Global Supply Chain Integration: Addressing The Trade-Off Between Procurement Cost And Lead Time

Federico Caniato[1], Ruggero Golini[2], Matteo Kalchschmidt[3]

[1]Politecnico di Milano, School of Management, Milano (Italy),
federico.caniato@polimi.it
[2]Università degli Studi di Bergamo, Department of Economics and Technology Management, Dalmine (Italy),
ruggero.golini@unibg.it
[2]Università degli Studi di Bergamo, Department of Economics and Technology Management, Dalmine (Italy),
matteo.kalchschmidt@unibg.it

Abstract: This paper aims at studying to what extent companies performing global sourcing adopt integration mechanism with suppliers, both in terms of information sharing and system coupling. Furthermore we analyze in our model the effect of purchasing strategies (i.e. procurement cost reduction and procurement lead time reduction) as relevant explanatory variables for supply chain integration. These research goals are addressed by means of the fourth edition of the International Manufacturing Strategy Survey (IMSS). A Structural Equation Model is developed to test the described relationships. Results show that global sourcing is performed primarily by those companies aiming at reducing procurement cost, while the goal of reducing lead of time is not related to global sourcing, neither negatively. Global sourcing is instead positively related to information sharing adoption but has no direct impact on system coupling. These results partially confirm existing literature but provide also new insights about supply chain integration in a global sourcing context.

1 Introduction

Firms today operate within complex supply chains, made of several tiers of customers and suppliers. Supply chain integration is one of the most advocated approaches to coordinate processes seamlessly across the various firms involved in order to make the whole supply chain more competitive (Anderson and Katz 1998; Frohlich and Westbrook 2001). To achieve this goal, the relationships between customers and suppliers need to become more collaborative and partnership oriented (e.g. Lamming 1993), moving from an adversarial and arm's-length relationship to a more collaborative one. Moreover, the general trend of outsourcing value-adding activities and developing virtual enterprises has strengthened the need for integration, especially from the information point of view (Gunasekaran et al. 2004). Many contributions (e.g. Frohlich and Westbrook 2001) show how a higher level of integration provides better operational performance, thus suggesting that all firms should invest in this direction.

This issue is becoming more and more relevant with the increasing level of globalisation of supply chains in the last twenty years. Recent studies (Cagliano et al. 2008; Trent and Monczka 2003) show that the adoption of global sourcing is significantly growing. This trend has motivated both practitioner and academic interest in *global supply chain management* (Prasad and Babbar 2000).

There can be several reasons underpinning global sourcing and explaining to what extent this practice contributes to increase companies' competitive advantage: some are related to the economic domain (e.g. taxation, currency) others to the operational domain (e.g. higher quality,

lower prices) (Alguire et al. 1994; Birou and Fawcett 1993; Frear et al. 1992; Trent and Monczka 2003; Womack and Jones 1996). One of the most important reasons, however, appears to be the goal to reduce procurement costs (Monczka and Giunipero 1985).

The drawback to these potential advantages, and in particular of lower costs, is that global supply chains are more difficult to manage than domestic supply chains (Dornier et al. 2008; MacCarthy and Atthirawong 2003; Wood 2002). At the economic level, uncertainty in currency exchange rates, political instability, and changes in the regulatory environment (Carter and Vickery 1989; Dornier et al. 2008) are a major source of risk. At the operational level geographical distances, multiple means of transportation and infrastructural deficiencies in developing countries tend to increase procurement lead time and its variability (Meixell and Gargeya 2005).

All these pitfalls make clear that, if a company chooses to source globally, supply chain management becomes critical to keep performance under control (Golini and Kalchschmidt 2010; Golini and Kalchschmidt 2009; Handfield 1994). On the other side, when operating in a global context, supply chain integration can be more difficult as it requires exchanging information and making joint investments with foreign suppliers, with the risk of reducing the sought cost advantages.

Although this issue is very relevant nowadays, literature presents only few contributions analyzing supply chain integration in a global context under the light of the cost vs. lead time trade-off. This paper aims at filling this gap by analyzing the relationship between global sourcing and the adoption of integration mechanisms along the supply chain. Specifically, the goals of this paper are twofold: first, we aim at investigating the relationship between global sourcing and integration along the supply chain. Second, we aim at analyzing the reasons why companies adopt both practices, in particular we focus on purchasing related objectives (i.e., procurement cost reduction and procurement lead time reduction). Our analysis is based on data collected within the fourth edition of the International Manufacturing Strategy Survey (IMSS 4), an international research project carried out in 2005 in 23 countries.

The remainder of the paper is structured as follows. In the next section literature supporting the research framework is taken into account. Subsequently, research objectives and methodology are detailed and empirical analyses are described. Then proper discussion of empirical results is provided and, in the end, we draw some conclusions and suggest potential future developments.

2 Literature review

We based our framework on three tightly related elements: what companies do (i.e. global sourcing), why (i.e. purchasing strategies) and how they manage it (i.e. supply chain integration).

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) 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.

The literature provided different measures to evaluate the extent to which companies expand their purchases internationally. Petersen et al. (2006) use a Local/Regional/Global scale for the section

of their questionnaire about logistic and supply chain processes. Handfield (1994) and others U.S. based studies consider global every supply that comes from outside that country. However when considering smaller countries (e.g. European countries) and operational performances (e.g. lead times) the "inside/outside the country" measure seems not significant enough. For example Cagliano et al. (2008) measure global sourcing as the percentage of purchases from suppliers outside the continent where the plant is located. When considering such long distances it is plausible that global sourcing may imply longer lead times, which is a typical drawback (Handfield 1994; Swamidass 1993; Vidal and Goetschalckx 2000).

