International Business Management 9 (4): 416-424, 2015
ISSN: 1993-5250

Insights from Action Research: Implementing an Innovative Lean Procurement Framework for Global Sourcing

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Abstract: The stressing worldwide competition moves organizations to global sourcing to take advantage from foreign markets. However, distance and complexity of cooperation and coordination may lead companies to increase their level of stocks. Supply process can apply lean production pillars, overcoming the JIT principle of supplier proximity, to design an innovative lean procurement process for enhancing operations performances. The contribution of this study is 2 fold. First, we present a set of lean practices, suitable to the procurement process, developing a specific framework for global sourcing. Second, we show results of an action research performed to test the framework with real global outsourcing requirements of an Italian company, operating in the electro-mechanical industry.

Key words: Lean procurement, global sourcing, nearshoring, supplier, Italy

INTRODUCTION

Since, the classical Porter's value chain representation, managers and scholars started to consider outbound logistics as a strategic process to increase revenues, in particular optimizing the supply of raw materials and components and the distribution of final products (Langley and Holcomb, 1992; Krause *et al*., 2007). In this field, the idea of inefficiency is mainly related to a misalignment of customers and suppliers information that can create delays in operations (i.e., loading, unloading or stocking) and increase variable costs for less than truckload transportations or current assets (Leatherman and Schneider, 1992). To obtain benefits such as stock reductions, mitigation of the bullwhip effect or minimisation of supply-demand mismatch costs, customers and suppliers should enhance cooperation and information sharing (Chen, 2003; Costantino *et al*., 2013b).

Moreover, production and logistics factors deeply influence the quality of products, according to the distinctive features of the supply process at every stage of the supply chain as for specific geographical issues (Biotto *et al*., 2012).

To reduce or eliminate these wastes and improve logistics processes, evolutions of the lean approach are playing a main role in an ever-increasing number of applications and specific fields (Ravikumar *et al*., 2013).

The so called lean retailing model (Abernathy *et al*., 1999) identifies sourcing patterns which reflect not only price and quality considerations but also speed and reliability of delivery, minimizing the inventory costs, slow-moving stock and ensuring stock availability that follows the different demand patterns (Strange and Newton, 2006).

Literature generally refers to specific aspects of the outsourcing process and on improvements in single areas like stock level, service level or economic impacts. The research propose a model that aims to overcome the lack of an integrated scheme for leaning the supplying activities, proposing an innovative framework to lead organizations through the implementation of a lean procurement project.

Strategic delocalization of suppliers can give advantages to organizations in terms of cost and/or innovativeness of goods. However, distance and complexity of cooperation and coordination may lead companies to increase the level of stocks.

Global performances of supply chains depend on the distortion generated by local choices of partners as without coordination, they tend to increase decisional risks and generate confusion. Resellers could push purchases if the demand is not clear or if there is any suspect of delays of insufficient deliveries or of disruptions (Costantino *et al*., 2014a); at the same time,

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production systems increase the duration of the operations to create buffers for any loss in yield or failures that interrupt schedules. Without visibility and control, excessive and uncontrolled orders spread in the supply chain to face uncertainty. The real state of information progressively hides while these distortions and misperceptions do not allow prompt responses to irregularities and unexpected events (Niranjan *et al*., 2011). This lack of coordination and visibility among partners (Costantino *et al*., 2013a) significantly affects business performances, causing inefficiencies and resulting in an increase of management costs due to:

- High levels of inventory to face unexpected variations of the demand with a relative increase of stocking costs
- Low service level to customers for unexpected stock-outs that in the worst cases can cause the cancellation of orders
- Reduction of quality for the necessity to increase production rates to satisfy peaks of demand
- Increase of costs for re-scheduling, updating of production plans and reworking
- Increase of transportation costs due to volatile scheduling and premium transport rates

In this context, the study presents an innovative reinterpretation of lean production principles in the case of global procurement from foreign suppliers. In particular, we apply the framework in the case of an Italian company operating in the electro-mechanical industry by performing an action research to fit the actual requirements of outsourcing from distant countries, illustrating the activities to implement, their interrelations and the actors involved.

