced activities. This is in line with the GVC analysis that identified a "captive" relationship among these players (Figure 11.6).

Together with a standardization and "commoditization" of electric motors, these companies are particularly exposed by competition low-cost countries, especially Chinese. As pointed out by M2, Chinese manufacturers can make good quality motors at a price equal to the cost of the components for a European manufacturer. As a matter of fact, raw materials prices are the same in every country, but Chinese manufacturers can enjoy a much lower cost of work together with economies of scale.

This of course pushes companies to source components from low-cost countries, but the advantages are limited if the company does not produce off-shore.

Purchasing from China has in fact high costs. First of all, large batches are needed to fill containers and because Chinese producers do not accept small orders. Next shipping oversea takes several weeks. Moreover, as Su2 told us, because of the crisis, ships tend to make more stops during their trips, so in the last years the time for naval transportation stretched.

Because of that, L is setting up a new facility in Asian Southeast where standard motors will be produced at lower costs and then shipped to Europe. However, setting up a plant off-shore is not easy, as M1 pointed out. The company tried to set up a factory in China, but it somewhat failed in finding the right connections with the local suppliers, so the production costs was not so lower than in Italy.

Because of this competitive scenario, the majority of the companies preferred to keep the production in Italy, relying on a local and reactive supplier base and competing more on quality, flexibility, customization, delivery speed and service (e.g. helping the customer in the design). As highlighted by S, large customers tend to buy standard motors from China in high volumes and ask local companies to make special motors or fast deliveries of standard motors. Because of that, it is necessary to keep a flexible production system and have long term relationships with suppliers in order to face together a continuously situation of emergency.

13.2 Position in the GVC

As shown in Figure 12.1 cases are positioned slightly differently in the value chain and this explains differences in their SC practices.

VS, S and M1 are focused just on motor manufacturing and their order winners are customization, delivery speed and flexibility. This focus on manufacturing and SC reactivity is tightly related to keep domestic suppliers and customers mainly inside Western Europe.

M2 moved slightly downstream on the chain, focusing on the integration of the motor with the fan system. Because of that, shares of the motors are purchased directly from another Italian manufacturer and from China from reliable suppliers in order to guarantee the quality. These motors are then assembled with the fan and the hood that are made in-house. Thank to this stronger focus downstream, they have a tighter relationship with their customers and they can ask for higher prices since they provide a customized subsystem.

L adopted a different strategy. It vertically integrated upstream, making in-house the metal plates and shafts. In this way they can buy steel at the internationally set price on the stock market and produce internally with significant advantages on price and manufacturing reactivity.

Finally, VL is able to make in house the motor and the control systems. In terms of global SC, this means that they have to interact also with suppliers of electronic components, located in the Far East. Moreover they make the castings in an off-shored plant so they can have cost advantages on the procurement side, but higher coordination costs and longer lead times on the other.

13.3 Type of market

As highlighted in the value chain, there are two types of markets for the product and the process applications of electric motors.

In the process applications, that characterizes VS, VL and partially M1 and L, the motor is employed in industrial machineries. Because of that, demand is more related to capital expenditures of the final users and, usually, motor manufacturers sell to system integrators rather than final users. In this case motors are generally more standardized so it is easier to sell them on a global scale. Nevertheless when the motors are extremely big (like in the case of VL) they are also highly customized so global sales have to be supported by local selling divisions.

In the second one – i.e. product applications - that characterizes S and M2 and partially M1and L the motor is put in a product sold to the end market. Because of that the demand is usually more stable and there is also higher need to design the motor in collaboration with the customer. The issue is that, as identified through the global value chain analysis (Figure 11.5), customers have the control and they can exploit suppliers to maximize their profit. As a matter of fact, often these customers order large batches of motors from China and they ask to Italian suppliers small batches, fast

deliveries and high flexibility. Generally speaking, this tends to limit the possibilities for a globalized distribution.

13.4 Size

Besides the industry and the market, size is definitely the main contingency explaining differences among cases.

Smaller companies (S, VS) usually have a very limited global sourcing and distribution and no global manufacturing in place. For purchases that must be done abroad (e.g. copper and steel) they usually rely on intermediaries. Moreover they usually do not have the bargaining power to influence big suppliers or customers to put in place SC integration. They compete strongly on speed, flexibility and customization (especially VS). Because of that they need reliable, known and fast suppliers. The weakness of this strategy are: losing some opportunities offered by globalization (like cheap supplies of spare material, access to new markets), be exposed to raw materials price fluctuations upstream and be reliant on few big customers that control the access to the market.

Medium companies (M1 and M2) have instead a more developed global SC. They buy raw materials on the London Metal Stock Exchange and also other components are bought globally (bearings, spare parts). M2 buys also some motors from China. Their market is more internationalized but mainly at the European level.

L is a globalized company in terms of sourcing and distribution and soon also in terms of global manufacturing thanks to the new plant in Asian Southeast. On the sourcing side, they have a devoted purchasing office that also uses financial hedging tools for copper. They buy materials and components at a global scale (around 50%), keeping some local suppliers as backup or for metal processing. Thanks to its size, L was also able to put in place an electronic kanban system with their suppliers, thus making deliveries faster and reducing inventories by 30%. Also its market is quite globalized thanks to sales units positioned in the countries where they sell. The relationship with customers is therefore mediated by the sales units that send the orders and interact in the design phase.

Finally, VL is a truly globalized company with several plants around the world. Some of these plants (e.g. the Indian one) supply other plants with parts of the finished product. In this case, there is an interaction between plants that can affect the performances of the receiving plants in case, for example, of delays. Some other plants are instead independent as they are specialized on different product lines. They extensively use global corporate agreements to procure standardized goods such as steel that is sent to external suppliers for processing it. However the level of globalization of purchases is still relatively low (around 20%), but the aim is to higher it always keeping some local backup suppliers. As in the case of L, they sell through local commercial units.

13.5 Type of purchases

Also the typology of purchases affects the global SC decisions. In particular we should distinguish between:

- Raw materials suppliers of copper or steel;
- Suppliers performing outsourced activities, as windings making or mechanical processing;
- Customized components suppliers, for metal plates, castings, shafts, permanent magnets.
- Standard components suppliers, for bearings, fans, insulating material;

Raw materials can have a particular dynamic. When they are bought on the international stock markets (like M1 and M2 do), the raw material is directly delivered to the supplier that performs the processing (e.g. copper wiredrawing). However, since copper is always the same, the supplier can produce before receiving the copper bought from the customer, using the one available in stock. In this way, the company purchases the copper globally, but practically it is where the supplier is located that really matters.

Suppliers performing outsourced activities help the companies on the mechanical processing or windings making. Usually these suppliers are close to the company as they somewhat participate to the production process, so transportation lead times can have a strong impact.

Similarly, customized components suppliers are usually located close to the companies. In fact, companies usually keep little stock of these components so they need these suppliers being reactive. Moreover the customization requires collaboration and trust, since the suppliers many times uses customer's equipments (e.g. dies). This is what mainly explains local supplies. The problem of transportation costs is in fact marginal: it was interesting to notice how some cases (namely L and VL) transport big and heavy metal castings with a relative easiness. As highlighted by L, these components have quite high work content, so the cost of procuring them off-shore fully compensates the transportation cost.

Finally, suppliers of standard components can be located far away much easier. The majority of the companies buys bearings, for example, globally and keeps them in stock.

Section E: Discussion

In this chapter we will discuss the results obtained through the survey and through the case studies. The first aim is to enrich the results of the survey with information from real cases highlighting possible limitations or aspect to be taken into account for future developments. The second one is to show how results are connected and extend the existing literature.

14 Global SC Configurations

We start the discussion from the four global SC configurations indentified in the data.

The first strong evidence is that in our international sample the vast majority of firms falls within the Locals, showing that SC globalization has still a limited diffusion (Table 7.3). This is somehow contrasting with the frequent claim that such globalization is a reality for most firms. It is important to remark that we are considering a strict definition of globalization, i.e. sourcing, manufacturing and sales outside the continent, therefore operations outside the country, but within the same continent, are still considered "local" (Cagliano et al., 2008). As a matter of fact, according to the WTO 2009 report, in developed regions (North America, Europe, Asia) that are the majority of our sample, intra-continent trades range from 50% to 70% of the total trades.

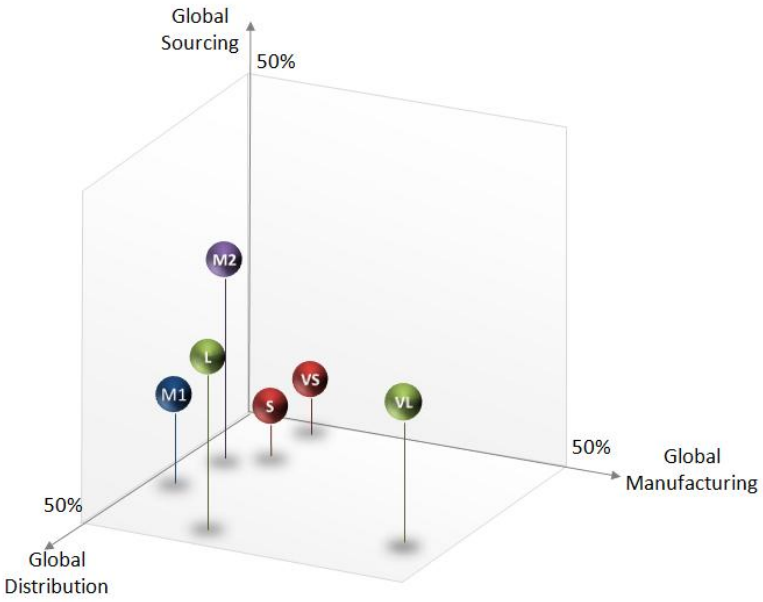
This is also confirmed by case studies: only large companies can reach markets that are far away especially when products are customized. In this case, there can be the need of local sales units to stay in touch with the customers. However, companies selling outside the country but in the same continent (i.e. Europe) show a more mature global SC in terms of multiple-plant production and higher global sourcing (cases M1 and M2). This highlights again that the threshold set in order to define globalization (country or continent) is quite critical for the results obtained.