Beyond lower procurement costs, Bozarth et al. (1998) identify other drivers for global sourcing: offset requirements, currency restrictions, higher quality, access to new markets or technology, shorter product development and life cycles. However, lower procurement costs are one of the main and most cited reasons (Alguire et al. 1994; Gunasekaran et al. 2004; Handfield 1994; Monczka and Giunipero 1985; Spekman et al. 1998). Other authors stressed as well the relationship between international sourcing and cost effectiveness strategies (Birou and Fawcett 1993; Herbig and O'Hara 1996; Kotabe and Omura 1989; Nellore et al. 2001; Spekman et al. 1998; Swamidass 1993). Because of that we considered the goal of reducing procurement costs as a key driver for global sourcing.

On the other side global sourcing is traditionally supposed to cause longer and more variable lead times (Handfield 1994; Levy 1997; Markides and Berg 1988). This is more and more relevant as today's competition among supply chains is very much played on time and dependability (Mentzer et al. 2001). However literature about global sourcing and higher lead times is controversial, with many examples of companies able to keep competitive lead times even from off-shore suppliers. Companies can in fact mitigate the impact of global sourcing on operational performance by increasing the level of supply chain integration (Golini and Kalchschmidt 2009; Meixell and Gargeya 2005; Mentzer et al. 2001). Supply chain integration has been analyzed in literature in two main areas of application: *technological collaboration,* i.e. collaboration in the product development (Dowlatshahi 1998; Hartley et al. 1997; Petersen et al. 2006), and *operational collaboration*, i.e. integration in the production-logistics processes (e.g. Cagliano et al. 2003; Frohlich and Westbrook 2001). The focus of this paper is on the latter, since it is directly connected to the cost and lead time implications of global sourcing. Supply chain integration in the production-logistics process is usually classified in two dimensions, which refer to the ways in which integration can occur: *information sharing* and *system coupling* (Cagliano et al. 2003; Vereecke and Muylle 2006).

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 very beneficial for companies (Lee and Whang 2000; Zhang et al. 2004) for example to reduce the bullwhip effect (Lee et al. 1997).

Information sharing has also been analyzed in the specific context of global supply chains, concluding that it is vital for an effective flow of materials (Gunasekaran et al. 2004; 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 (e.g. Gélinas and Jacob Jocelyn 1996; González-Benito 2002). Specifically in global sourcing contexts, one of the most analyzed practices is JIT (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). As a matter of fact, Golini and Kalchschmidt (Golini and Kalchschmidt 2009) show that JIT is actually more diffused among companies that source mainly locally while no other differences were found in other supply chain integration practices among these and global sourcing companies.

Other potentially interesting practices for global supply chain management 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.

Anyway supply chain integration requires dedicated investments: system coupling practices in particular imply significant investments, but also information sharing does not come for free: for example, communication standards have to be adapted between suppliers and customers (Doblies 1997). For this reason, companies aiming at reducing procurement costs by sourcing globally may not be willing to spend more money to achieve supply chain integration.

In conclusion, literature highlights that there is a complex relationship between global sourcing, supply chain integration and purchasing goals. Global sourcing can bring cost advantages but seems to require investments to be effectively managed (e.g. keep lead times under control). Thus companies have to face a dilemma in which from one side benefits can be gained through global sourcing, but from the other investments are needed to limit risks and drawbacks.

3 Research framework and hypotheses

Based on the literature review we aim at analyzing the relationships among global sourcing, purchasing goals and supply chain integration. Thus we formulate different hypotheses to be tested.

At first we focus on the relationship between the two supply chain integration practices, information sharing and system coupling. It is generally agreed that information sharing is a prerequisite for system coupling (Cagliano et al. 2003), since information is needed in order to make joint decisions. Therefore we formulate the following hypothesis:

H1: *Information sharing positively affects system coupling.*

Next, we consider the relationship between global sourcing and supply chain integration. It is generally agreed that managing suppliers on a global scale is more difficult and complex than on a local scale, given the geographical and cultural distance (Dornier et al. 2008; MacCarthy and Atthirawong 2003; Wood 2002). Therefore, firms try to compensate these difficulties with increased communication, but such distance makes system coupling more difficult. For these reasons, we formulate the following hypotheses:

H2a: *Global sourcing positively affects information sharing.*

H2b: *Global sourcing negatively affects system coupling.*

The third set of hypotheses refers to the drivers behind the adoption of both global sourcing and supply chain integration. The reduction of procurement cost is generally considered the first reason for adopting global sourcing (Handfield 1994; Monczka and Giunipero 1985), but also for increasing the level of both information sharing and system coupling (Aviv 2002; Lee and Whang 2000; Zhang et al. 2004). On the other hand, when a firm aims at reducing procurement lead time, usually it tries to source locally (Handfield 1994), as well as to increase the level of both information sharing and system coupling (Aviv 2002; Lee and Whang 2000; Zhang et al. 2004). For these reasons, we formulate the following hypotheses:

H3a: *The goal of reducing procurement cost positively affects global sourcing.*

H3b: *The goal of reducing procurement cost positively affects information sharing.*

***H3c**: The goal of reducing procurement cost positively affects system coupling.*

***H3d**: The goal of reducing procurement lead time negatively affects global sourcing.*

***H3e**: The goal of reducing procurement lead time positively affects information sharing.*

***H3f**: The goal of reducing procurement lead time positively affects system coupling.*

The research framework considered is shown in Figure 1.