Literature review: In the purchasing process, the supplier's ability to produce reliable, lasting and consistent inputs in compliance with the buyer's specifications is fundamental (Forker *et al*., 1996) and a greater integration between suppliers and customers produces advantages for both (Lee *et al*., 1997). Many options are available to reduce wastes in the procurement processes, considering the main activities of selecting suppliers, establish collaboration policies, manage processes and performances (Anderson and Katz, 1998). Lean procurement focuses on the Just In Time (JIT) implementation (Gilbert and Schonberger, 1983; Hahn *et al*., 1983; Ansari and Modarress, 1990; Stamm and Golhar, 1993), starting from operative inbound solutions as for the reduction of lot sizes and the increase of orders frequency and then considering suppliers partnership on co-design and integrated master production plans. However, distance from suppliers and cultural differences raise barriers to lean procurement from foreign countries while organizations should rely on this strategy to take full advantages of offshoring (Levy, 2005). The practices proposed in the lean procurement literature are:

A. Kaizen improvement: Every lean project needs a systematic problem solving approach. The Deming wheel (Plan-Do-Check-Act) demonstrated its applicability in supply chain management and operations (Fahmy Salama *et al*., 2009) where resources are limited and every improvement project must consider the opportunity of achieve targets with a step by step implementation.

B. Supplier selection and monitoring: Vendor rating and ranking procedures are necessary to build a solid relationship with suppliers and control their performances (Rao, 2007).

C. Assistance to suppliers and training: These activities can support the understanding of production requirements, increase application of quality management principles, motivate suppliers to succeed in the project (Inman, 1990).

D. Incentives: Dedicated acknowledgements can justify the efforts of suppliers. Long term contracts can incentivize innovation, quality improvements and investments. Clauses that relates a set of benefits to performances and results lead to a stronger collaboration (Newman, 1988; Cachon and Lariviere, 2005).

E. Opportunity of coordination and collaboration: The integration of processes drives organizations towards common objectives: co-design, coordinated quality procedures, shared investments or any other action to align operations (Lee and Ansari, 1985; Meier *et al*., 2008). Every opportunity to involve suppliers must be considered in a project to lean the procurement process. Suggested best practices are vendor managed replenishment, collaborative planning and forecasting, synchronization of information systems (i.e., by EDI), etc.

F. JIT dispatches: Reducing lot size and increasing frequency of dispatches reduce inventory level (Costantino *et al*., 2014b). It is to determine the opportune quantity and frequency, comparing the reduction of

inventory costs with the increase of costs for transportation, packaging, ordering, acceptance activities, handling, etc. for every dispatch (Ramasesh, 1990).

G. Synchronization of production and logistics scheduling: Lean production needs to implement a pull system. A specific and common method to enable the alignment of production and inventory is kanban, a visible record that shares signals between the two areas. With kanban, scheduling for suppliers is directly issued by production without a further intervention of planning and scheduling department (Sarmah *et al*., 2006; Nonino and Panizzolo, 2007).

H. Quality of materials: Quality of raw materials and components reduces wastes and increase the speed of production flows. Suppliers must manage their quality aspects to reduce at minimum controls on organization's incoming materials to achieve a straight inline positioning, without significant losses in production (Inman, 1990).

I. Standardization of packaging: The identification of the characteristics of the packaging is not to delegate to suppliers but has to be unified. To implement a lean philosophy, packaging should be designed to comply with the requirements of production, internal and external handling, storage and transportation systems (Newman, 1988).

J. Control of logistics network: Small lot sizes and frequent dispatches increase the requirement of reliability of the logistics network as long as its service level. This suggests the alignment of organization and supplier processes to design, manage and control outbound logistics (O'Neal, 1987) and to select the most suitable configuration of echelons and agents (Costantino *et al*., 2014c).

Lean procurement framework: Starting from these practices, we developed a specific framework to implement a lean procurement project for global sourcing following the process stages. The framework is presented with a swim lane diagram to better identify activities and the role of the different organization's functions (Fig. 1).

The Plan-Do-Check-Act (PDCA) methodology is the underlying assumption of the framework to assure a continuous improvement and a systematic development. Activities of the Plan phase are in red, Do phase are in green, Check is in purple and Act in blue. Straight lines show the evolution of activities while dotted lines show potential inputs for modifications.

Table 1 gives a more specific description of the activities, linking them to the practices of the literature review (letter captions) and showing the relationship with the stages.