In order to understand how the 4-configurations model fits our cases, we classified them in the different configurations (Table 14.1). The percentages used - represented also in Figure 14.1 - are in terms of volumes (purchased, manufactured and sold).

Table 14.1 - Classification of the cases into the configurations (percentage are based on volumes purchased, manufactured or sold abroad)

	Global Sourcing	Global Manufacturing	Global Distribution	Configuration
S	Almost 0%	0%	16% Europe	Local
M1	20-25%	0%	50% Europe	European Baron
M2	50%-60%	0%	30% mainly Europe	Shopper
VS	Almost 0%	0%	Almost 0%	Local
VL	25%-30% (target 50%)	Above 50%	Above 50%	Global
L	50%	(30%)	70% global	Global

Figure 14.1 - Graphical representation of the cases on global sourcing, manufacturing and distribution axes



Given their level of global sourcing, manufacturing and distribution, cases S and VS resulted to be Locals. M1 can be considered a European Baron, since it exports a lot in Europe. We classified M2 as a Shopper. VL is a Global and L will be a Global once the new off-shored plant will be set-up.

VL and L differ in their being Globals. VL, in fact, imports WIPs from other plants, while L will just have a "cloned" plant manufacturing end-to-end products. Moreover, VL is not perfectly fitting in the Globals' configuration as its level of global sourcing is still limited.

Given its relevant share of sales in Europe, we classified M1 as a European Baron. No Barons with global sales outside the continent exist among our cases. This can depend on a sample selection, but also on the characteristics of the industry. In fact, in the electric motor industry, the main raw materials are not available in Italy, so companies either use intermediaries (like VS and S) or they easily move to the Shoppers or Globals configurations.

The second interesting evidence is the fact that configurations are mostly determined by the different combinations of global sourcing and sales, while global manufacturing appears only in the Globals configuration (Table 7.3). Comparing this result to those of Cagliano et al. (2008), who identified configurations based only on global sourcing and sales, we observe that our configurations are coherent with those. This is an interesting confirmation of the stability of the configurations based on sourcing and sales, however we provide an additional specification by including also global manufacturing. In particular, our results show that most companies in our sample are characterized by local manufacturing, in particular, not only Locals, but also Shoppers and Barons, while only Globals are characterized by global manufacturing. This is in line with some consolidated patterns of SC globalization, which suggest a gradual approach, in which the first step is usually either sourcing or sales, while generally manufacturing comes afterwards (Bozarth et al., 1998; Chetty and Holm, 2000; Johanson and Wiedersheim-Paul, 1991; Shi and Gregory, 1998).

Our case studies confirm this pattern. As we saw in Table 14.1, there is no configuration characterized by global manufacturing only, since this is generally the most difficult and critical step

and it is implemented only after or together the globalization of sourcing and sales, as, for instance, L is doing.

In the following paragraphs we will take a deeper look to the single SC processes (sourcing, manufacturing and distribution) and then we will focus on the other aspects analyzed, namely SC improvement programs and performance.

15 Global sourcing

In the statistical analysis we measured global sourcing as the percentage of purchases outside the continent where the plant is based finding companies with a low degree of global sourcing (i.e. Locals and Barons) and companies with a high degree (Globals and Shoppers). However, also high adopters never go over 50-60% of global sourcing (Table 7.3) and cases helped in understanding the reasons for this upper-bound limit.

First of all, we saw in Chapter 13.5 (Type of purchases) that it is difficult, especially for smaller companies, to globalize supplies related to outsourced activities or customized products; in other words when the relationship is "captive" or highly "relational".

Another factor motivating the upper-bound limit in global sourcing is risk management. Having all the suppliers far away exposes the company to higher risks of SC disruption. Moreover, some Far East suppliers have grown overtime becoming kind of monopolists. Because of that, as remarked by VL, it is usually better to keep some local suppliers in order to be reactive in case of any issue with suppliers abroad. This aspect, treated already in the risk management literature (Jüttner et al., 2003), has therefore a strong connection with the global sourcing literature.

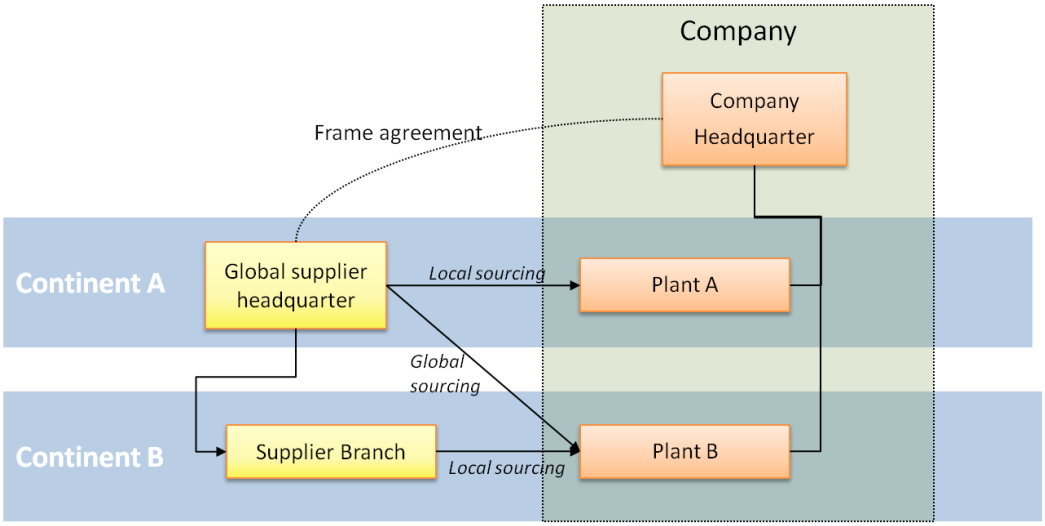
This result contributes to the literature on global sourcing and growth models (Bozarth et al., 1998; Monczka and Trent, 1991). These models say that companies usually move towards higher levels of global sourcing developing progressively the necessary capabilities. We agree with these models, as clearly in our sample we have companies at different stages of global sourcing adoption. However, over a certain threshold, a balance between global and local sourcing must be found, depending on the purchasing categories and risk management policies.

On the other side, we got from data that, on average, also Locals perform some kind of global sourcing. First of all, there might not be availability of materials locally, as for example copper and steel in our cases. This is in line with what Monczka and Trent (1991) say: one of the first motivators to source globally is the local unavailability of some materials. However, this highlights the importance of knowing the GVC when analyzing global sourcing adoption in a certain industry. In fact, a higher adoption of global sourcing might be explained just by local unavailability of suppliers rather than by companies "maturity". Another factor contributing to global sourcing, also for Locals, is that there are some components (e.g. spare parts) that are becoming easier and convenient to buy from abroad (as S told us).

Next, what case VL highlighted is that when there is a complex manufacturing network the sourcing process can be complex too. In the example in Figure 15.1, the company headquarters signs a frame agreement with a global supplier (e.g. a steel producer). Then the supplier ships directly to the Plant A, located in its continent, and to Plant B, located in another continent. In this case Plant A performs a local sourcing even if is within a global frame agreement. In practice, they exploit the advantages of

both global sourcing (e.g. in terms of costs) and local sourcing (e.g. in terms of deliveries). Plant B instead performs global sourcing, "imposed" by the headquarters. If the suppliers instead ships to Plant B through a local branch, in this case Plant B performs a local sourcing, that, however, is again "imposed" by the headquarter. This tells us that the measure of global sourcing used in the survey that is at the plant level, is able to catch the operational concept of global or local sourcing, but not the responsibilities or the strategies in the sourcing localization decision.

Figure 15.1 - Global sourcing models for case VL



Another interesting element brought by case studies is the role of intermediaries. As we have seen, several companies, especially the small ones (VS and S) use intermediaries to procure raw materials and components. In this case the role of intermediaries is clear: companies can exploit the advantages of global sourcing but dealing with local players. In this way they avoid complications related to supplier scouting, transportation management, communication at a global scale. Of course buying from intermediaries has a cost, so bigger companies prefer to deal directly with foreign suppliers. However intermediaries can have also a logistic function. As pointed out by the supplier of permanent magnets (Su2), the value added they provide is not only in procuring permanent magnets from China, but also in keeping a local inventory with a two-months coverage.

We summarized these conclusions in Table 15.1. According to our interviews, sourcing globally can provide a cost advantage to the company, but it involves higher scouting and coordination costs, longer lead times (especially due to transportation) and larger batches. When buying from an intermediary, the company is basically paying more in order to avoid coordination and scouting costs. Lead times can remain long and batch size is related to the possibility for the intermediary to bundle together different customers' orders. Finally, the intermediary can keep locally a stock of material. This can happen when the material is standardized or there are frame agreements with the customers so that the intermediary can buy in advance. In this case there are further advantages: the lead time is shorter and smaller batches are allowed. From the operational point of view, this is like performing a local sourcing.