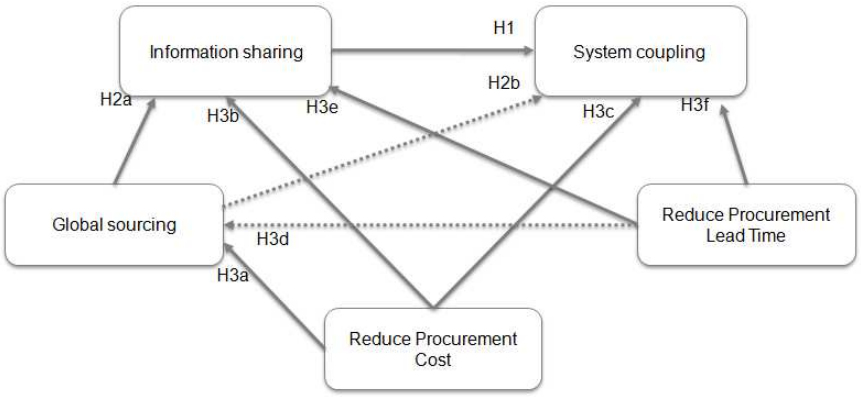

***Figure 1:** Research framework (The dotted line indicates an expected negative relationship)*

4 Methodology

4.1 Sample

In order to investigate the research hypotheses, data collected within the fourth edition of the International Manufacturing Strategy Survey (IMSS IV), a research project carried out in 2005 by a global network, have been used. This project, launched in 1992 by London Business School and Chalmers University of Technology, periodically studies manufacturing and supply chain strategies within the assembly industry (ISIC 28-35 classification) through a common questionnaire administered simultaneously in many countries by local research groups. Responses are gathered in a unique global database (Lindberg et al. 1998). Even if we had data from IMSS V available, data provided in IMSS IV allowed us to better test the research hypotheses since it provides enough information on all considered variables.

The choice of using the IMSS database derives also from the fact that it has been already used for SEM analyses and the testing of hypotheses similar to ours in terms of structure and data type (Cagliano et al. 2004; Größler et al. 2006; Zhang et al. 2004). In fact, it is a database with a high number of records and a long history (more than 15 years) of previous editions so that items and constructs are considered quite robust. On the other side, the dataset has not been designed exclusively for the topics here treated, but it contains many other sections and variables. Nevertheless, we wanted to focus the model and test very specific hypotheses. Finally, the international set of companies offers the opportunity of testing this model on a broad and global sample, thus enhancing the generalizability of the results by overcoming possible country related biases (e.g. national regulations) that can emerge when studying globalization.

Data have been collected on 591 firms from 21 countries as the result of the data gathering process that witnessed a response rate of 22%. Two countries of the original database, namely China and Greece, have not been included in the analysis since data were not usable for the purpose of this study. The usable sample included 591 firms, which provided enough information for the purpose

of this study. The distribution of the sample in terms of country, industry and size is shown in the Table 1.

(a)

*Reg.**	*Country*	*N*	*%*	*Reg.**	*Country*	*N*	*%*
SA	Argentina	43	7.3%	E	Italy	39	6.6%
O	Australia	12	2.0%	E	Netherlands	59	10.0%
E	Belgium	26	4.4%	O	New Zealand	28	4.7%
SA	Brazil	12	2.0%	E	Norway	14	2.4%
NA	Canada	21	3.6%	E	Portugal	9	1.5%
E	Denmark	31	5.2%	E	Sweden	76	12.9%
E&M	Estonia	20	3.4%	E&M	Turkey	33	5.6%
E	Germany	17	2.9%	E	United Kingdom	16	2.7%
E&M	Hungary	51	8.6%	NA	United States	31	5.2%
E	Ireland	8	1.4%	SA	Venezuela	28	4.7%
E&M	Israel	17	2.9%				
					Total	591	100.0%

*Regions: NA: North America, SA: South America, E: Europe, E&M: East Europe & Middle East, O: Oceania

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

(b)

*Size***	*N*	*%*
Small	346	58.5%
Medium	113	19.1%
Large	129	21.8%
NA	3	0.5%
Total	591	100.0%

(c)

ISIC	N	%
28	225	38.1%
29-30	139	25.5%
31-32	101	17.1%
33	24	4.1%
34-35	96	16. 2%
NA	6	1.0%
Total	591	100.0%

ISIC (Rev. 3.1) Code	*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

Table 1: *Descriptive statistics in terms of (a) country, (b) size, (c) industrial sector (ISIC codes)*

4.2 Measures

To measure the level of globalization of sourcing, we considered the percentage of purchases outside the region where the plant is based. Five regions have been investigated in this work, namely South America, North America, West Europe, East Europe & Middle East, Oceania.

In order to measure the goals of reducing procurement lead time and procurement cost, companies were asked to provide the importance of these two goals. These two variables are measured on a 1-5 Likert scale, where 1 represents “Not Important” and 5 “Very Important”. These two variables look ahead in the future, since they refer to objectives, but actually represent what the objectives of companies are today; thus we assume that what companies are doing today in terms of global sourcing and supply chain integration is strictly related to what they want to achieve in the next future.