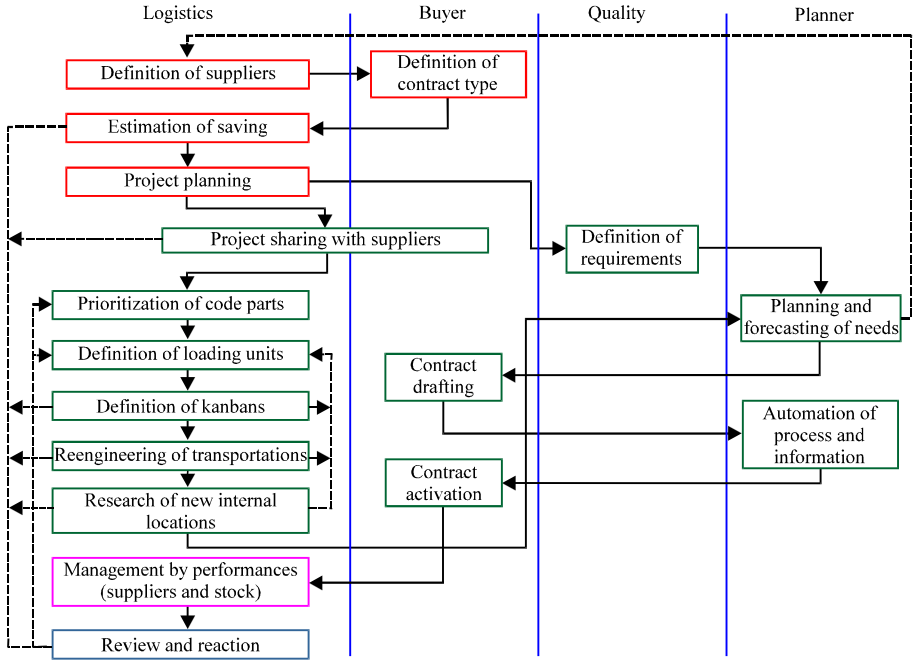

Fig. 1: Lean procurement framework for global sourcing

Table 1: Activities of a lean procurement project

Phases	Activity (references)	Description	Global sourcing characterization
Plan	Definition of suppliers (B)	The project needs suppliers to agree on a new management strategy. Proper vendor qualification and selection is fundamental for achieving the target of the project	Lead times can be long and variable with an uncontrolled amount of uncertainty. Vendor selection must consider all the characteristics of countries that can reduce uncertainty, as for the availability of infrastructures, basic services, complementary industries, level of education, along with political stability and legality (Sounderpandian *et al.*, 2008). Nearshoring suggests choosing suppliers in the closest countries to partially reduce difficulties in coordination and collaboration while offshoring remains always a main alternative (Blinder, 2006; Roza *et al.*, 2011)
	Definition of contract type (D)	Through an accurate definition of the best contract agreement, suppliers have the possibility to stabilize demand to reinforce cooperation and coordination	Since, cultural differences can be deep, the contract is the main tool to align partnership goals. Contract clauses can increase either manufacturer's expected profit or reduce its financial risk (Blinder, 2006). Furthermore, foreign countries need restrictions on currency, arbitration, applicable law and generally require a local agent as an expert of regulation. Then, every contract should last enough to achieve an adequate return on the investment and align results to objectives with a direct and on-site manager to verify and monitor agreements
	Estimation of saving	Estimation of savings should consider warehouse renting, material handling, transportation, inventory and cost of capital. This evaluation depends on the demand level and stability: A risk analysis and evaluation allows to establish the right level of exposure	The evaluation relies on internal data and is generally free from foreign countries implications. Of course, the potential benefits are to compare with costs affected by the delocalization of suppliers
	Project planning (A)	The application of the framework is gradual and not all the products can be included at the same time. A methodology of continuous improvement should start from the top priorities and compare results of specific projects to deploy new procedures and identify opportunities	A simple Pareto analysis on demand and inventory stock is not enough to identify top priorities. The maturity of suppliers should be considered at this stage, as their characteristics strongly imply the probability of succeeding in lean project
Do	Project sharing with suppliers (C)	Target of the project, contract features, scheduling of dispatches and main critical issues have to be presented to the suppliers in an on-site visit. A first agreement with suppler is to settle down	A cultural and business intermediary is generally needed. The interpretation of laws and contractual clauses could vary in principles and applications. Organizations risk to fail projects in distant countries if not accurately supported as a reactive approach is not sufficient
	Prioritization of code parts (B, E)	The identification of priority must consider the impact on business results (costs and effect on production)	A risk management approach is required to make project managers conscious of the hazards of the initiative. Priorities of code parts are determined by evaluating the maturity of the suppliers, their reliability and capability of the organization to face incidental situation (e.g., identifying an available substitute for the supplier). The improvement project is delicate in its application: Every step has to be solid in its chance of succeeding to carry on stage by stage, consolidating and deploying achieved results
	Definition of loading units (I)	It is to verify or define a loading unit for each of the products, considering fragility, weight, stock position and possible reduction of movements for operators	Long distance transportation can be intermodal with possible multiple manipulations that require a specific packaging. Logistics operators are not always experienced or can not provide the correct equipment (transpallet, forklifts, automated trucks, etc.) affecting the integrity of the loading units
	Definition of kanbans (F, G)	The total amount of travelling kanbans depends on the lot size of every trip. The dimensioning process mainly considers a target time coverage (between two deliveries), the average demand and a safety index, according to loading units	Quantities have to be calculated with an higher level of confidence than in solution with local suppliers, due to distance, uncertainty and transportation complexity
	Reengineering of transportation (J)	Whether transportation of incoming product avoiding that an high frequency of shipments could dramatically increase their impact	Organization must consider logistics best practices, as milk run algorithms, cross-docking and merge in transit to reduce lot sizes and frequency (Nemoto *et al.*, 2010)