Table 15.1 - Pros and cons of global sourcing and intermediated models

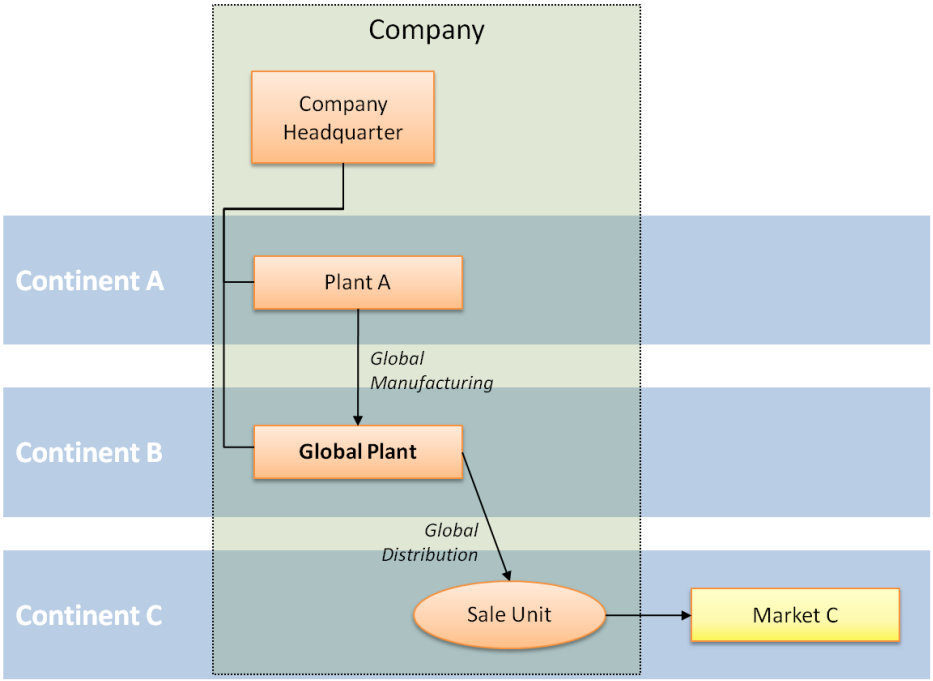
Cost or risk source	Global Sourcing	Intermediary	Intermediary with stock
Cost for material	+	-	-
Scouting and coordination cost	-	+	+
Lead time	-	-	+
Batch size	-	+/-	+

16 Global manufacturing and distribution

Case studies highlighted that global manufacturing is a relevant element to be taken into account also for its effect on global distribution. Cases also shed some light on the role of the sales units (see cases L and VL). Sales or commercial divisions in other countries basically act as customers for the plant and they are essential in the negotiation, design and after sales phases. From the customer perspective, they make the purchase more "local", but this limits the possibility to integrate the SC between the plant and the customers as detailed in the following.

VL, for instance, highlighted the higher complexity (in terms of communication and coordination) that arises when components come from plants abroad. We represented its situation in Figure 16.1. The company has a delocalized Plant A that ships components to the interviewed plant (i.e. Global Plant in the figure). Next, they sell globally through sales unit. Of course, this taxonomy is not exhaustive and it would be probably hard to find a synthetic way to describe all the possible alternatives. What we want to underline here is that the 4-configurations model is more applicable as most companies are single plant. The closer we go to the "global" configuration, where many plants are involved, and the more possible alternative configurations emerge because of different plant roles and the presence of sales units.

Figure 16.1 - Configuration of sales and distribution for a company in the Globals configuration



This complexity is reduced if - like in L or Su1 cases - the off-shored plants build products end-to-end. Because of this, it would be useful to ask in the questionnaire if the companies in our sample performing global manufacturing do have or not some WIP exchanges (i.e. interactions) with other plants.

With this information we could identify sub-configurations of global manufacturing interaction and distribution. These two dimensions are related and we identified three possible situations for multinational companies according to the reason for which the off-shored plant was opened (Table 16.1). If the off-shored plant is specialized in the production of a specific product line globally distributed (see case L), the level of interaction with other plants will be low. If the off-shored plant is opened to serve other plants of the company in other continents (see case VL), both the level of global manufacturing interaction and distribution will be high. Finally, if the off-shored plant is opened to serve a market or follow a customer (see case Su1), the level of global manufacturing interaction and distribution will be both low.

Table 16.1 - Possible configurations of global manufacturing and distribution for multinational companies according to the plant localization advantages.

Plant localization advantages	Case	Global Manufacturing Interaction	Global Distribution
Off-shored plant specialized in the production of a product line	L	Low	High
Off-shored plant opened to serve other plants of the company	VL	High	High
Off-shored plant opened to follow a customer	Su1	Low	Low

Of course the possible situations can be more than the identified ones. However, the important point is that it appears to exist a correlation between the role of the plant as defined by Ferdows (Ferdows, 1997b) and the level of global manufacturing and distribution that was not so evident in the statistical analyses (Table 7.10 and Table 7.11).

17 Configurations characteristics

About the characteristics of the configurations, we found that company size, wealth of the country of origin (Table 7.4), industry (Table 7.5) and role of the plant (Table 7.10 and Table 7.11) are significant contingent variables in determining the global SC configurations.

As far as size is concerned, we found from the survey (Table 7.4) that Globals are significantly larger than both Locals and Shoppers, in line with other contributions (Chetty and Holm, 2000; Shi and Gregory, 1998). It is not surprising that Globals are larger, however it is interesting that Shoppers, i.e. companies that do only global sourcing, are smaller, and very similar to Locals. Also Barons are not significantly different from Locals, therefore we can conclude that today also smaller firms can globalize their SCs, although partially. Case studies confirm this trend. Locals are represented by the smaller companies, medium companies are Shopper and Barons (even if just at the European level), Globals include the two bigger companies.

On the wealth of the country, measured through the GNI per capita, we observed (Table 7.4) that Locals are on average located in lower GNI per capita countries, i.e. in emerging countries, while Barons show the highest average GNI per capita. However we found almost no Barons in our sample of Italian companies. This can be due to the small sample, but also to the fact that the industry pushes companies out from the Barons cluster. In fact, in the electric motor industry, the main raw materials are not available in Italy, so companies either use intermediaries (like VS and S) or they easily move to the Shoppers or Globals configurations.

About the industry, we found in the survey that some configurations are more concentrated in some ISIC codes (Table 7.5). Case studies demonstrated that the industry plays a fundamental role in determining global SC decisions. As seen in Chapter 13.1 (Industry structure), the type of suppliers, their localization and the type of competition drives part of the decisions taken by the companies about their global SCs.

About the strategic advantages provided by the plant (Table 7.10) we found fewer differences than expected and just limited to:

- Proximity to customers: Barons give a lower importance of this advantage, in particular, in comparison with Locals, in line with a configuration which is rooted locally in terms of sourcing and manufacturing, while sales are global. Quite interestingly, even if Shoppers give a high importance of this advantage on average, this difference is not significant compared to other companies due probably to the high variance of this variable among these companies;
- Low cost labor: also for this advantage Barons show the lowest value, again in contrast to Locals and in line with their configuration and strategy. We have already discussed that Barons are located in countries with an higher GNI per capita, and therefore with a higher cost of labor, confirming that this is not their main driver for selecting the location of manufacturing;
- Social and political factors: Barons are the least focused also on this third factor, which is somehow related to the previous since it refers to tax and regulation advantages which can reduce costs. In this case however the difference is in comparison with Shoppers, who instead show that they have chosen their manufacturing location for these reasons, but they need to source from far away.

It is interesting also to notice that all other factors do not show significant differences among the configurations, although this does not mean that they are not relevant. Some of them, in particular, skills and know-how, transportation and logistics, and company image have rather high values, but are very similar across the four groups, suggesting that they have no direct and constant relationship with the global SC configuration. Other reasons, such as proximity to suppliers, low cost materials and competition are quite less important for all configurations.

Case studies helped in understanding that actually a connection exists between the strategic advantages provided by the plant and the configurations, but sometimes it is necessary to consider the whole network rather than the single plant (e.g. Table 16.1).

18 SC improvement programs and performance

Next, in this research we have investigated the moderating effect of global SC configuration on the relationship between the investment on SC improvement programs and performance improvement.

First of all, we found that Locals have the lower adoption of SC improvement programs (Table 8.2). In particular, we found in the data that: Locals invest less than Shoppers on supplier development and distribution strategy; Locals invest less than Barons on coordination with suppliers; Locals invest less than Globals on supplier development.

When looking at the relationship with the performance improvement, we found that (Table 9.4):

- Locals get significant performance improvement on all the performance from coordination with suppliers, supplier development and distribution strategy.
- Barons get significant performance improvement from upstream programs (supply strategy and supplier development) for all the performance but quality.
- Shoppers get significant performance improvement on all the performance by adopting risk management and coordination with suppliers.
- Globals do not show any significant relationship.

We summarized these results in Table 18.1.

Table 18.1 - Synthesis of the significant relationships identified in (Table 9.4). The "V" sign indicates a significant relationship between the performance improvement and the SC improvement program for that cluster.

	Locals			Barons		Shoppers	
	Supplier development	Coordination w/ Suppliers	Distribution strategy	Supply strategy	Supplier development	Coordination w/ Suppliers	Risk management
Cost		V	V		V	V	
Delivery		V	V	V			V
Flexibility	V	V				V	
Lead Time		V	V	V			V
Quality	V			V			V
Inventory Turnover			V	V			V

In conclusion we identified a predominant effect of improvement programs for in the local portions of SCs that can be justified by the major complexity of managing global SCs, which somehow reduces the benefits of improvement programs, or worse discourages companies from investing in that direction. This is in line with some previous contributions that have highlighted the problems and limitations of global SCs, although they have not provided extensive empirical evidence for them (Meixell and Gargeya, 2005; Steinle and Schiele, 2008)

Looking at our cases, these results are only partially confirmed. In order to make possible some comparisons, we mapped our cases in terms of configurations and SC improvement programs (Table 18.2) and configurations and competitive priorities (Table 18.3).

First of all, we found a low adoption of SC improvement programs. This probably depends mainly on the industry. For example Su1, the supplier of metal sheets, told us that among its customers only with few of them there are in place some kind of SC programs, namely dedicated capacity, just-in-time, VMI and co-location. Another reason is that the main suppliers are raw materials suppliers. Usually these companies are big multinational that are not specialized in the electric motor industry

so their willingness to invest in SCM with smaller clients is limited. This is also confirmed by literature: Cagliano et al. (2003) found that companies in the upstream part of the value chain tend to have a lower adoption of integration and eBusiness tools with suppliers.

Table 18.2 - SC improvement programs put in place by cases belonging to different configurations.