To measure information sharing and system coupling we used several questions of the IMSS questionnaire related to supply chain integration and we applied a confirmatory factor analysis. In particular companies were asked the extent of adoption of different coordination means with their suppliers and specifically: i) Share inventory level knowledge (IL), ii) Share production planning

decisions and demand forecast knowledge (PP), iii) Order tracking/tracing (OT), iv) Agreements on delivery frequency (DA), v) Require suppliers to manage or hold inventories of materials at your site (e.g. Vendor Managed Inventory, Consignment Stock) (VMI), vi) Collaborative Planning, Forecasting and Replenishment (CPFR) and vii) Physical integration of the supplier into the plant (PI). The first four items are related to the exchange of data between customers and suppliers, while the last three items refer to the integration of processes and thus to system coupling. This choice is based on previous works that identify these measures as reliable for evaluating the two considered constructs (Cagliano et al. 2006).

We assessed convergent validity and unidimensionality of the two constructs defined with a confirmative factor analysis model. Previous works recommend using normed fit index (NFI) and comparative fix index (CFI) together in assessing model fit. NFI is 0.96 and CFI is 0.97 which let us consider the model as acceptable (Bentler and Bonett 1980; Hu and Bentler 1999). In addition RMSEA is 0.07 which suggests that the model fit is acceptable. Factors loads are all significant and higher than the minimum suggested value of 0.40 (Gefen et al. 2000).

Cronbach's Alpha was also measured in order to verify reliability of the constructs; constructs were considered reliable if Alpha's value is above the minimum requirement of 0.60 (Nunnally et al. 1967). Both constructs have Cronbach's Alpha equal to 0.69.

4.3 Data analysis

Research hypotheses have been tested by means of a structural equation model illustrated in Figure 2.

The validity of the model has been assessed by mean of several goodness of fit indexes. NFI is 0.934 and CFI is 0.956 which let us consider the model as acceptable. In addition RMSEA is 0.056 which suggests that the model fits is good.

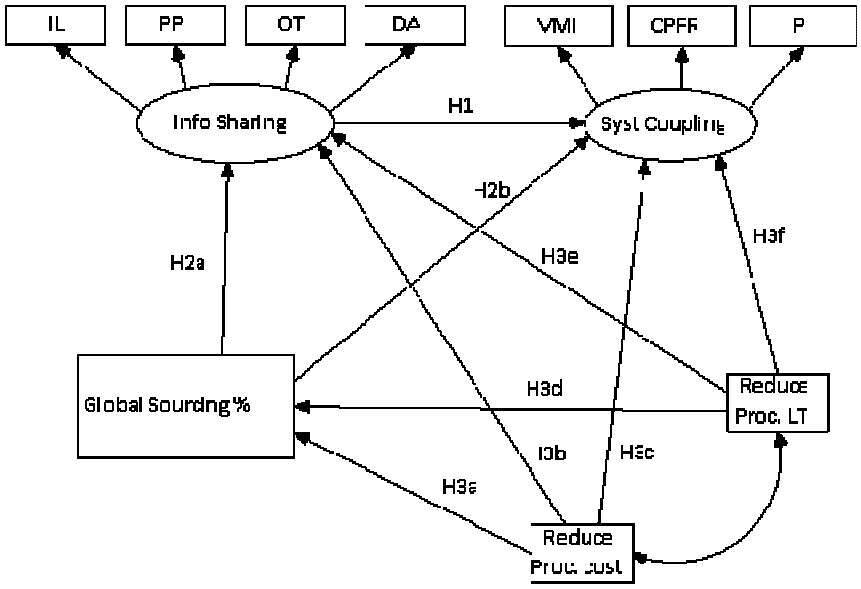

Figure 2: *The structural model considered*

Common Method Bias (CMB) can affect statistical results, when survey data are considered. In order to check for the eventuality of this problem we adopted a confirmatory factor analysis (CFA) on competing models that increase in complexity (Podsakoff et al. 2003). If method variance is a significant problem, a simple model (e.g., single factor model) should fit the data as well as a more complex model (in this case a five factor model). The hypothesized model, containing five factors

yielded a better fit of the data than the simple model (one factor model: CFI 0.55 and RMSEA 0.15; five factors model: CFI 0.96 and RMSEA 0.06). Further, the improved fit of the five factors model over the simple model was statistically significant: the change in χ^2 is 465.61 and the change in df is 9 ($p < 0.001$). Thus, CMB did not appear to be of concern in our analysis.

5 Results

Figure 3 summarizes the results of the model.

From the model we can identify that there is a positive and significant relationship between information sharing and system coupling, thus confirming hypothesis H1. Interestingly global sourcing is positively related to information sharing (confirming hypothesis H2a), but is not related to system coupling, thus rejecting hypothesis H2b. Considering the two procurement goals, we observe that they are correlated to each other. By analyzing their impact on global sourcing and supply chain integration, we test the third group of our hypothesis. The goal of reducing procurement cost is positively related to global sourcing and information sharing (supporting hypotheses H3a and H3b) but there is no relationship with system coupling, so hypothesis H3c is rejected. Finally, the goal of reducing procurement lead time has no significant relationship with global sourcing and system coupling, thus we reject hypotheses H3d and H3f. Hypotheses H3e is instead accepted, since the relationship between the reduction of procurement lead time and information sharing is significant. Table 2 synthesizes results.