Table 1: Countinue

Phases	Activity (references)	Description	Global sourcing characterization
	Research of new internal locations	Inbound locations are needed to unload materials directly in line without passing through storage. Operators can directly identify desired locations and points of feeding of production lines	Every internal location needs enough space to allow an inline safety stock that manages uncertainties, due to distances and reliability of suppliers
	Definition of requirements (H)	Definition of requirements in advance and declarations of conformity allow avoiding quality controls on incoming materials. This enables a first process of supplier qualification based on statistical tests of its production process	International standards certifications help to recognize quality and reliability of suppliers while training improves results of auditing or statistical sampling and tests
	Planning and forecasting of needs (G)	Suppliers can accurately schedule production and stocks through information sharing on forecast of order lists	In some low-cost countries, information sharing with suppliers can be difficult due to lack of IT systems or digital divide (Fuchs and Horak, 2008). This issue could have high implications in the choice of partners
	Contract drafting (D)	Contracts with suppliers report quantities, procurement time, technical requirements, penalties, etc.	As during contract definition, a local agent is needed to limit difficulties derived from cultural differences and practices
	Automation of processes and information (E, G)	The alignment of ERP systems to the new strategies enables the coordination with the supplier. Information technology solutions allow the organization to manage incoming products records, locations and quantities schedule production	Automation of processes must consider the IT level of the supplier that could not allow to fully exploit automatic functionalities of the ERP systems. Suppliers are rarely able to build a reliable set of data of production and inventory, ready to process. Investments in identification tools (barcode scanners, RFID systems, etc.) could be required
	Contract activation (B)	The new contracts are activated and made effectives	From the contract activation, the organization has to start monitoring performances by a close presence to the suppliers, allocating a team in the foreign country to establish a robust relation
Check	Management by performances (A, C)	To identify results, benefits and criticalities, key performance indicators have to be monitored, such as supplier reliability, lateness, quality rate, internal events of stock out, stock rotation index, etc.	Adopting the same control strategy across a range of overseas countries may be unproductive (Piercy *et al*., 2004). Therefore, monitoring procedures and parameters should be tailored on suppliers, products and countries. Cultural aspects, security of territories, maturity in management of production, etc., suggest priorities of monitoring
Act	Review and reaction (A, B)	The previous phase activates reactions to improve performances, extending the methodology to an increasing number of part codes. A lesson-learned approach allows to reduce times of implementation and to increase results. The reaction phase consists on updating activities too, to notify modification of parameters to suppliers because of new performance requirements	In some low-cost countries, project with suppliers could challenging, generally because of limited experience in high quality production, low diffusion of information, absence of motivation and incentive policies in human resource management (Vinas *et al*., 2001). Therefore, the reaction phase is harder than in a domestic project, to achieve and share good results, reinforce best practices, improve processes and upgrade technology. Since, every country is different, the knowledge acquired in global sourcing project is generally reduced in reuse (e.g., contract type, logistics parameters, IT solution, etc.)