	Local (VS, S)	Barons (M1)	Shoppers (M2)	Globals (L, VL)
Supply strategy	Long term and personal relationships	Long term and personal relationships	Long term relationships	Supply base reduction
Supplier development	-	-	-	Vendor rating program, certifications
Coordination w/ Suppliers	-	Frame agreements	Frame agreements	Frame agreements. Exchange of 3, 6 and 12 months forecasts. Electronic kanban.
Distribution strategy	-	Direct sales	Direct sales	Sales units
Coordination w/ Customers	Long term relationships	Frame agreements	Frame agreements	Order tracking. Electronic platform to exchange orders and information.
Risk management	-	Contracts indexed to material price	-	Financial risk hedging. Back-up local suppliers.

Table 18.3 - Competitive priorities pursued by cases belonging to different configurations. (+ : important; ++ : very important)

	Local (VS, S)	Barons (M1)	Shoppers (M2)	Globals (L, VL)
Flexibility	++	++	+	
Delivery speed	++	++	+	
Customization	++	+	++	++
Quality	+	+	+	+
After sales service				++
Price				+
Inventory turnover	+	+		++

Before analyzing the different configurations, we can notice from Table 18.3 that quality is an important competitive priority for all the configurations and this sometimes pushes companies to select local and known suppliers.

As in the survey data, Locals (VS and S) are the less active companies in terms of SC improvement programs, they just rely on long term relationships with suppliers and customers that are made possible by the local SC. The tight relationship with small and local suppliers allows them to be flexible in the production (they usually produce small batches) and be relatively fast in the deliveries. On the other side the closeness to customers facilitates the collaboration during the product design. Nevertheless they do not exploit this situation to implement SCM practices also because their customers do not require them.

M1 represents the Barons. M1 is similar, in terms of SC programs, to the Locals just analyzed. It has long term relationships with a local supplier base, just more formalized through frame agreements and contracts with prices indexed on the raw materials stock markets. In this way they can be flexible and fast in the production. They also sell outside the country keeping a high level of customization thanks to the direct relationship established with customers abroad. However this is easier as customers are mainly located in Europe, otherwise, as M1 confirmed, it would be difficult if they were in other continents.

M2, given its Shopper configuration, is less in touch with its suppliers, but they tend to have long term relationships formalized through frame agreements. They also have frame agreements with customers that are mainly domestic. They in fact focus a lot on service and customization and this made easier by the closeness with the customers as highlighted by M2. Differently from our data, this company does not adopt risk management practices that are instead used by Globals.

Finally, Globals (L and VL) are quite active in implementing SC improvement programs like supply base reduction, vendor rating, supplier certification, frame agreements. They also adopt financial hedging when buying raw materials. However, VL mainly realizes big motors with a very limited series production. Because of that, the possibilities for a strong SC integration with suppliers are limited. L is instead the most active on SC programs implementation also because its production is in higher volumes. They have in place an electronic kanban system with suppliers and a platform to communicate with customers. Despite the high level of globalization they were able to successfully implement these systems with a positive effect on inventories. In order to keep a high level of customization and after sales service, these companies have to support their global distribution through local sales units.

The fact that in the data Globals did not show significant relationships, under the light of the cases, can depend on the many different configurations that Globals can have (Figure 16.1).

19 Contingent variables

Contingent variables have been already used to describe configurations characteristics. Here, however, we focus on the effect of contingent variables on the entire model.

Our analyses provide significant evidence that supports the existence of a strong contingent impact on global SC, SC improvement programs and performance. Literature about global SCM has always considered some contingent variables like the degree of product differentiation, labor content, transportation cost, total volumes (Sweeney, 1994). However in our analysis we found some newer contingencies that have a significant impact on the global SC strategy.

The key result is that companies can compensate the negative impacts of globalization by investing on SCM and, in the end, can be able to keep performance under control. However this result is more or less valid according to different characteristics of the companies.

First of all, we considered global sourcing, upstream SCM investments and inventory performance (Chapter 10.1 - Global Sourcing). We found a complex relationship between the model and the contingent variables. In particular, the model is valid only in some contexts: specifically for larger companies, for companies with a limited number of suppliers, for companies characterized by

ATO/MTS production processes and when purchases are mainly for raw materials. Quite interestingly the model is not completely significant when product complexity is considered.

Results say that larger firms tend to adopt global sourcing and SC investments more than smaller firms and the impact of these variables on material inventory level is stronger for larger companies. This consequence is also related to the capabilities that larger firms may have of copying with higher inventories and their financial implications.

Next companies facing contexts where simple products are managed and manufactured, the only significant relationship is between SC investments and inventory levels, while companies with higher product complexity show a significant relationship between global sourcing and SC investments. These results suggest further investigation in how global sourcing is adopted in contexts characterized by different product complexity.

About the type of production, the model is verified only for one group - i.e., companies based on ATO/MTS production systems. In this case the impact of SC investments is very high (std. estimate is -.318) also considering the strong impact of global sourcing on inventory level. Companies based on ATO/MTS production systems have to pay particular attention to inventory levels also due to the relevant implications of out of stock situations.

After that, the model is significant only for companies that buy mainly raw materials. The impact of global sourcing on inventory level is high (std. estimate is +.167), thus these companies tend to use global sourcing less than companies, mainly buying parts and components.

Finally, the model is verified only for companies with a limited number of suppliers - i.e. less than 100 suppliers. For these companies the impact of SC investments on inventory level is very high (std. estimate is -.214). This means that when only a limited number of suppliers is adopted companies can more easily leverage on SC investments. The total effect of global sourcing on inventory level, even if still positive, is lower than the case for larger firms. This result is particularly interesting since SC investments are not significantly different between the two groups of companies.

When considering global distribution (Chapter 10.2 - Global Distribution), we found again a rather complex relationship between the considered variables, i.e. globalization investment, SC investment and delivery performance.

Companies that invest more in globalization are larger firms, operating in stable contexts and with highly customized production systems. On a second perspective, the relationships between the considered variables change according to the specific group of companies considered. In particular, larger companies tend to invest more on the SC when globalization increases; this is true also for companies operating in uncertain contexts where globalization can be critical. The position of the decoupling point has a significant impact on the relationships between both globalization and SC investments with performance. This result is explained by considering that companies operating in ATO and MTS contexts can find more difficult to keep delivery performance under control on a global scale, due for example to a higher complexity of transportation systems. For the same reason, companies operating in ATO and MTS contexts show also more benefits from SC investments.

In the end our analysis provides significant evidence that support the existence of a strong contingent impact on global SC improvement programs.

What we observed from cases is quite aligned with these results. Basically, the global SC configuration explains only partially the choices in SCM and the performance achieved. In particular, in the electric motor industry that is characterized by:

- Being positioned upstream in the value chain;
- A high incidence of raw material costs and direct work;
- Production mainly PTO/MTO;

the global SC configurations should be analyzed together with the company size, the degree of product customization and the performance pursued. The larger the company and the easier are to be global with more possibilities to implement SC improvement programs together with suppliers and customers. If the product is highly customized or there is a relevant part of after sales service, this induces companies to have closer customers (e.g. M2) or have local sales units (like VL and L). Then the level of SC reactivity (in terms of flexibility and speed) pushes companies to keep local supplier with well established relationships. If the company performs global sourcing, the implementation of some SC improvement programs, like done by L, can be necessary also to keep inventories low.

Interestingly product size does not affect the level of global sourcing or distribution. Components and motors, even the bigger ones, can be easily and economically shipped around the world. The only critical point is the lead time. As the supplier of permanent magnets (Su2) pointed out, also using air transportation requires long lead times if the off-shore supplier produces in MTO (2 months instead of 3 months).

Section F: Conclusions and further developments

As shown in the literature, there are several trade-offs when analyzing global SCs from an Operations Management perspective. Mainly, the number of variables and of their possible values these can take is very high so every model developed so far has some limitations. Some models, for instance, consider only global sourcing (e.g. Monczka and Trent, 1991) or distribution (e.g. Keegan and Green, 2003), others look at the manufacturing network without considering the supply chain (e.g. Ferdows, 1997b).

Given the gaps, we focused our model on the plant as unit of analysis and its SC. Thanks to this positioning we could investigate the entire global SC - namely global sourcing, manufacturing and distribution - and its relationship with SC improvement programs and operational performance.

We gained such results through an international survey and a set of six case studies. The survey includes more than 650 companies from 19 countries operating in the assembly manufacturing industry of different sizes ranging from 50 to 5000 employees. Case studies have been selected, instead, in one single industry (i.e. electric motor industry) in order to fix some parameters and allow an effective comparison among them.

Using a mixed methodology of cases and survey, is reported by literature as a good way to hedge the weaknesses of the different methodologies (Campbell and Fiske, 1998; Creswell, 2009; Jick, 1979). As a matter of fact, quantitative methods like surveys help in the results conceptualization and generalization, while case studies let researchers better understand the whys and connections with the environment surrounding the company (Creswell, 2009). Moreover, given also the focus on globalization, an international survey is particularly suitable to avoid possible country biases (e.g. tariffs, duties, logistics) and thus we could get more reliable and generalizable results.

Another strength of the methodology is that we used the GVC analysis to support our case studies. GVC first of all provides clear understanding of the industry. This helped both in interviewing the companies and interpreting their global SC strategies. Moreover, the GVC analysis provides an effective theoretical framework to generate hypotheses about the relationships between players along the value chain, thus helping the case study research in being more explanatory rather than exploratory.

By means of this mixed methodology we got several results. First of all we identified 4 main configurations of global SC in terms of percentage of global sourcing, manufacturing and sales outside the continent. These configurations have been labeled and defined as follows:

- Locals: characterized by local sourcing, manufacturing and distribution;
- Barons: characterized by local sourcing and manufacturing, global distribution;
- Shoppers: characterized by global sourcing, local manufacturing and distribution;
- Globals: characterized by global sourcing, manufacturing and distribution.

This result provides a contribution to research, since the literature so far has often considered these aspects separately (Prasad and Babbar, 2000), while we have shown that they are strictly interrelated,

although the leading variables in global SC configurations are sourcing and sales, while manufacturing comes afterwards.

We have also shown that these configurations differ in terms of contingent variables, namely size, wealth of the country where the plant is located and localization advantages sought by the plant. In particular, we showed that also smaller firms are starting to globalize, at least in terms of sourcing. Moreover we demonstrated that plant localization advantages - which have been seldom analyzed in relationship with global SC configurations - have a significant effect.