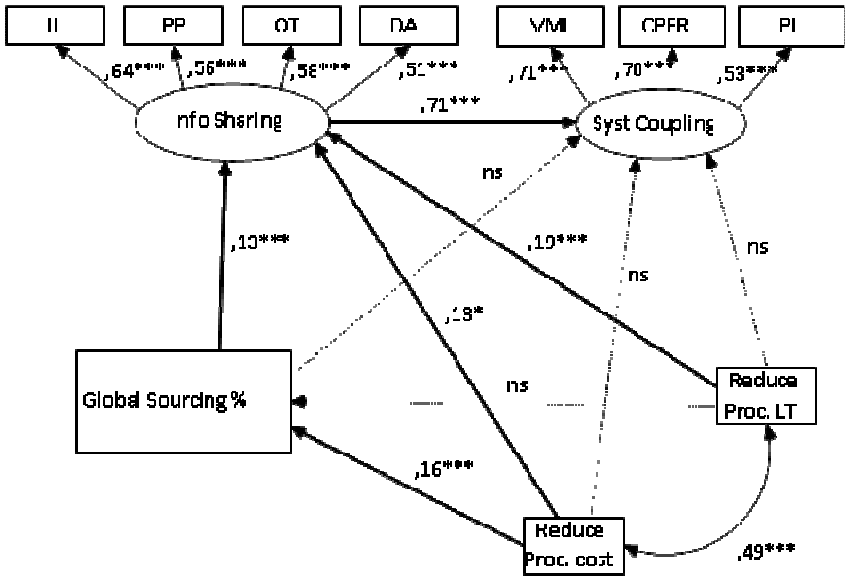

Figure 3: *Structural equation model results (Chi square 76.58 df = 27 p = 0.000; NFI = 0.934 CFI = 0.956 RMSE = 0.056) (*** sig < 0.001; ** sig < 0.01; * sig < 0.05; ns: not significant)*

Hypothesis	*Relationship*			*Result*
H1	Information sharing	→	System coupling	Accepted
H2a	Global sourcing	→	Information sharing	Accepted
H2b	Global sourcing	→	System coupling	Rejected
H3a	Reduce proc. cost	→	Global sourcing	Accepted
H3b	Reduce proc. cost	→	Information sharing	Accepted
H3c	Reduce proc. cost	→	System coupling	Rejected
H3d	Reduce proc. lead time	→	Global sourcing	Rejected

H3e	Reduce proc. lead time	→	Information sharing	Accepted
H3f	Reduce proc. lead time	→	System coupling	Rejected

Table 2: *Summary of results*

These results confirm that companies aiming at reducing procurement costs tend indeed to adopt global sourcing (this is coherent with the literature, e.g. Monczka and Giunipero, 1985; Handfield, 1994). This however may have negative effects due to rigidity and loss of control in procurement and thus leading to worse performance in terms of quality and lead time (e.g. Swamidass 1993). In order to compensate or to anticipate the potential problems that global sourcing arises, companies that have invested in global sourcing tend to increase the amount of information exchanged with suppliers. However this is not the only reason for adopting information sharing, as demonstrated by the fact that there is also a direct, significant relationship between the goal of reducing procurement costs and the adoption of information sharing in line with several authors, (e.g. Lee and Whang 2000). Anyway we can verify that there is a significant moderation effect of global sourcing on this relationship. In fact the total effect of the goal of reducing procurement costs on information sharing is 0.148 (standardized total effect) of which 0.127 (86% of this relationship) is explained by the direct relationship and 0.021 (the remaining 14% of this relationship) is due to the indirect connection moderated by global sourcing. In order to test the significance of this indirect relationship we evaluated Wald's statistic for the moderation effect of global sourcing on information sharing (Little et al. 2006). The Wald's statistic is 1.73 associated to $p < 0.05$, claiming for the significance of this effect.

When the goal of reducing procurement lead time is considered, its relationship with information sharing is again significant, confirming that this is an important mean also for those companies willing to speed up their inbound supply chain (e.g. Lee and Whang 2000). However, there is no significant relationship between lead time reduction and global sourcing adoption, partially contradicting previous results (e.g. Handfield, 1994). The two choices are therefore independent: companies willing to reduce lead times seek suppliers both locally and globally. It is important to remind here that we are considering, as an objective, the reduction of procurement lead times and not having more reliable lead times. This can partially explain the absence of a link between this objective and global sourcing.

Finally, system coupling can be considered. System coupling is positively influenced by information sharing; this is due to the fact that system coupling is supported by information sharing and so a strong relationship between the two can be found. This result is coherent with previous contributions that highlight how information sharing is usually a prerequisite to integration mechanisms since some kind of information has to be shared (e.g. Cagliano et al. 2003). However, there is no relationship with global sourcing, which claims that companies that invest in global sourcing are not able to couple their production system with suppliers, due to long distances and cultural differences (Das and Handfield 1997; Golini and Kalchschmidt 2009; Vickery 1989). System coupling is also not impacted by procurement improvement goals. This happens because such goals are mainly attracted by information sharing and there can be broader and more strategic reasons for investing in system coupling (e.g. lower inventories, better quality, and higher flexibility) not considered here (Christopher 1999; Frohlich and Westbrook 2001).

6 Discussion

Our results in general confirm that a relationship between global sourcing and supply chain integration exists, in particular in terms of positive impact on information sharing. This is in line with what we expected, but we could not give it for granted, since in a global sourcing context any form of coordination is generally more difficult than on a local scale, for reasons related to

language, distance, culture, etc. (Dornier et al. 2008; MacCarthy and Atthirawong 2003; Wood 2002). Indeed, firms are adopting information sharing in a global sourcing context, thus demonstrating that ways to overcome such difficulties exist. Information technology plays a critical role, but also experience and competence in managing a global supply base are fundamental to increase the level of coordination.

