Supply Chain Management in Industrial Engineering

Abhishek Dixit, Vikas Dave
Department of Mechanical Engineering, JIET, Jodhpur
Department of Mechanical Engineering, JIET, Jodhpur

ABSTRACT
From an early stage, mainly characterized by a major attention to costs and contract terms, supply policies have developed to become part of articulate relational strategies based on variables such as: The positioning of the firm along the production chain, hence the identification of core activities opposed to those that can be conveniently outsourced, the strategic assessment of the role and the relevance of the various suppliers, the supplier’s potential for technological and innovation development, the actual reversibility of investments on a specific relationship and/or on a specific technological trajectory, the risk associated with dependency on suppliers and the opportunities of multiple and/or parallel relationships, and so on.

In the manufacturing industry the problem of setting up and managing supply chain relationships has recently become of an unprecedented complexity and importance. Today even the most common products are obtained through processes that are highly complex as regards the production technology, the required knowledge and the number of stages involved. The processes in the value chain are spread upon several different technological areas and they require the application of specialized and advanced knowledge in all phases. Consequently firms involved in the development of a new product must coordinate with the other actors in the chain from the earliest stages of design and engineering.

Generally speaking, Supply Chain Management (SCM) activities are focused on creating value, either through innovation in processes and through the improvement of products and services to the end customer. Our aim is to summarize the reasons that led to the transition from the traditional procurement policies to the SCM approach and the main variables involved in the process of defining SCM relations.

Keywords – Suppliers, SCM, Technological

I. INTRODUCTION
The birth of the concept of SCM lies in the growing importance assigned to procurement and logistics, such that they become strategic elements of operational management (Oliver & Webber, 1982; Kraljic, 1983). However, the logistical and operational aspects and the strategic ones have evolved and have been dealt with separately until the ‘90s (Tan, 2001). The concept of SCM has several definitions; Mentzer et al. (2001) identifies three main categories of SCM definitions in literature: a) a management philosophy, b) the implementation of a management philosophy and c) a set of management process. Cooper, Lambert and Pagh (1997) argue that the concept of SCM is, to an extreme, used as a synonym for logistics and, at the other end, as all-encompassing business integration. In fact some authors (e.g. Ellram & Cooper, 1993; Lummus & Vokurka, 1999; Lambert & Cooper, 2000) somehow equate SCM with the management of anything that stands between the raw materials and the product delivered to the final customers, including after sales service. In brief, since academic literature has probably identified for the SCM all the possible definitional combinations that are between the mere logistics and business operations as a whole, to list all the past and present definitions of the concept would not be too meaningful. Other contributors (e.g. Harland, 1996; Croom et al., 2000; Svensson, 2002; Chen & Paulray, 2004) has provided wide reviews of the literature in this field. Such a
variety in the conception of SCM is aided by the fact that SCM involves many fields of analysis and by the fact that it can be approached from different perspectives. Moreover, in the everyday experience firms are far from having a unique and/or a uniform approach towards this matter (Frohlich & Westbrook, 2001), but often SCM activities are focused on a limited set of supply & production stages (Fawcett & Magnan, 2002).

According to the various interpretations, SCM is of an intermediate complexity between PS and the organization of any activity connecting the raw materials and the product delivery, then it reasonably remains a process which require a considerable degree of effort and involvement. Therefore, it is not convenient to adopt an advanced / complex SCM approach in all relationships with third parties. Better try to differentiate the approaches according to the characteristics of each relation, specifically according to their impact on competitiveness. Firms could probably obtain more advantages from an approach to supply relationships that distinguish different policies for each relation rather then adopting a generic method. Therefore, some key points should be highlighted in order to better understand to what extent the SCM approach is actually coherent with, and/or necessary for, the fulfillment of the firm’s strategic objective:

SCM emerges as the systemic response of the firm to the increasing complexity and uncertainty of the environment; such complexity pushes towards the adoption of a holistic perspective about process management. SCM is embodied in the integration of the supply process within the strategic analysis process. It involves/affects strategic decisions and it has (or can have) a specific relevance for the competitiveness of the firm. SCM is a process far more extensive and pervasive than the traditional purchase & logistics function. It assumes the possible role of third parties in supporting the competitiveness of the firm and implies cross-boundaries coordination processes, therefore it underlies concepts of network management. SCM tries to overcome the traditional duality between hierarchy and market. the first typically has a connotation of flexibility and reversibility, while the latter is generally put in relation with benefits of control and of stability.