The other result is that the global SC configuration does affect the relationship between SC improvement programs and performance. As a matter of fact, some relationships that are significant for the whole sample become insignificant when considering single groups of companies representing different global SC configurations. At the same time, other relationships that are not significant for the whole sample are significant for one or more configurations. In particular:

- Locals have significant improvements from both upstream (coordination with suppliers, supplier development) and downstream (distribution strategy) investments;
- Barons get significant advantage from only upstream programs (supply strategy and supplier development).
- Shoppers have significant performance improvements by using risk management related investments;
- Globals do not show any significant relationship. Under the light of the cases, this can depend on the many different configurations that Globals can have.

Looking at these results, we observe a predominant effect of improvement programs in the local portions of SCs can be justified by the major complexity of managing global SCs, which somehow reduces the benefits of improvement programs, or worse discourages companies from investing in that direction. This is in line with some previous contributions that have highlighted the problems and limitations of global SCs, although they have not provided extensive empirical evidence for them (Meixell and Gargeya, 2005; Steinle and Schiele, 2008).

We can therefore conclude that the overall SC configuration is a major factor to be considered when evaluating investments in SC improvement programs. This is in line with some previous contributions (Das and Handfield, 1997; Golini and Kalchschmidt, 2010b; Vickery, 1989), but provides a relevant extension. Indeed, previous results focused only on one dimensions of globalization at a time (either sourcing or sales), while in this research we have considered the three dimensions together (sourcing, manufacturing and sales). Besides, previous contributions considered only a very limited set of performance (either inventory or lead time), while in this research we have considered a broad range of performance, covering the whole range of main operational performance (i.e. cost, quality, lead time, flexibility and inventory turnover). Finally, literature focused on specific SC improvement programs (e.g. just-in-time or purchasing organization), while we considered a broad range from internal to external programs with suppliers and customers. Furthermore we took into account risk management programs.

Finally, we got interesting insights from the contingency analysis. These results further contribute to literature about global SC configurations, especially from the Contingency Theory standpoint (Sousa and Voss, 2008). In fact, given a so complex topic, as the one of global SCs, it is important to analyze all the possible factors affecting companies' choices.

Concerning global sourcing, we found that companies can mitigate the negative effect of global sourcing on inventory level by investing in SCM, but this works only for larger companies, for companies with a limited number of suppliers, for companies characterized by ATO (assembly-to-order) and MTS (make-to-stock) production processes and when purchases are mainly for raw materials.

Next, we found that companies can keep also a good delivery performance, in the case of global distribution, if they invest in SCM downstream. In particular, larger companies tend to invest more on the SC when global distribution increases; this is true also for companies operating in uncertain contexts. Finally, ATO and MTS companies can find it more difficult to keep delivery performance under control on a global scale.

We deem our results interesting also for practitioners, since the globalization of SCs is a challenge for most companies. Our results provide some evidence of the different models of globalization that can and are adopted by firms, providing some hints on the characteristics of each of them, which can help managers to define their globalization strategy. Moreover we show which investment in the SC can be more beneficial to improve some performance for companies adopting different configurations and having different characteristics.

About the limitations of this work, cases pointed out that as long as the analyzed company is a single-plant company or it has a simple global manufacturing network, the 4-configurations model appears to be accurate. However, when we apply the model to companies with several production facilities, the model still works in describing the analyzed plant, but it is not able to catch some dynamics typical of multinational companies. For example purchasing centralization or manufacturing network configuration decisions taken in the headquarters can significantly affect the global SC of a plant level. Because of that when analyzing multinational companies, our model should be used jointly with other models in literature (e.g. Ferdows, 1997a).

About the measures, we saw that the threshold used to define what is global and what is local is quite critical. Many U.S. based works (e.g.Cohen and Mallik, 1997; Handfield, 1994) take the United States as a boundary to define what is local and what is global. However, in Europe, where countries are much smaller, it might be necessary to take the inter- or intra- continent as the threshold for local or global flows. Our study is strongly affected by this measure, but it helped to shed some light on the problem. If the focus is to analyze the impact of geographical distances and especially the effect of longer transportation lead times, then a continent boundary - as we did in the survey study - is probably the most correct. If we want instead to analyze some patterns of development of the global SC, than taking an inside/outside the country boundary - as we did in the case studies - is preferable.

Other limitations of this work are related to the dataset that includes companies only from the manufacturing industry, even if the ISIC code range is relatively wide. Anyway different outcomes could be found in other types of industries, for example, process industries.

Moreover only some contingency variables were considered and they have been analyzed separately without considering joint effects.

Further developments of this work are connected to its actual limitations. First of all we could try to use a different measure for globalization, for example inside/outside the country instead of the continent. Next, the 4-configurations model could be extended in order to be better applicable to multinational companies. In particular, the model works well to describe what happens at the plant

level, but it should be extended to catch what happens at the network level. Next a deeper investigation into data and cases could highlight configurations different from the four identified and other meaningful contingencies. Moreover, it would be interesting to test the model in other industries. Finally, since contingent variables can have joint effects, e.g. a higher complexity product could be related to a higher number of suppliers, studying moderating effects could be beneficial to find further evidences.

Looking with a wider perspective on the topic, global SC management is a complex and evolving field. Much literature has been produced on the topic with different perspectives, but still many gaps exist. However it is important that research continues to investigate this phenomenon, not only for companies' performance, but also for the economy in general and the society. This is even truer looking at the recent facts. First of all, the economical crisis put in light the weaknesses of global SCs and recently many companies back-sourced in their home country. On the other side, linking to global value chains, especially those passing through China, seems the only way for many European countries to recover from the downturn. From the company perspective, this means that globalization is not a one-way strategy, but companies should take decisions looking at the geo-political context and balancing opportunities, costs and risks. The topic of global SC risk management, little investigated so far, could be very beneficial in this way. Another recent fact is the social and scientific concern for sustainability. This topic is tightly connected to global SCs. First of all, global supply chains imply transportation and use of packaging, both with significant environmental impacts. Moreover, in global SCs managing reverse logistics can pose several issues. Research should definitely take into account this aspect in order to find ways to reduce their impact. Next, there are economical and social sustainability aspects. Multinational companies can, in fact, with their global SC strategies, affect the economies and the wealth of societies. Traditional managerial models for managing global SCs should thus be integrated with Corporate Social Responsibility aspects.

As we can see here, the study of global SC is a multidisciplinary topic and significant benefits could come from integrating different perspectives. In this work, for example we tried to integrate the Global Value Chain analysis that traditionally comes from another field of research. Given the positive outcomes got, I would recommend for future researches, especially in the global SC field, to be open to new experiences and perspectives.

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Appendixes

IMSS questionnaire

Interview protocol for case studies

International Manufacturing Strategy Survey

Fifth Edition - 2009

International Manufacturing Strategy Survey

Fifth Edition – 2009

This survey is designed to explore and identify the manufacturing strategies, practices and performance of manufacturing firms around the world during 2008.

The survey is divided into three sections:

SECTION A Description, strategy and performance of the business unit
SECTION B Description, strategy and performance of the dominant activity of the plant
SECTION C Current manufacturing and supply chain practices, and past action programs

Questions should be answered by the Director of Operations/Manufacturing (or equivalent).

If you cannot answer a question, please leave it blank and go to the next one.

Results will be distributed in 2010.

All responses will be treated with ABSOLUTE CONFIDENTIALITY. The names of companies, business units, products or individuals will not be released!

MANY THANKS FOR YOUR COOPERATION!

Please provide the following information:

The name of the business unit: _____

Please tick the industry code that best describes the activities of your business unit:

- ☐ 28 - Manufacture of fabricated metal products, except machinery and equipment
- ☐ 29 - Manufacture of machinery and equipment not elsewhere classified
- ☐ 30 - Manufacture of office, accounting and computing machinery
- ☐ 31 - Manufacture of electrical machinery and apparatus not elsewhere classified
- ☐ 32 - Manufacture of radio, television and communication equipment and apparatus
- ☐ 33 - Manufacture of medical, precision and optical instruments, watches and clocks
- ☐ 34 - Manufacture of motor vehicles, trailers and semi-trailers
- ☐ 35 - Manufacture of other transport equipment

Country: _____

Your name: _____

Your email address: _____ Your phone number: _____

What is your job title? _____

How long have you been working in this company? (number of years) _____

How long have you been working in operations/manufacturing in this company? (number of years) _____

Please return this questionnaire to:

Section A

Description, strategy and performance of the business unit

Description of the business unit

A1.What are the name, origin, size and sales of the business unit your plant belongs to?

Name_____ Origin (headquarters' country) _____

Size of the business unit (# of employees): _____Total sales of the business unit - currency _____ figure _____

A2. How do you perceive the following characteristics?

Market dynamics	Declining rapidly	1	2	3	4	5	Growing rapidly
Market span	Few segments	1	2	3	4	5	Many segments
Product focus	Physical attributes	1	2	3	4	5	Service emphasis
Geographical focus	National	1	2	3	4	5	International
Competition intensity	Low intensity	1	2	3	4	5	High intensity
Market concentration	Few competitors	1	2	3	4	5	Many competitors
Market entry	Closed to new players	1	2	3	4	5	Open to new players

A3. Please indicate what characterizes technological change in your business:

Logistic processes change	Slowly	1	2	3	4	5	Rapidly
Core production processes change	Slowly	1	2	3	4	5	Rapidly
Products become obsolete	Hardly ever	1	2	3	4	5	Frequently
New product are introduced	Hardly ever	1	2	3	4	5	Frequently

The business unit's competitive strategy

A4.Consider the importance of the following attributes to win orders from your major customers.