This is relevant to confirm that, despite the literature has focused mostly on either global sourcing or supply chain integration separately, actually the two topics are interrelated and therefore it is important to analyze them jointly.

At the same time, while we may have expected a negative impact on system coupling, we actually found no significant relationship (neither positive nor negative). A possible interpretation of this is that system coupling is independent from global sourcing, meaning that firms can decide whether or not to adopt this practice even if they source from far away. Clearly the way system coupling will be implemented will differ between local and global sourcing, however highly collaborative relationships can be implemented also with distant suppliers.

A second important set of results concerns the drivers of global sourcing and supply chain integration. There is quite large consensus on the fact that the goal of reducing procurement costs leads to an increase in global sourcing, and therefore there is no surprise in this result. For sure, this is not the only possible driver, but still this is definitely a relevant one. However, our results show that the goal of reducing procurement costs drives also the adoption of information sharing, suggesting two implications. First that global sourcing, in order to be properly managed and really provide the desired benefits, requires a certain level of supply chain integration, in particular by means of shared information between customer and supplier. Second, since procurement costs are not only the price paid to the supplier, but entail also the costs related to the management of the transaction and the coordination of the flow of goods, by sharing information firms can achieve a lower total cost. Therefore information sharing is directly impacted by this goal, also in the case of local sourcing, since the expected benefits on the procurement process are mostly independent from global sourcing. We could even argue that, when the customer is willing to share information with the supplier, thus creating better conditions for him, a better price could be negotiated.

Finally, the goal of reducing procurement costs has no significant impact on system coupling (although there is an indirect impact through information sharing). This contradicts our expectations and suggests that a strong level of coordination, such as system coupling, is not put in place for reducing procurement costs, but probably for other reasons such as better service level in terms of reliability and flexibility. We could also argue that, since system coupling could be a quite expensive practice, at least in terms of coordination efforts required, it is not seen as the easiest way to reduce costs.

We also considered a second possible goal, i.e. reducing procurement lead time. We clearly expected this goal to have a negative impact on global sourcing, but actually we found no significant relationship (neither positive nor negative). This is also quite interesting because it suggests that global or local sourcing is not actually dependent on the desired procurement lead time, but rather it is a decision made for other reasons (such as cost reduction as we have seen), and procurement lead time is then managed accordingly. Furthermore, the goal of reducing procurement lead time has instead a positive impact on information sharing, thus suggesting that a better coordination through visibility is considered as a way to speed up the procurement process, in particular by enabling the supplier to anticipate customer requirements. Therefore, in the case of global sourcing, since the lead time is expected to increase, information sharing can be used to mitigate this undesired effect. In synthesis, procurement lead time does not affect directly the decision for global sourcing, but rather the implementation of information sharing for keeping it under control.

Finally, also this goal has no significant direct impact on system coupling (even if the indirect impact through information sharing remains), once again contradicting our initial hypothesis. This could appear rather surprising, since a high level of supply chain integration is generally expected

to allow faster procurement. However we can interpret this result in the sense that the reduction of procurement lead time is not the main reason for implementing this level of integration, but rather other goals are the ones really driving the adoption of system coupling. As we already anticipated, the synchronization of processes and a better service level in terms of speed and flexibility can be the main drivers behind system coupling.

7 Conclusions

In this paper we have analyzed the relationships among global sourcing and supply chain integration, in terms of both information sharing and system coupling, as well as the impact of two drivers (procurement cost reduction and procurement lead time reduction) on such variables. Results have shown that a significant relationship exists between global sourcing and information sharing, as well as between information sharing and system coupling. Besides, also the considered drivers have a significant impact on global sourcing and information sharing (but not on system coupling).

We claim these results to be relevant for research, for several reasons. First of all, most research so far has focused on global sourcing or supply chain integration separately, while we have shown that the two concepts are related and therefore studying them jointly is worthwhile. Besides, the impact of global sourcing on supply chain integration is more complex than expected: we have shown a significant impact on information sharing but no significant relationship with system coupling, which is not so straightforward and probably is worth further analysis. In addition, the analysis of the impact of the two drivers also confirmed some expected relationships, but also showed complex interactions (both direct and indirect effects on information sharing), as well as not significant relationships with system coupling, again calling for further investigation. In particular, the analysis of a wider set of drivers could help in casting more light on the strategic reasons behind the adoption of global sourcing and supply chain integration.

At the same time, we claim these results to be of interest also for practice, since first of all they show that supply chain integration is possible also in the context of global sourcing, in particular in the form of information sharing. It is worth also to consider information sharing both as an empowering tool for increasing procurement cost reduction, as well as a way for mitigating the undesired effect of increasing lead times. It is important to consider that often global sourcing is adopted for reducing costs, without considering lead time as a factor influencing the decision. But once global sourcing has been adopted, often the lead time issue emerges, thus requiring keeping it under control and possibly reducing it; therefore information sharing appears as a way to act in this direction without renouncing to the benefits of global sourcing.

Clearly there are many possible ways to deepen this line of research, for example by considering a broader set of drivers for both global sourcing and supply chain integration, or analyzing the different tools for implementing information sharing on a global scale.

In the end we would like to summarize the limitations of this works. Even if our analyses are based on a wide sample, we argue that future empirical research is needed to verify the relationships we identified and to extend the provided results. Also, we limited our analyses to the two typical goals that literature associates to global sourcing (reducing procurement lead time and cost). Our work highlights that other objectives may explain the described relationships. Future works should better analyze this topic.

