

GLOBAL SUPPLY CHAIN CONFIGURATIONS AND MANAGEMENT: EVIDENCES FROM THE ELECTRIC MOTOR INDUSTRY

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ABSTRACT

Supply chains (SC) globalization significantly grew in the last years and this pushed companies to find ways to manage international supply networks effectively. However, in the literature, very few contributions addressed the problem considering the whole SC. The aim of this paper is therefore to study global SC configurations and management through a set of case studies in the electric motor industry. Moreover, we interpreted the results under the light of a set of contextual variables ranging from competitive priorities to the value chain that characterizes the industry.

Keywords: globalization; supply chain management; value chain analysis

INTRODUCTION

According to the UNCTAD [1], 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. In the following years, 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 more and more preferred non-equity entry modes, such as partnerships with suppliers and customers [2]. Because of that, the complexity of global SCs (e.g. new and more suppliers, variable exchange rates, changing local policies) has increased and this can affect firms’ performance if they are not properly managed [3]. Global SCs are in fact more difficult to manage than domestic SCs [4][5]. As a result, a growing academic interest has been devoted to the concept of *global SCM* [6].

Global SCs have been analyzed from different perspectives: global value chains [7], international networks [8] or - focusing on a company perspective - the coordination and

management of sourcing, manufacturing and distribution activities on a global scale [5][9-11]. Taking this last perspective, the 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. 12] analyzing at the same time management practices and performance achieved. One of the problems is that the number of possible strategies is very broad and, even if in the literature there are some attempts to provide a conceptualization, still there are some gaps. Moreover, the dependency from contextual variables (e.g. industry, competitive priorities, company characteristics) is very high [13] and makes the problem even more complex to analyze.

OBJECTIVES

Therefore, the aim of this paper is to provide a conceptualization of global SC strategies, meaning how global SCs are configured and managed. In particular, we focused on a single industry, the electric motor one, and we performed an accurate analysis of the value chain in order to have a clear overview of the context. Then, through a set of case studies, we identified different global SC configurations. We assume that the global SC configuration (measured in terms of degree of global sourcing, manufacturing and distribution) is related to the way in which the SC is managed, considering both suppliers and customers, therefore our first research question is:

RQ1: what is the relationship between global SC configurations and SC management practices?

Next, in order to have a deeper understanding of the phenomenon, we take into consideration relevant contextual variables. First of all, we considered the competitive priorities pursued by the company. A SC aimed at lower costs can, in fact, be different from a SC that aims at higher quality or flexibility. By consequence, our second research question is:

RQ2: what is the effect of the competitive priorities on global SC configuration and management?

Furthermore, according to the literature it is fundamental to consider company size that is a proxy of the financial resources and the bargaining power of the company in the relationships with customers and suppliers. Our third research question, is thus stated as follows:

RQ3: what is the effect of the company size on global SC configuration and management?

Finally, since these results can be dependent on the industry, we decided to run this study in a single industry and explicitly take into account its characteristics on the relationships studied above. As already mentioned, we analyzed the industry through a value chain analysis. Our last research question, therefore is:

RQ4: what is the effect of the electric motor industry characteristics (i.e. value chain governance) on the relationships among global SC configuration and global SC management?