	Importance in the last three years				
	Not important				**Very important**
Lower selling prices	1	2	3	4	5
Superior product design and quality	1	2	3	4	5
Superior conformance to customer specifications	1	2	3	4	5
More dependable deliveries	1	2	3	4	5
Faster deliveries	1	2	3	4	5
Superior customer service (after-sales and/or technical support)	1	2	3	4	5
Wider product range	1	2	3	4	5
Offer new products more frequently	1	2	3	4	5
Offer products that are more innovative	1	2	3	4	5
Greater order size flexibility	1	2	3	4	5
Environmentally sound products and processes	1	2	3	4	5
Committed social responsibility	1	2	3	4	5

Business unit performance

A5. What is the current business unit performance? For market share indicate average in market(s) served by the business unit.

	Compared to three years ago the indicator has:					*Relative to our main competitor(s), our performance is:*				
	deteriorated more than 5%	stayed about the same -5%/+5%	improved 5%-15%	improved 15%-25%	improved more than 25%	much worse		equal		much better
Sales	1	2	3	4	5	1	2	3	4	5
Market share	1	2	3	4	5	1	2	3	4	5
Return on sales (ROS)[1]	1	2	3	4	5	1	2	3	4	5
Return on investment (ROI)[2]	1	2	3	4	5	1	2	3	4	5

1 ROS = Earnings before interests and taxes / Sales *2 ROI = Earnings before interests and taxes / Total assets*

A6. Approximately what proportion of the business unit annual sales is invested in (average % of total sales):

% Research and development	% Process equipment	% Training and education
_____ %	_____ %	_____ %

Organization of the plant

*O1. How many organizational levels do you have (from plant manager to blue collar workers included)?*_____

O2. How many employees are under the responsibility of one of your line supervisors (on average)?

_____ in Fabrication _____ in Assembly

O3. At the end of the last fiscal year, you had:

a. _____ Number of shop-floor employees, of which:

b. _____ % are permanent workers

_____ % are long term (i.e. yearly) temporary workers

_____ % are medium term (i.e. monthly, seasonal) temporary workers

_____ % are short term (i.e. weekly) temporary workers

Total **100 %**

O4. a. On average, what proportion of your shop-floor employees' compensation is based on incentives?

_____% of compensation

b. Indicate the usage of incentives (select all relevant alternatives):

☐ Work Group incentive ☐ Individual incentive ☐ Companywide incentive

O5. To what extent are employees involved in product or process improvement initiatives?

No involvement 1 2 3 4 5 Continuous, deep involvement

O6. What proportion of your total workforce works in teams?

In functional teams _____ % In cross-functional teams _____ %

O7. How many hours of training per year are given to the regular work-force? _____ hours per employee

O8. How many of your production workers do you consider as being multi-skilled[1]? _____ % of the production workers

1 A multi-skilled operator is skilled in several operational tasks.

O9. How frequently do your production workers rotate between jobs or tasks?

Never 1 2 3 4 5 Very frequently

O10. To what extent is your workforce autonomous in performing tasks?

No autonomy (only execution) 1 2 3 4 5 High autonomy (planning, execution and control)

O11. Indicate the effort put into implementing the following action programs in the last three years.

	Effort in the last three years				
	None				High
Increasing the level of delegation and knowledge of your workforce (e.g. empowerment, training, autonomous teams)	1	2	3	4	5
Implementing the lean organization model by e.g. reducing the number of levels and broadening the span of control	1	2	3	4	5
Implementing continuous improvement programs through systematic initiatives (e.g. kaizen, improvement teams)	1	2	3	4	5
Increasing the level of workforce flexibility following your business unit's competitive strategy (e.g. temporary workers, part time, job sharing, variable working hours)	1	2	3	4	5
Enhancing corporate reputation through firm's direct contribution and other campaigns (e.g., employment, safety, work conditions, corporate social activities, support community projects)	1	2	3	4	5

Shifting manufacturing towards services

S1. To what extent does your business unit/plant offer the following services alongside with the products?

	None				High
Maintenance of products sold to customers	1	2	3	4	5
'Power-by-the-hour' (total responsibility for the product, including spare parts and maintenance)	1	2	3	4	5
Product upgrades (software, product modifications)	1	2	3	4	5
Help desk/customer support centre	1	2	3	4	5
Training in using the products	1	2	3	4	5
Repairs	1	2	3	4	5
Spare-parts	1	2	3	4	5

S2. How much of your turnover is based on sales of:

Parts and components	Assembled products	Service coming with the products (e.g. installation, maintenance, upgrades)	**Total**
_____ %	_____ %	_____ %	**100 %**

S3. Indicate the effort put into implementing the following action programs in the last three years.

	Effort in the last three years				
	None				**High**
Our company actively engages in expanding the service offering to our customers (e.g. by investing in new service development)	1	2	3	4	5
We are actively developing the skills in the organization needed to improve the service offering	1	2	3	4	5
We deliberately design products so that the after sales service is easier to manage/offer (e.g. by using design for manufacturing/assembly/maintenance/service)	1	2	3	4	5

Section B

Description, strategy and performance of manufacturing for the dominant activity of the plant

From now on, please refer always to the dominant activity of your plant. Dominant activity refers to the most important activity, which is considered to best represent the plant.

Description of the plant's dominant activity

B1. Describe the most important product of your plant: _____

B2. How would you describe the complexity of the dominant activity?

Modular product design	1	2	3	4	5	Integrated product design
Single manufactured components	1	2	3	4	5	Finished assembled products
Very few parts/materials, one-line bill of material	1	2	3	4	5	Many parts/materials, complex bill of material
Very few steps/operations required	1	2	3	4	5	Many steps/operations required

B3. Indicate the percentage of sales represented by the dominant activity: _____ %

B4. Estimate the present cost structure in manufacturing (percentages should add up to 100 %).

Direct salaries/wages	Manufacturing overheads[1]	Outsourced/contract work[2]	Direct materials/parts/ components	**Total**
_____ %	_____ %	_____ %	_____ %	**100 %**

1 Manufacturing overheads include salaries within design, planning and maintenance, and of indirect personnel in production, but exclude costs such as administration and sales.

2 Outsourced/contract work is all work performed outside the company, but necessary for and incorporated into the final products.

B5. To what extent does your organization have a structured manufacturing strategy formulation process in place?

Not at all	1	2	3	4	5	To a very large extent

Role of the plant's dominant activity

B6. The strategic role of the plant's dominant activity is (if there are other plants with the same dominant activity in the company, consider the role of this plant relative to the other plant (s)):

To get the products produced. Managerial investment in the plant is focused on running the plant efficiently.	To have sufficient internal capabilities to develop and improve its own components, products and production processes	To develop specific important components, products or production processes, also for other plants.	To develop and contribute know-how for the whole company.	To be a "center of excellence" for building strategic capabilities in the manufacturing function.
1	2	3	4	5

B7. What is the importance of the following advantages provided by the location of the plant?

	None				High
Proximity to suppliers	1	2	3	4	5
Availability of low cost labor	1	2	3	4	5
Availability of low cost material and/or energy sources	1	2	3	4	5
Availability of skills and know-how	1	2	3	4	5
Access to transportation & logistic facilities	1	2	3	4	5
Proximity to customers	1	2	3	4	5
Social and political factors (e.g. tax advantages, incentives, regulation)	1	2	3	4	5
Competition (e.g. to be close to competitors or to prevent them from settling in the area)	1	2	3	4	5
Company image (e.g. Made In…, social acceptance, reputation)	1	2	3	4	5

Manufacturing process design

B8. To what extent do you use the following process types (% of volume)? (percentages should add up to 100%):

One of a kind production	Batch production	Mass production	Total
_____ %	_____ %	_____ %	100 %

B9. What proportion of your customer orders are (percentages should add up to 100 %):

Designed/ engineered to order	Manufactured to order	Assembled to order	Produced to stock	Total
_____ %	_____ %	_____ %	_____ %	100 %

Manufacturing performance

B10. How has your operational performance changed over the last three years? How does your current performance compare with main competitor(s)[1]?

Compared to three years ago the indicator has						Relative to our main competitors, our performance is				
deteriorated more than 5%	stayed about the same -5%/+5%	improved 5%-15%	improved 15%-25%	improved more than 25%		much worse		equal		much better
1	2	3	4	5	Manufacturing conformance	1	2	3	4	5
1	2	3	4	5	Product quality and reliability	1	2	3	4	5
1	2	3	4	5	Product customization ability	1	2	3	4	5
1	2	3	4	5	Volume flexibility	1	2	3	4	5
1	2	3	4	5	Mix flexibility	1	2	3	4	5
1	2	3	4	5	Time to market	1	2	3	4	5
1	2	3	4	5	Product innovativeness	1	2	3	4	5
1	2	3	4	5	Customer service and support	1	2	3	4	5
1	2	3	4	5	Delivery speed	1	2	3	4	5
1	2	3	4	5	Delivery reliability	1	2	3	4	5
1	2	3	4	5	Unit manufacturing cost	1	2	3	4	5
1	2	3	4	5	Procurement costs	1	2	3	4	5
1	2	3	4	5	Manufacturing lead time	1	2	3	4	5
1	2	3	4	5	Procurement lead time	1	2	3	4	5
1	2	3	4	5	Labor productivity	1	2	3	4	5
1	2	3	4	5	Inventory turnover	1	2	3	4	5
1	2	3	4	5	Capacity utilization	1	2	3	4	5
1	2	3	4	5	Manufacturing overhead costs	1	2	3	4	5
1	2	3	4	5	Employee satisfaction	1	2	3	4	5
1	2	3	4	5	Employee knowledge	1	2	3	4	5
1	2	3	4	5	Environmental performance	1	2	3	4	5
1	2	3	4	5	Social reputation	1	2	3	4	5

1 Consider the average performance of the group of competitors that are the direct benchmark for the plant

B11. What is the current performance level on the following dimensions?

Throughput time efficiency (the time the products are worked on as a % of the total manufacturing lead time)? _____%

Late deliveries to customers (as percentage of orders delivered)? _____%

Scrap and rework costs (as percentage of sales) _____%

Customer complaints (as percentage of orders delivered) _____%

Section C

Current manufacturing and supply chain practices, and past action programs[1]

1 By action program we mean a major project involving considerable effort and changes in the company's management practices and organization

Remember to answer considering the plant's dominant activity identified in the previous section.