References

Alguire, M.S.; Frear, C.R.; Metcalf, L.E. (1994) An examination of the determinants of global sourcing strategy, Journal of Business & Industrial Marketing, 9 (1994) 2, pp. 62-74.

Anderson, M.G.; Katz, P.B. (1998) Strategic sourcing, International Journal of Logistics Management, 9 (1998) 1, pp. 1-13.

Aviv, Y. (2002) Gaining benefits from joint forecasting and replenishment processes: The case of auto-correlated demand, Manufacturing & Service Operations Management, 4 (2002) 1, pp. 55.

Babbar, S.; Prasad, S. (1998) International purchasing, inventory management and logistics research, International Journal of Operations & Production Management, 18 (1998) 1, pp. 6-36.

Bentler, P.M.; Bonett, D.G. (1980) Significance tests and goodness of fit in the analysis of covariance structures, Psychological bulletin, 88 (1980) 3, pp. 588.

Birou, L.M.; Fawcett, S.E. (1993) International purchasing: Benefits, requirements, and challenges, Journal of Supply Chain Management, 29 (1993) 2, pp. 27-37.

Bozarth, C.; Handfield, R.; Das, A. (1998) Stages of global sourcing strategy evolution: an exploratory study, Journal of Operations Management, 16 (1998) 2-3, pp. 241-255.

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 (2008) 2, pp. 86-94.

Cagliano, R.; Caniato, F.; Spina, G. (2003) E-business strategy: how companies are shaping their supply chain through the internet, International Journal of Operations & Production Management, 23 (2003) 10, pp. 1142-1162.

Cagliano, R.; Caniato, F.; Spina, G. (2004) Lean, agile and traditional supply: how do they impact manufacturing performance?, Journal of Purchasing and Supply Management, 10 (2004) 4-5, pp. 151-164.

Cagliano, R.; Caniato, F.; Spina, G. (2006) The linkage between supply chain integration and manufacturing improvement programmes, International Journal of Operations & Production Management, 26 (2006) 3, pp. 282-299.

Carter, J.R.; Vickery, S.K. (1989) Currency exchange rates: their impact on global sourcing, Journal of Purchasing and Materials Management, 25 (1989) 3, pp. 19-25.

Christopher, M. (1999) Logistics and supply chain management: strategies for reducing cost and improving service, International Journal of Logistics Research and Applications, 2 (1999) 1, pp. 103-104.

Das, A.; Handfield, R.B. (1997) Just-in-time and logistics in global sourcing: an empirical study, Management, 27 (1997) 3/4, pp. 244-259.

Doblies, D.I.M. (1997). 'Global supply chain integration', in Editor (ed)^(eds), *Book Global supply chain integration*, City, CRC Press, pp. 95.

Dornier, P.P.; Ernst, R.; Fender, M.; Kouvelis, P. (2008) Global operations and logistics: text and cases, Wiley-India

Dowlatshahi, S. (1998) Implementing early supplier involvement: a conceptual framework, International Journal of Operations & Production Management, 18 (1998) 2, pp. 143-167.

Frear, C.R.; Metcalf, L.E.; Alguire, M.S. (1992) Offshore sourcing: its nature and scope, International Journal of Purchasing and Materials Management, 28 (1992) 3, pp. 2-11.

Frohlich, M.T.; Westbrook, R. (2001) Arcs of integration: An international study of supply chain strategies, Journal of Operations Management, 19 (2001) 2, pp. 185-200.

Gefen, D.; Straub, D.; Boudreau, M.C. (2000) Structural equation modeling and regression: Guidelines for research practice, Communications of the Association for Information Systems, 4 (2000) 1, pp. 7.

Gélinas, R.; Jacob Jocelyn, R. (1996) Just-in-time purchasing and the partnership strategy, European Journal of Purchasing & Supply Management, 2 (1996) 1, pp. 39-45.

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 (2010).

Golini, R.; Kalchschmidt, M. (2009) 'Threats of Sourcing Locally Without a Strategic Approach: Impacts on Lead Time Performances', in (ed)^(eds), *Rapid Modelling for Increasing Competitiveness*, pp. 277-292.

González-Benito, J. (2002) Effect of the characteristics of the purchased products in JIT purchasing implementation, International Journal of Operations & Production Management, 22 (2002) 8, pp. 868-886.

Größler, A.; Grübner, A.; Milling, P.M. (2006) Organisational adaptation processes to external complexity, International Journal of Operations & Production Management, 26 (2006) 3, pp. 254-281.

Gunasekaran, A.; Patel, C.; McGaughey, R.E. (2004) A framework for supply chain performance measurement, International Journal of Production Economics, 87 (2004) 3, pp. 333-347.

Handfield, R.B. (1994) US global sourcing: patterns of development, International Journal of Operations & Production Management, 14 (1994), pp. 40-40.

Hartley, J.L.; Zirger, B.J.; Kamath, R.R. (1997) Managing the buyer-supplier interface for on-time performance in product development, Journal of Operations Management, 15 (1997) 1, pp. 57-70.

Herbig, P.; O'Hara, B. (1996) International procurement practices: a matter of relationships, Management Decision, 34 (1996) 4, pp. 41-45.

Hu, L.; Bentler, P.M. (1999) Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives, Structural Equation Modeling: A Multidisciplinary Journal, 6 (1999) 1, pp. 1-55.