SCM approach, when actually applied, requires a strong commitment and a relevant effort by the firms involved, since once the SCM relationship is implemented the switching cost is relevant both for supplier and customer, while an eventual poor performance of one of the contractors will affect its partners.

II. PURCHASE AND LOGISTICS TO SCM

In the second half of the 20th century the evolution of the industrial competitive environment has deeply modified the reference framework of supply-chain relationships. Until the early seventies the issue of supply relationships has received a limited attention. The dominant paradigm was focused on mass production and little room was left for strategic cooperation. The emphasis was rather on the advantages of vertical integration on the one hand and in the bargaining power on the other. During the oil shock of the ‘70s the incidence of logistics and raw materials on costs breakdown increased dramatically, bringing attention to criticality in purchase & logistic activities and towards the development of tools aiming to improve the efficiency of operation management, like the earlier Material Requirement Planning systems (MRP).

Efficiency remained the buzzword until the early eighties, when it was sided by concepts oriented to innovation and to customer satisfaction: time-based competition, product life-cycle, value for customer, and so on. Effectiveness and quality (variously defined) started to pose the issue of an evaluation of supply relationships which goes beyond the mere costs analysis. Specifically, the evolution of production systems that started around the eighties, with the shift from the mass production paradigm to the “flexible” one, has increased dramatically the intricacy of product and process architecture. Throughout the nineties the spread of the lean philosophy, together with the globalization of markets, contribute to drive both theory and practice to a constant improvements and broadening of the SCM concept. In the common orientation
towards the application of the lean philosophy within and between firms, SCM comes to fore as a natural evolution of processes towards a general integration. At the same time, the opportunities brought by the technological hybridization of products (that is opportunities deriving from incorporating complementary technologies within products in order to enhance its features and performance) gained a critical role as a competitive advantage. In those industries whose products are complex and require the confluence of technological expertise and advanced knowledge in several technical and scientific areas, the policies of SCM are significant and pervasive enough to require a managerial coordination involving not only procurement and operations, but also functions such as marketing, R&D, and the financial area. The list of tasks assigned to SCM includes all the traditional purchasing & logistics, plus: the definition of criteria for supplier selection and for the evaluation of their performance; the definition of different policy supply for different types of supply; negotiation and trading; the coordination of complex and diverse activities carried out by third parties, such as the co-design and co-engineering of specific components to be manufactured by the supplier; the convergence of supplier and customer on targets which might be partially or totally in contrast, such as the decision about the innovation trajectories to be implemented; the joint development & innovation of new products, processes and forms of distribution; the management of cross-boundaries investment, the development of programs and joint projects to improve the service to the end customer the strategic analysis of market and technological trajectories. The traditional approach to purchase management is not abandoned; rather it is combined with a perspective of value creation. This perspective goes beyond the traditional PS criteria since it introduces: i) principles for the assessment of the strategic capability of the suppliers to create value for customer, rather than just being able to fulfill the assigned task; ii) a tendency towards a unified analysis and coordination of processes occurring outside the firm; iii) the spread of customer’s satisfaction principles to all ring of the chain. The traditional supply approach, mainly cost-oriented, remains in use for simple, standardized, and low-value goods, the peculiarities of both PS and SCM are the elements driving the most opportune policy to be adopted, depending on the type of procurement. At the same time, such peculiarities describe and explain the transition from one perspective to the other as a consequence of the increasing complexity presented over time by the competitive environment.