Planning and control of the plant's dominant activity

PC1. How do you cope with demand fluctuations?

	Degree of use				
	None				High
Slack and redundancies (e.g. inventories, equipment overcapacity)	1	2	3	4	5
Outsourcing of production capacity	1	2	3	4	5
Workforce flexibility (e.g. flexible working hours, temporary workers, overtime)	1	2	3	4	5
Leveling production plan	1	2	3	4	5

PC2. Production orders are planned through (tick one):

☐ Push systems (e.g. MRP) ☐ Pull systems (e.g. kanban, replenishment) ☐ Bottleneck (Theory of Constraints)

PC3. How many days of production (on average) do you carry in the following inventories:

_____ Raw material/components _____ Work-in-process _____ Finished goods

PC4. Indicate degree of the following action programs undertaken in the last three years.

	Effort in the last three years				
	None				High
Expanding manufacturing capacity (e.g. buying new machines; hiring new people; building new facilities)	1	2	3	4	5
Restructuring manufacturing processes and layout to obtain process focus and streamlining (e.g. reorganize plant-within-a-plant; cellular layout)	1	2	3	4	5
Undertaking actions to implement pull production (e.g. reducing batches, setup time, using kanban systems)	1	2	3	4	5

Technology of the plant's dominant activity

T1. How advanced is the core process technology of your dominant activity?

Mostly manual operations, using hand tools and/or manually operated general purpose machine tools and handling/transportation equipment	1	2	3	4	5	Most operations are done by highly automated machine tools and handling/transportation equipment (computer-controlled machines, robots, automated guided vehicles)
Mostly stand alone machines	1	2	3	4	5	Fully integrated systems (e.g. flexible manufacturing cells/systems)
No information system supporting process monitoring and control	1	2	3	4	5	The overall process is monitored and controlled in real time by a dedicated information system

T2. Indicate the effort put into implementing the following action programs in the last three years.

	Effort in the last three years				
	None				High
Engaging in process automation programs (e.g. automated parts loading/unloading, automated guided vehicles, automated storage systems)	1	2	3	4	5
Engaging in flexible manufacturing/assembly systems - cells programs (FMS/FAS/FMC)	1	2	3	4	5
Engaging in product/part tracking and tracing programs (bar codes, RFID)	1	2	3	4	5
Implementing ICT supporting information sharing and process control in production	1	2	3	4	5

Quality of the plant's dominant activity

Q1. What is the approximate proportion of quality costs (the percentages should add up to 100 %)?

Inspection/control costs (sampling, supervision, lab tests)	_____ %
Internal quality costs (e.g. scrap, losses)	_____ %
Preventive costs (training, documentation, preventive maintenance, etc.)	_____ %
External quality costs (e.g. warranty costs, returns, etc.)	_____ %
	100 %

Q2. Indicate the effort put into implementing the following action programs in the last three years.

	Effort in the last three years				
	None				High
Quality improvement and control (e.g. TQM programs, six sigma projects, quality circles)	1	2	3	4	5
Improving equipment productivity (e.g. Total Productive Maintenance programs)	1	2	3	4	5
Utilizing better measurement systems for self-assessment and benchmarking purposes	1	2	3	4	5
Improving the environmental performance of processes and products (e.g. environmental management system, Life-Cycle Analysis, Design for Environment, environmental certification)	1	2	3	4	5
Increasing the control of product quality along the supply chain (raw materials and components certification, supplier audit, product integrity in distribution, etc.)	1	2	3	4	5
Monitoring corporate social responsibility of partners along the supply chain (e.g. labor conditions)	1	2	3	4	5

Product development of the plant's dominant activity

PD1. How do you technologically coordinate design and manufacturing?

	No use				High use
CAD/CAM software	1	2	3	4	5
Enterprise resource planning systems (ERP)	1	2	3	4	5
Shared databases	1	2	3	4	5
Design for manufacturing/assembly/...	1	2	3	4	5
Failure Mode and Effect Analysis (FMEA)	1	2	3	4	5
Quality Function Deployment (QFD)	1	2	3	4	5
Web based tools (teleconferencing, web-meetings, ...)	1	2	3	4	5
Rapid prototyping	1	2	3	4	5

PD2. How do you organizationally coordinate design and manufacturing?

	No use				High use
Rules and standards	1	2	3	4	5
Formal meetings	1	2	3	4	5
Standard process (e.g. stage gate model)	1	2	3	4	5
Concurrent engineering (i.e. overlapping product and process design)	1	2	3	4	5
Informal discussions and communication	1	2	3	4	5
Cross-functional or multi-skilled teams	1	2	3	4	5
Job rotation between design and manufacturing	1	2	3	4	5
Co-location of design engineers and manufacturing managers	1	2	3	4	5
Liaison roles (i.e. people in charge of ensuring coordination)	1	2	3	4	5

PD3. Indicate the effort put into implementing the following action programs in the last three years.

	Effort in the last three years				
	None				High
Increasing design integration between product development and manufacturing through e.g. platform design, standardization and modularization, design for manufacturing, design for assembly	1	2	3	4	5
Increasing the organizational integration between product development and manufacturing through e.g. teamwork, job rotation and co-location	1	2	3	4	5
Increasing the technological integration between product development and manufacturing through e.g. CAD-CAM, CAPP, CAE, Product Lifecycle Management	1	2	3	4	5
Improving the environmental impact of products by appropriate design measures, e.g. design to recycle	1	2	3	4	5

Supply chain of the plant's dominant activity

This section refers to your suppliers of the materials, parts, or components that are used in your dominant activity production system to produce/assemble your final product.

SC1. What is the percentage of spending on the following categories of goods purchased (your answers should add up to 100%)?

Raw materials	Parts/components	Subassemblies/systems	**Total**
_____ %	_____ %	_____ %	**100 %**

SC2. Indicate the following supplier figures:

Total number of suppliers _____ Average number of suppliers per item _____ Proportion of suppliers considered as key/strategic suppliers _____%

SC3. What criteria do you use for selecting your key/strategic suppliers? Specify the level of importance of each criterion.

	None				**High**
Lowest price bid	1	2	3	4	5
Delivery performance (reliability, speed, flexibility)	1	2	3	4	5
Quality of products/services offered	1	2	3	4	5
Logistical costs (transportation, storage and handling)	1	2	3	4	5
Ability to provide innovation and co-design	1	2	3	4	5
Physical proximity to/within region (local sourcing)	1	2	3	4	5
Willingness to disclose cost/other information	1	2	3	4	5
Evaluation of supplier potential (development programs or past performance record)	1	2	3	4	5

This section refers to your direct customers

SC4. Indicate the percentage of sales in the following categories of customers (your answers should add up to 100%):

Manufacturers of subassemblies	Manufacturers of finished products	Wholesalers / distributors	End users	**Total**
_____ %	_____ %	_____ %	_____ %	**100 %**

SC5. Indicate the following figures:

Total number of customers: _____ Proportion of customers considered as key/strategic customers: _____ %

SC6. To what extent do you agree with the following statements?

	Not at all				**To a great extent**
Our master production schedule has a high percentage of variation in demand.	1	2	3	4	5
Our demand fluctuates drastically from week to week.	1	2	3	4	5
Our supply requirements vary drastically from week to week.	1	2	3	4	5

From now on, please refer to your key/strategic suppliers and customers.

SC7. How do you coordinate planning decisions and flow of goods with your key/strategic suppliers and customers?

Adoption with suppliers						**Adoption with customers**				
None				**High**		**None**				**High**
1	2	3	4	5	Share inventory level information	1	2	3	4	5
1	2	3	4	5	Share production planning and demand forecast information	1	2	3	4	5
1	2	3	4	5	Order tracking/tracing	1	2	3	4	5
1	2	3	4	5	Agreements on delivery frequency	1	2	3	4	5
1	2	3	4	5	Dedicated capacity	1	2	3	4	5
1	2	3	4	5	Vendor managed inventory or consignment stock	1	2	3	4	5
1	2	3	4	5	Plan, forecast and replenish collaboratively	1	2	3	4	5
1	2	3	4	5	Just-in-time replenishment (e.g. kanban)	1	2	3	4	5
1	2	3	4	5	Physical integration within the same plant	1	2	3	4	5

SC8. Indicate to what extent you use electronic tools with your key/strategic suppliers and customers for the following.

Adoption with suppliers						**Adoption with customers**				
None				**High**		**None**				**High**
1	2	3	4	5	Scouting/ pre-qualify	1	2	3	4	5
1	2	3	4	5	Auctions	1	2	3	4	5
1	2	3	4	5	RFx (request for quotation, proposal, information)	1	2	3	4	5
1	2	3	4	5	Data analysis (audit and reporting)	1	2	3	4	5
1	2	3	4	5	Order management and tracking	1	2	3	4	5
1	2	3	4	5	Contract and document management	1	2	3	4	5

SC9. Indicate the effort put into implementing the following action programs in the last three years.

	Effort in the last three years				
	None				High
Rethinking and restructuring supply strategy and the organization and management of supplier portfolio through e.g. tiered networks, bundled outsourcing, and supply base reduction	1	2	3	4	5
Implementing supplier development and vendor rating programs	1	2	3	4	5
Increasing the level of coordination of planning decisions and flow of goods with suppliers including dedicated investments (e.g. information systems, dedicated capacity/tools/ equipment, dedicated workforce)	1	2	3	4	5
Rethinking and restructuring distribution strategy in order to change the level of intermediation (e.g. using direct selling, demand aggregators, multi-echelon chains)	1	2	3	4	5
Increasing the level of coordination of planning decisions and flow of goods with customers including dedicated investments (e.g. information systems, dedicated capacity/tools/ equipment, dedicated workforce)	1	2	3	4	5
Improving the environmental impact generated by transportation of materials/products and outsourcing of process steps	1	2	3	4	5
Implementing supply chain risk management practices including early warning system, effective contingency programs for possible supply chain disruptions	1	2	3	4	5

Globalization of the plant's dominant activity

G1. Where do you source the raw materials, parts/components, subassemblies/systems and manufacture and sell the finished products/services resulting from your plant's dominant activity (answers should add up to 100%):

	Sourcing	Manufacturing[1]	Sales
This country	_____ %	_____ %	_____ %
Within your continent	_____ %	_____ %	_____ %
Outside your continent	_____ %	_____ %	_____ %
Total	**100 %**	**100 %**	**100 %**

1 In case there are other plants in your company involved in your plant's dominant activity

G2. Have you moved or established part of your own production activities outside your country? ☐ Yes ☐ No

If yes, what was the importance of the following reasons?