Ives, B.; Jarvenpaa, S.L. (1991) Applications of global information technology: key issues for management, MIS Quarterly, 15 (1991) 1, pp. 33-49.

Kotabe, M.; Omura, G.S. (1989) Sourcing Strategies of European and Japanese Multinationals: A Comparison, Journal of International Business Studies, 20 (1989) 1.

Lamming, R. (1993) Beyond partnership: strategies for innovation and lean supply, Prentice Hall

Lee, H.L.; Padmanabhan, V.; Whang, S. (1997) Information distortion in a supply chain: the bullwhip effect, Management Science, 43 (1997) 4, pp. 546-558.

Lee, H.L.; Whang, S. (2000) Information sharing in a supply chain, International Journal of Manufacturing Technology and Management, 1 (2000) 1, pp. 79-93.

Levy, D.L. (1997) Lean production in an international supply chain, Sloan Management Review, 38 (1997) 2, pp. 94-102.

Lindberg, P.; Voss, C.; Blackmon, K.L. (1998) International manufacturing strategies: context, content, and change, Kluwer Academic Pub

Little, T.D.; Bovaird, J.A.; Widaman, K.F. (2006) On the merits of orthogonalizing powered and product terms: Implications for modeling interactions among latent variables, Structural Equation Modeling: A Multidisciplinary Journal, 13 (2006) 4, pp. 497-519.

MacCarthy, B.L.; Atthirawong, W. (2003) Factors affecting location decisions in international operations a Delphi study, International Journal of Operations & Production Management, 23 (2003) 7/8, pp. 794-819.

Markides, C.C.; Berg, N. (1988) Manufacturing offshore is bad business, Harvard Business Review, 66 (1988) 4, pp. 113-120.

Meixell, M.J.; Gargeya, V.B. (2005) Global supply chain design: A literature review and critique, Transportation Research, 41 (2005) 6, pp. 531-550.

Mentzer, J.T.; DeWitt, W.; Keebler, J.S.; Min, S.; Nix, N.W.; Smith, C.D.; Zacharia, Z.G. (2001) Defining supply chain management, Journal of Business logistics, 22 (2001) 2, pp. 1-26.

Monczka, R.M.; Giunipero, L.C. (1985) International purchaasing: characteristics and implementation, The International Executive, 27 (1985) 1, pp. 11-12.

Monczka, R.M.; Trent, R.J. (1991) Global sourcing: a development approach, International Journal of Purchasing and Materials Management, 27 (1991) 2, pp. 2-8.

Nellore, R.; Chanaron, J.J.; Eric Söderquist, K. (2001) Lean supply and price-based global sourcing--the interconnection, European Journal of Purchasing & Supply Management, 7 (2001) 2, pp. 101-110.

Nunnally, J.C.; Bernstein, I.H.; Berge, J.M.F. (1967) Psychometric theory, McGraw-Hill New York

Ovalle, R.O.; Marquez, C.A. (2003) The effectiveness of using e-collaboration tools in the supply chain: an assessment study with system dynamics, Journal of Purchasing and Supply Management, 9 (2003) 4, pp. 151-163.

Petersen, K.J.; Prayer, D.J.; Scannell, T.V. (2006) An empirical investigation of global sourcing strategy effectiveness, Journal of Supply Chain Management, 36 (2006) 2, pp. 29-38.

Podsakoff, P.M.; MacKenzie, S.B.; Lee, J.Y.; Podsakoff, N.P. (2003) Common method biases in behavioral research: A critical review of the literature and recommended remedies, Journal of applied psychology, 88 (2003) 5, pp. 879-903.

Power, D. (2005) Supply chain management integration and implementation: a literature review, Supply Chain Management: An International Journal, 10 (2005) 4, pp. 252-263.

Prasad, S.; Babbar, S. (2000) International operations management research, Journal of Operations Management, 18 (2000) 2, pp. 209.

Spekman, R.E.; Kamauff Jr, J.W.; Myhr, N. (1998) An empirical investigation into supply chain management: a perspective on partnerships, Supply Chain Management: An International Journal, 3 (1998) 2, pp. 53-67.

Swamidass, P.M. (1993) Import sourcing dynamics: An integrative perspective, Journal of International Business Studies, 24 (1993) 4, pp. 671-691.

Trent, R.J.; Monczka, R.M. (2003) Understanding integrated global sourcing, International Journal of Physical Distribution & Logistics Management, 33 (2003) 7, pp. 607-629.

Vereecke, A.; Muylle, S. (2006) Performance improvement through supply chain collaboration in Europe, International Journal of Operations & Production Management, 26 (2006) 11, pp. 1176-1198.

Vickery, S.K. (1989) International sourcing: implications for just-in-time manufacturing, Production and Inventory Management Journal, 30 (1989) 3, pp. 66-71.

Vidal, C.J.; Goetschalckx, M. (2000) Modeling the effect of uncertainties on global logistics systems, Journal of Business, 21 (2000) 1, pp. 95.

Womack, J.P.; Jones, D. (1996) Lean thinking: banish waste and create wealth in your corporation, Free Press

Wood, D.F. (2002) International logistics, AMACOM/American Management Association

Zeng, A.Z. (2003) Global sourcing: process and design for efficient management, Supply Chain Management: An International Journal, 8 (2003) 4, pp. 367–379.

Zhang, S.; Shen, W.; Ghenniwa, H. (2004) A review of Internet-based product information sharing and visualization, Computers in Industry, 54 (2004) 1, pp. 1-15.