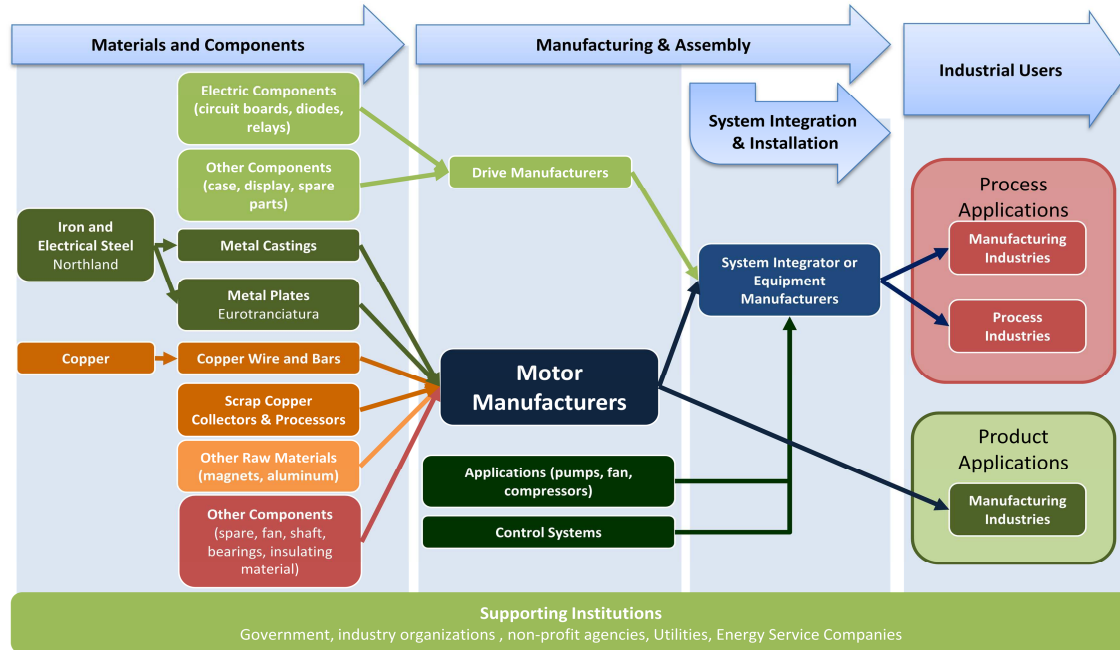
METHODOLOGY

To answer our research questions, we focused on a specific industry, that is the electric motor one, and we analyzed only case studies operating in this industry.

Given our aims, the electric motor industry shows interesting characteristics. Basically electric motor can be produced in different sizes with different target markets, but the

upstream part of the SC (suppliers and the production process) remains more or less the same for all the players. In this way we have some elements that change and others that are common to all the players, thus allowing literal and theoretical replication when analyzing case studies (Yin, 2009). Identifying and fixing some common and relevant characteristics is in fact essential to correctly interpret case studies [15]. We started from the analysis of the value chain in the electric motor industry already provided by Lowe et al. [16]. Figure 1 reports the scheme of the value chain.

Figure 1 - Electric motor value chain. Adapted from Lowe et al. [16]



Next, we contacted nine companies belonging to the Italian electric motor industry. Out of the nine cases, seven are motor manufacturers, while two are suppliers of specific components. For anonymity sake, we labeled every motor manufacturer according to its size (e.g. VS: very small, S: small, M: medium, L: large, VL: very large) and the two suppliers as Su1 and Su2.

Table 1 - Case studies set

Case	Size	Empl.	Interviewed person(s)	Type of company	Production facilities
VS	Very Small	3	Owner	Motor manufacturer	1 in Italy
S	Small	7	Owner	Motor manufacturer	1 in Italy
M1	Medium (1)	85	Managing Director	Motor manufacturer	3 in Italy in a 7 km radius
M2	Medium (2)	100	President	Motor manufacturer	1 in Italy
L1	Large	550	Operations Director	Motor manufacturer	1 in Italy and 1 Asian Southeast (from 2011)
L2	Large	360	Managing director	Motor manufacturer	1 in Italy, 1 in Hungary
VL	Very Large	700	Plant purchasing manager, buyer	Motor manufacturer	4 in Europe, 1 in India, 3 in China, 1 in South Africa and 1 in South America.
Su1	Large	511	Logistic director	Supplier of metal plates	1 in Italy
Su2	Small	25	Owner	Supplier of permanent magnets	1 in China

RESULTS

In line with the analysis of Cagliano et al. [17], we found four configurations according to the degree of global sourcing, manufacturing and distribution:

- Locals (S, VS): their sourcing, manufacturing and distribution is local
- Global Purchasers (M2): only their sourcing is global
- Global Sellers (M1): only their distribution is global
- Globals (L1, L2, VL): their sourcing, manufacturing and distribution are global.

These clusters show several differences in how sourcing, manufacturing and distribution are managed.

Global sourcing management

Purchasing organization and strategy: only VL and L1 have a structured purchasing department, while, in the other cases, purchasing is managed more or less directly by the production manager. Suppliers' selection: all the companies give high importance to the quality granted by suppliers. Especially for more standardized products, the price requested by suppliers 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 L1 delivery dependability of suppliers is particularly important. Supply strategy: only VL expressed the commitment to reduce the supply base to few strategic suppliers, while all the others rely on their traditional supply base made, on average, of 50 key suppliers. Globals are also the only ones supporting supplier development programs and adopting a formal vendor rating. Global Sellers, tend to establish long term and personal relationships with their suppliers. Duration of relationship and information exchange: S and M1 tend to have long term relationships with their suppliers, mainly to face together demand uncertainty. 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 L1 are instead more structured (just-in-time, CPFR). Inventories: usually companies keep a stock of standard parts (mainly spare parts, standard shafts), higher when components come from overseas. Thanks to the kanban system, L1 reduced these inventories by 30%. Risk management practices: Globals hedge financial risk on raw materials and keep back-up local suppliers in case of SC disruptions.

Global manufacturing management

About the way manufacturing is managed, companies mainly operate in make-to-order. For companies producing standardized motor, part of the production is in assembly-to-order or make-to-stock. The minimum lead time to fulfill the received order is one week for L1, three weeks for VS, four weeks for M1, M2 and S and, given the size of the motor 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 overseas. Of course, only Globals can use the leverage of how the global manufacturing network is managed. Interestingly, we found different approaches to network configuration, for example, VL operates within a global network of companies, while L2 just moved part of the production to a low cost country. Finally, L1 moved some product lines to a low cost country. About inventories, only Globals keep inventories of WIP as they need to transfer them from different plants. The other cases just have minimum or no amount of WIP inventory.