III. SUPPLY RELATIONSHIP ACCORDING TO TRADITIONAL APPROACH

Four key-aspects characterize the ideal-type of the PS perspective. Skills and efficiency are the main determinants of make-or-buy strategies. Key-decision about the extension of vertical integration and about the positioning along the production chain are taken primarily according to technical knowledge and to the expected relative efficiency, the latter measured by the comparison between the sum of market costs and the costs of internal production. According to this criterion vertical integration is a feasible and effective solution if the firm has the technical capability to implement the upstream production stages with at least the same efficiency of the firms that already operate in those stages. On the contrary, if the company can find components, parts and pre-products on the market at a price that is lower than the cost of internal production, then the firm adopts a policy of outsourcing and focuses only on higher value-added stages of production. Once assured the availability of resources and know-how, the key information for this make-or-buy decision, comes from an analysis of breakeven. No evaluation about strategic opportunities or threats is taken into consideration in such perspective. Short term, cost-based perspective. Decisions on the supply policies are taken mainly by evaluating the economic efficiency of each transaction. Each company formalizes its objectives, and then directs the negotiation with the third parties assuming such objectives as a reference point, given the constraints imposed by the autonomous decisions of the counterparts. In other words, in this view each contractor evaluates its best strategy in advance, and then
negotiates with its suppliers and customers by putting its own constraints and challenging the counterpart on the basis of negotiating power, each one of the parties aiming at bringing the agreement towards its own optimal situation. Other possible elements are relatively less important: the potential impact of the contract on future costs or on competitiveness, the idiosyncrasy of the relationship, the reversibility of the investments.

IV. WIN-LOSE ORIENTED RELATIONSHIP

The negotiations are based on bargaining power and oriented towards the appropriation of the value added. The prevailing attitude in the negotiation is inspired by the rules of a zero-sum game in which the increase in the share of value added of one contractor is at the expense of the others. In such view neither strategic advantages nor synergies take place in supplier-customer relationships. The managerial perspective that is framed in this model tends to interpret the system as the mere sum of its parts. The coordination of the supply chain is the sum of bilateral decisions and negotiations among the only firms that are in direct contact with each other. The chain’s activities are coordinated sequentially, usually through adaptive response to the requests of the final rings. There is no cross borders management activities and the main coordination levers are: i) vertical integration, ii) the production of supplies on the customer's specifications or, conversely, the make-to-stock production, iii) the application of bargaining power.

V. CONTRACT-ORIENTED COMMITMENT

Contracts, and consequent firms’ behaviors, tend to pay more attention to the compliance with contract terms than to the improvement of performances. The supplier-customer relationship is almost entirely framed within contractual rules that are strongly committed on mutual protection from possible contingencies and opportunist behavior. The majority of clauses are focused on transaction conditions and on the solution of possible exceptions or unexpected events. Aiming at preventing the emergence of situations that could radically change the conditions of the exchange, contracts seek to formalize ex ante all possible contingencies relating to the specific relationship. This does not imply, however, that the relationship must necessarily be rigid, or prevaricating. The agreement can be declined in many ways, can be written in very simple forms up to an extremely complex structure, and may provide numerous exceptions aiming at renegotiating the terms of the deal to face situations of potential uncertainties. Contracts can also be determined according to a logic of collaborative and mutual concessions, as in the case of a partnership. Nevertheless, formalization and predictability are the central reference point for the terms of agreement, and uncertainty is managed through an attempt of predicting rather than leaving room for flexibility and re-negotiation.

The approach to supply relationships which emerges in this traditional view might be weak or effective depending on the specific context. In theory, if properly applied this approach allows the company to evaluate the different possible relationships of supply from a very self-centered perspective. It reduces the risks related to uncertainty and opportunism by establishing contractual links and activating instead adjustment mechanisms for those factors on which uncertainty weighs more.

VI. SUPPLY RELATIONSHIP ACCORDING TO SCM APPROACH

SCM is a complement to (not a substitute for) the traditional approach and is characterized by some ideal-typical key features that both complement and contrast with the four key issues listed: Partnership opportunities and competitiveness are the main determinants of make-or-buy strategies. Vertical integration decisions are taken also according to the relational and coordination capabilities. The decisions about the degree of vertical integration and about the positioning along the value chain depend not only on technological skills (in broad sense) and efficiency, but also on the relational and coordination capabilities. For instance, successful firms that operate downstream of the
value chain in most dynamic sectors can exploit their knowledge of demand and customers’ needs to assume a proactive role and to pull the entire chain towards projects of improvement and innovation. These capabilities will then put the firm in a crucial role within the supply network, feeding a situation in which the leading role of the firm allows it to control the critical phases of the value chain without the need for internalization. In contrast, a firm that for various reasons suffers the bargaining power of suppliers for critical components and parts will be more oriented to choose the path of integration even with a cost disadvantage.