	Within your continent					Outside your continent				
	None				High	None				High
Proximity to suppliers	1	2	3	4	5	1	2	3	4	5
Availability of low cost labor	1	2	3	4	5	1	2	3	4	5
Availability of low cost material and/or energy sources	1	2	3	4	5	1	2	3	4	5
Availability of skills and know-how	1	2	3	4	5	1	2	3	4	5
Access to transportation & logistics facilities	1	2	3	4	5	1	2	3	4	5
Proximity to customers	1	2	3	4	5	1	2	3	4	5
Social and political factors (e.g. tax advantages, regulation)	1	2	3	4	5	1	2	3	4	5
Competition (e.g. to be close to competitors or to prevent them from settling in the area)	1	2	3	4	5	1	2	3	4	5
Company image (e.g. Made In…, social acceptance, reputation)	1	2	3	4	5	1	2	3	4	5

G3. Indicate the effort put into implementing the following action programs in the last three years.

	Effort in the last three years				
	None				High
Increasing the level of globalization of the production network (i.e. shifting production activities to off-shored plants)	1	2	3	4	5
Increasing the level of globalization of sourcing	1	2	3	4	5
Increasing the level of globalization of sales	1	2	3	4	5
Increasing the level of globalization in product design and new component parts development	1	2	3	4	5

Thank you for your help!

Global Supply Chain Strategies Research Project

Protocollo di intervista

1 Informazioni generali

1. Nome dell'impresa:
2. Nome della persona intervistata:
3. Ruolo, funzioni:
4. Da quanto tempo la persona lavora in azienda:
5. Da quanto tempo la persona occupa la posizione:
6. Stato giuridico:
7. Gruppo di appartenenza:
8. Numero di dipendenti:
9. Settore di appartenenza:
   28 – Produzione di prodotti in metallo, esclusi macchinari e attrezzature
   29 – Produzione di macchinari e attrezzature che non rientrano in altre categorie, inclusi elettrodomestici
   30 – Produzione di macchinari per uffici, contabilità e calcolo (ad es. computer, fotocopiatrici, ecc.)
   31 – Produzione di macchinari elettrici ed apparati che non rientrano in altre categorie, inclusa illuminazione
   32 – Produzione di attrezzature e apparati radio, televisivi e di comunicazione
   33 – Produzione di strumenti medici, ottici e di precisione, orologi
   34 – Produzione di veicoli a motore, rimorchi e semi-rimorchi (ad es. automobili, autocarri, ecc.)
   35 – Produzione di altri mezzi di trasporto, incluse biciclette, moto, navi, aerei, treni
10. Tipologie di prodotti:

2 Prodotto

2.1 Descrizione del prodotto

1. Modulare/integrato
2. Numero di fasi di produzione
3. Numero di componenti
4. Intensità tecnologica
5. Peso-Volume
6. Prezzo
7. Volumi annui
8. Struttura dei costi
   a. Lavoro
   b. Materiali/componenti
   c. Ammortamenti (capital intensive)
9. Tecnologia di produzione (avanzata/base)

10. Diversità geografica
11. Personalizzazione
12. Rilevanza dei servizi
13. Tipologia di produzione (ETO, MTO, ATO, MTS)

2.2 Fattori critici di successo

1. Prezzi di vendita inferiori
2. Differenziazione
    a. Design e qualità di prodotto superiore
    b. Conformità alle specifiche del cliente superiore
    c. Consegne più puntuali
    d. Consegne più veloci
    e. Assistenza al cliente superiore (post vendita e/o supporto tecnico)
    f. Gamma di prodotti più ampia
    g. Offrire nuovi prodotti più frequentemente
    h. Offrire prodotti più innovativi
    i. Flessibilità nella dimensione degli ordini maggiore
3. Prodotti e processi ecocompatibili
4. Impegno sulla responsabilità sociale

3 Livello Corporate

3.1 Business environment

3.1.1 Fattori di mercato

1. Dinamica del mercato
2. Ampiezza di mercato
3. Focalizzazione sui prodotti
4. Focalizzazione geografica
5. Intensità della concorrenza
6. Concentrazione di mercato
7. Ingresso nel mercato

3.1.2 Fattori di supply chain

1. Chi sono i fornitori principali?
2. Chi sono i clienti principali?
3. Chi è la focal firm?
4. Chi detiene il potere nella supply chain?

3.2 Supply Chain Strategy

3.2.1 Configurazione

Strategia di global sourcing

1. Quanto sono centralizzate nell'headquarter le attività di:
    a. Attività di ricerca, selezione, negoziazione e stesura del contratto con i fornitori principali
    b. Attività di emissione dell'ordine, ricevimento della merce, fatturazione
2. Quanto si persegue una strategia di global sourcing (ricerca di fornitori distanti)
3. Quali sono i driver principali

Strategia di global manufacturing

4. Descrivere il network di manufacturing e i flussi di prodotti (evidenziando se si tratta di una struttura orizzontale o verticale e le attività nei diversi plant)

5. Quanto è forte il ricorso all'outsourcing
6. La strategia dell'azienda prevede di ridurre il ricorso all'outsourcing?
7. La strategia dell'azienda prevede di ridurre il ricorso all'off-shoring?
8. Qual è l'importanza dei driver nella scelta della localizzazione
    a. Disponibilità input produttivi a basso costo (materie prime, componenti, ecc..)
    b. Disponibilità di forza lavoro a basso costo
    c. Accesso a risorse umane e competenze pregiate (managers, tecnologie, know how, ecc.)
    d. Conquista di nuovi mercati, espansione quote di mercato
    e. Accesso ad assets strategici (reti locali di fornitura o distribuzione, acquisizione di un fornitore, di un concorrente o di un partner commerciale con assets strategici da integrare ecc.)
    f. Miglioramento dell'efficienza (accesso a infrastrutture con rapporto vantaggioso qualità-costi, ricerca di economie di scala e di specializzazione, necessità di abbattere costi di trasporto, transazione commerciale, barriere tecniche e tariffarie,ecc.)
    g. Necessità di seguire il cliente
    h. Necessità di emulare i leader di mercato

Strategia di global distribution

9. Quanto sono centralizzate nell'headquarter le attività di:

   a. Attività di ricerca, selezione, negoziazione e stesura del contratto con i clienti principali
   b. Attività di ricezione e processamento dell'ordine, spedizione della merce, fatturazione, stoccaggio
10. Quanto si persegue una strategia di global distribution
11. Quali sono i driver principali

3.2.2 Domande di collegamento

1. Come le caratteristiche del prodotto (es. modularità, struttura dei costi, etc.) hanno influenzato la global supply chain strategy?
2. Come le caratteristiche del business (es. competizione) hanno influenzato la global supply chain strategy?
3. Quanto le attività di sourcing-manufacturing-distribution sono interconnesse tra loro?
4. Quali sono le sinergie e i vantaggi competitivi ricercati nella definizione delle diverse fasi?
5. I competitor adottano strategie differenti?

3.3 Prestazioni

3.3.1 Corporate

1. Fatturato:
2. Percentuale all'estero del fatturato:
3. Tasso di crescita del fatturato negli ultimi 3 anni:
4. ROS:
5. ROI:

3.3.2 Supply chain

1. Capacità di strutturare un network efficace (per servire al meglio i clienti a costo di duplicazioni nelle attività)
2. Capacità di strutturare un network efficiente
3. Capacità di condividere le best practices all'interno del network
4. Capacità di sviluppare partnership globali
5. Gestione efficiente dei flussi produttivi

3.3.3 Domande di collegamento

1. Quanto le prestazioni corporate sono state dovute ad una buona global supply chain strategy (ossia qual è la relazioni tra prestazioni corporate di supply chain)?

4 Livello Plant

4.1 Supply chain management

4.1.1 Configurazione

1. Quanto i plant fanno ricorso a fornitori globali e distanti geograficamente?

2. Quanto – al contratio - i plant fanno ricorso a fornitori locali o in co-location?
3. Quanto i plant fanno ricorso ad outsourcing? È outsourcing globale o locale?
4. Quanto i plant servono mercati geograficamente lontani?
5. Quanto al contrario i plant servono mercati o clienti vicini?

4.1.2 Supply chain management

1. Quanto i plant sono localmente integrati con i propri fornitori:
    a. Nella condivisione di informazione
    b. Nell'integrazione operativa
2. Quanto i plant sono localmente integrati con i propri clienti:
    a. Nella condivisione di informazione
    b. Nell'integrazione operativa
3. Quanto i plant locali decidono i propri investimenti in supply chain
4. Quanto i plant locali investono in Just-in-time
5. Quanto i plant locali sono autonomi del definire le proprie politiche di inventory management

4.1.3 Prestazioni

1. Come valutate le prestazioni dei vostri plant sulle seguenti prestazioni:
    - Qualità
    - Flessibilità
    - Costi
    - Lead Time
    - Puntualità
    - Livelli di scorta

4.1.4 Domande di collegamento

1. Come si lega il ruolo assegnato al plant con la propria configurazione?
2. Come si lega il ruolo assegnato al plant con le proprie scelte di supply chain management?
3. Come le scelte di global sourcing e distribution vincolano le scelte di supply chain management?
4. Come le configurazioni si legano alle prestazioni, in particolare, quali sono gli effetti di:
    - Global sourcing (fornitori distanti)
    - Global distribution (servire mercati distanti)
5. Quanto gli investimenti di supply chain management sono in grado di migliorare tali prestazioni?