Global distribution management

About the distribution strategy, Locals tend to rely to direct sales and long terms relationships. Also Global Sellers and Purchasers use direct sales. We have however to remind that M2 (the Global Seller) actually sells most of its product in Europe, so keeping a direct relationship is feasible without incurring in too high costs. Only Globals are involved in an actual global distribution and to support these they have local sales units. Relatively to

coordination with customers, smaller companies (VS, S, M1, M2), but also VL, do not exchange much information with customers other than order information and some tracking of the production progress. Only L1 uses an eCommerce portal for exchanging information with customers. About co-design, 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 cost or performance. VL, which produces one-of-a-kind motor, has a strong level of co-design with customer through sales units.

Competitive priorities (RQ2)

Competitive priorities appear to be a relevant contextual factor in the definition of how global SC is managed. In particular, we classified competitive priorities into order winners and market qualifiers as in the definition of Hill [18].

For Locals (VS and S), 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, that are two important competitive priorities. M1 represents the Global Sellers. In terms of competitive priorities, M1 is similar to the Locals just analyzed. However they sell outside the country keeping a high level of customization thanks to the direct relationship established with customers abroad. This is feasible since customers are mainly located in Europe, otherwise, as M1 confirmed, it would be difficult if they were in other continents.

M2, competes on customization and product integration offering not only the motor, but a sub-assembled fan-system. The need to stay in touch with its customers affected the decision to keep mainly local customers, while they use global sourcing to save on purchases.

Globals, finally, differentiate themselves especially for customization and after sales services on a global scale. They can support this through their local sales units. Competing internationally, Globals are also the most careful about costs. This pushes them to a higher global sourcing and manufacturing to exploit cost advantages on a global scale.

Size (RQ3) and industry (RQ4)

Moving to the company characteristics, size is by far 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. Medium companies (M1 and M2) have instead a more developed global SC. L1 is a globalized company in terms of sourcing and distribution and soon also in terms of global manufacturing thanks to the new plant in Southeast Asia. Finally, VL is a truly globalized company with several plants around the world.

Finally we took into consideration the effect of the industry in terms of value chain governance. Applying the value chain governance model of Gereffi (2005), we identified the governance typologies in Table 2.

Table 2 - Governance structures and relationships between key players in the electric motor value chain

Upstream link	Type of relationship	Downstream link	Type of relationship
Raw Materials	Market	Process application	Modular
Subcontractors	Captive	Product application	Captive/Relational
Customized components	Relational/Modular		
Standard components	Market		

Raw materials are procured through a market governance. They are bought on the international market mainly because there is no local availability. Subcontractors are usually managed through a captive relationship in which the motor manufacturers exert some form of “control”. 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. Customized components suppliers, which are managed through a relational/modular relationship, are still usually located close to the companies. Finally, suppliers of standard components, which are classified into a market relationship, can be located far away much easier. The majority of the companies buys bearings, for example, globally and keeps them in stock.

Looking downstream, industrial users that buy motor for process applications are supplied by manufacturers or system integrators and they employ the motor in their production processes. Motor used for these applications are usually more standard so the relationship has been classified as modular. In this case, motor manufacturers are more independent from their customers, there is less pressure on delivery lead times and motor are generally more standardized, so it is easier to sell them on a global scale. On the contrary, the industrial users that buy for product application (i.e. the motor becomes part of their own product) establish with motor manufacturers a relational or even captive form of governance. Because of that, a relevant part of this customers are close to the suppliers, even if larger customers are able to source customized motor from China.

CONCLUSIONS

The first contribution of this paper is related to the definition of global SC configurations. Configurations are mostly determined by the different combinations of global sourcing and sales, while global manufacturing appears only in the Globals configuration. In the case studies 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 with the globalization of sourcing and sales, as, for instance, L1 is doing.

The second interesting result is the connection between global SC configuration and management. Local companies tend to manage more informally their relationships, while Globals tend to be more structured. Moreover, when Locals have to buy globally, they tend to rely more on intermediaries that play a significant role in the SC.

Finally we can summarize the effect of the context variables (competitive priorities, size, industry) over the global SC configurations and management. In particular, from our analysis, the factors related to a higher globalization of the SC are: cost and after-sales based competition; larger company size; market or modular value chain governance typologies. On the other side, factors related to a lower globalization of the SC are: flexibility and delivery based competition; lower company size; relational or captive governance typologies.

Further developments of this work are connected to its actual limitations. First of all, 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. Finally, it would be interesting to replicate the study in other industries in order to achieve a higher generalizability.

REFERENCES AVAILABLE UPON REQUEST