MATERIALS AND METHODS

After the design of the framework, we performed an action research study to test it with actual requirements to evaluate its applicability and to discover criticalities and opportunities of improvement. We used the Coughlan and Coghlan (2002)'s framework of the Action Research (AR) cycle. Action research is an inquiry process in which researchers integrate applied science knowledge with existing organizational knowledge and apply it to solve real organizational problems (Shani and Pasmore, 1985). The AR cycle comprises three types of steps (Fig. 2):

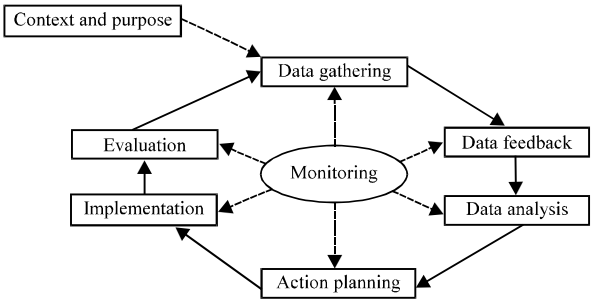

Fig. 2: The action research cycle (Coughlan and Coghlan, 2002)

- A pre-step to understand context and purpose
- Six main steps to gather, feedback and analyse data and to plan, implement and evaluate action
- A meta-step to monitor (Coughlan and Coghlan, 2002)

We carefully selected the company in which performing the action research. Context plays a fundamental role in the case selection process for qualitative case study research in international business (Poulis *et al*., 2013). Moreover, as highlighted by Lee (2002), lean and efficient supply chains relates to the compliant, monitored supply chain procured for most mass-market sustainable products. The >20% of medium and large companies in Italy started projects in the last years to move abroad specific non-core processes, especially in non-European countries. Looking for motivation, the lower labour cost prevails along with the remaining operational costs and opportunities of entering new markets. We tested the framework in an Italian medium company operating in the electro-mechanical industry.

We presented research objective to the top management of the company to receive their sponsorship. After their approval, we organized a 1st meeting in order to deepen the comprehension of the context and to formalize the project scope. Subsequently, we followed the six steps of AR cycle:

Data gathering e data feedback: We developed a semi-structured questionnaire for describing the context and criticalities and we sent it to all workers involved in production and procurement processes; subsequently, researchers interviewed key informants (operation and procurements managers) to triangulate data, collect quantitative data and deepen the analysis of the as is state.

Data analysis e action planning: After the data analysis, we met top managers to illustrate them the framework developed, the to be state and to define the implementation plan.

Implementation: The company implemented the processes described in the framework in 2 months.

Evaluation: We evaluated the performances obtained after the implementation of the framework.

During all the six steps, we monitored the process to write the research report containing all the results obtained.

Context and purpose description: The company produces low voltage breakers and switchers on parallel operative units, using a make-to-stock policy for mass products and an assemble-to-order policy for specific products not significant in terms of revenues (Fig. 3). The total portfolio consists of >35.000 products generated by combining >3.000 input code parts.

The domestic suppliers implemented a reliable kanban management for lean procurement according to the organization's requirements. JIT processes allowed an inline direct supply of low value goods that do not need continuous quality tests. The experience with domestic suppliers and high expertise in just in time philosophy convinced the firm to implement a lean procurement project with suppliers from foreign low-cost countries. When the project started, these suppliers used to replenish an outsourced storage center with a classic MRP management policy. The picking from the storage center relies on storebans which are a kanban like solution to align the production to the stock of raw materials or components. However, the average inventory cost was high, considering the stock levels, renting, handling and shuttle from the outsourced storage center to production.