VII. MEDIUM/LONG TERM, STRATEGY-BASED PERSPECTIVE
Supply decisions involve the assessment of the medium or long-term strategic perspective. Without neglecting the economic assessments, supply policies also take into account opportunities typical of a medium to long term perspective (eg.: innovation, learning economies, flexibility), then adopting choices that may also have sub-optimal effect in the immediate future, but against a upcoming better result or a strategic necessity. The key-principle of assuring the long-term profitability is not neglected. Rather it is declined on several dimensions, including evaluations that are not directly translatable into monetary or financial terms, such as quality, competitiveness, technology leadership, customer satisfaction, and so on.

VIII. WIN-WIN ORIENTED RELATIONSHIP
Supply chain relationships are managed with the perspective of seeking a win-win outcome or according to an overall optimization. Firms aim to increase their share of added value by increasing the value generated by the whole chain rather than through its division. The competition in the research for individual optimum is seen as leading to a systemic sub-optimal outcome. Usually, the coordination promoted by one or a few actors in the chain, typically downstream firms or those with the largest potential market and technology.

IX. GOAL–ORIENTED–COMMITMENT
The regulation of supplier-customer relationships is in part ruled by orientation to common goals rather than by contractual clauses. The adjustment of the supplier-customer relationships, while being formally established by the enforcement of contractual terms, indeed is largely determined by the orientation to common goals, which may be, for instance: the development of a new product, the opening of a plant, the entry into a new market, and so on. This does not imply the loss of constraints: common contractual obligations are added to targets systems that cannot be placed in explicit terms as they go beyond the firms’ boundaries. In conclusion, the SCM approach includes the management of issues related to procurement and placement of products on the market; then goes further, analyzing and regulating relations with other firms in order to build up the convergence of interests among industry players and in order to build common processes aimed at improvement of processes and products. For this reason we can say that the SCM is a process, including assessment of the competitive implications of decisions on supply. Therefore, it must involve the coordinating role of the top executives at least in the design of strategic guidelines.

X. CONCLUSION
The frenetic changes of recent years have led firms to suffer from conflicting pressures. In particular, the tendency towards specialization contrasts with the increased need for coordination; new and higher barriers to vertical integration challenge the need for direct control of the most critical stages of production. Over time both theory and practice have developed tools to enable firms to respond effectively to environmental challenges. Faced with unprecedented complexity, firms have extended the strategic coordination outside their boundaries and across the supply chain, trying to merge the advantages of integration with those of flexibility and specialization. The result is the development of an extremely diversified range of relationships.
In those industries characterized by high technology and high rates of innovation, the relationship between companies and their suppliers are generally much more intense and pervasive than the traditional market agreements. For this reason the SCM perspective tends to give great importance to the sharing of goals rather than the contract itself, according to a logic that relies on the mutual interest in flexibility. These relationships settle long-term cooperation that, if successful, increases the competitiveness of each contractor. Concretely, the competition between companies is evolving towards a competition between supply chains. However, the SCM approach requires significant efforts and it is not without risk. It is therefore necessary to understand the conditions of effectiveness of this perspective to discern those cases where SCM is appropriate. Indeed, to understand if a particular supply can be critical to the competitiveness and to future strategies it is probably more important than the terms of the contract. The retrospective analysis of the competitive scenario that led to the birth and evolution of this approach is a useful element for understanding the strengths and the limitations of SCM. Through the review of the main factors in the evolution of supply issues, SCM emerged as an organizational / systemic response to complexity. Its application is appropriate in dynamic and uncertain environments, while in other cases the traditional PS alternative might bring equal or greater benefits.

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