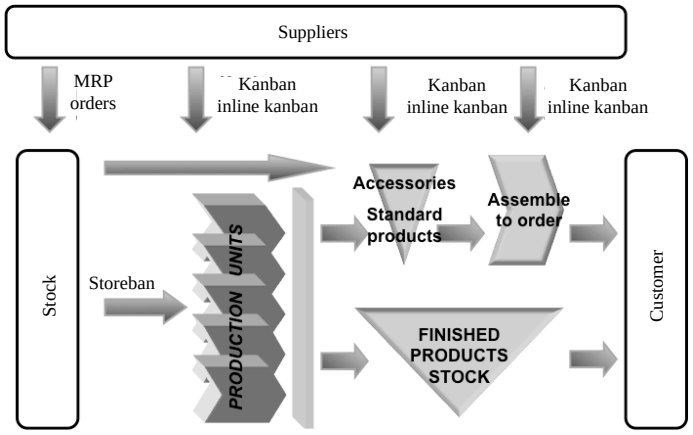

Fig. 3: Company's procurement processes

The organization focused its attention on the reduction of these costs, by passing the storage center even for products from low-cost countries, increasing lean features of the procurement process. A nearshoring scenario was available as a cluster of suppliers moved to Tunisia because of proximity to owners homeland and Italian market, moderate transportation costs and low labor costs.

Code parts involved in the project were 110 produced in Tunisia, stocked in the outsourced storage center and then moved with storebans to production. The seven high priority codes were identified, according to the representativeness (significant average inventory level and cost of capital) to determine opportunities and drive further applications of the project.

After 2 months of application of the lean procurement framework, the company obtained good results on service level, capital costs and transportation costs.

The pilot application on the 7 code parts allowed a stock reduction that cleared about 52 locations in the warehouse, previously rented with an estimated average cost of 2,50 € $month^{-1}$ for a total saving of 1.600 € $year^{-1}$. The direct inline feeding decreased material handling costs of about 4.700 € $year^{-1}$ (calculated on the rates of the outsourced handler) through a reduction of 10 storeban/day. This generates a further reduction, related to the shuttle cost that can be estimated in 5.500 € $year^{-1}$, as the cost of any single trip can be divided by the total amount of the pallets moved. The total saving is about 11.800 € $year^{-1}$ for the 7 code parts. The extension of the framework, due to the significant results, suggested the organization to pass all the 110 code parts to a kanban management system with suppliers abroad. The expected average saving on logistics will be proportional to the tested one achieving about 160.000 € $year^{-1}$.

The total inventory calculated on the 110 code parts was 280.000 units, corresponding to about 1.300.000 € of stock. Kanban management will not totally remove stocks due to the distance of the suppliers and their reliability, so it was to consider at least a 7 days inventory to protect against uncertainty. The final project will lead to a 5% reduction of the inventory turnover ratio (inventory/net sales) that will pass from 8.4-8.0% with a 50% cut on the inventory cost. In particular, the application showed also that 11 critical code parts with high prices but low consumption with an high probability of obsolescence. The lean procurement process allowed to pass from an average value of inventory of 260.000 € to an inline inventory of 60.000 € with a strong reduction of capital expenditure.

RESULTS AND DISCUSSION

The application of the lean project highlighted a set of criticalities and opportune actions to avoid interferences to the improvement process. The following lesson learned can be considered in advance during future implementations.

Information in the organization are not always up to date and can harm the identification of priorities. It is always to evaluate the needing of aligning internal databases to the real scenario.

Suppliers capability have to be accurately evaluated, according to their technological level and possible investments. Offshore experience showed two critical points:

- Definition of packaging: the suppliers could not have specific producers close to them with a consequent limited support and set of choices
- Increase of production capacity to assure a fast alignment to the demand: without stocks, an higher level of flexibility is needed while suppliers are not always willing to invest in it

Project targets have to be accurately scheduled and monitored and the coordination of the different functions is crucial. For example, inline location consumed more resources of what estimated. The activity involved many functions and the buying process for storage equipment slowed down the project. Moreover, the occupation of spaces close to the production lines, due to the direct inline feeding, caused a first perception of disorder in the operators.

CONCLUSION

Results have to be accurately evaluated in times, balancing the improvements with possible new arising risks of inefficiency. As expected, the reduction of inventory costs was limited by the high transportation costs but at the same time, the leaning of the process had an impact on the performances of the production system, as the required quality and reliability levels are not always granted by the suppliers.

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