

Solutions to improve the procurement process in small and unique series production

[FILIP]

Abstract — Currently more and more enterprises are focused to the small and unique series production, because the demand from consumers are increasingly diversified. For to succeed in this challenge they must adopt a series of specific measures to reduce the cost. This type of production have the highest cost. The paper aims to provide some solutions to improve the procurement process.

Keywords — Procurement, supply chain, purchasing, ERP (in own network vs. in cloud), mathematical modeling.

I. Introduction

A consequence of the increasingly diversified consumer demand is expanding production of small series and unique with an increasing speed compared to mass and large mass production. Industries that dominate the production of large series and mass, are: chemical, food, energy, cars, etc., But these industries are trying to diversify their products in a range much smaller than those carrying out production of small series and unique.

Because the competition level is high, companies must continuously optimize to production activities for to reduce the cost and to offer products/services at to competitive prices.

The best solution is to reduce indirect costs, i.e. reduce common costs, this category contains: supply and marketing costs, directing department and enterprise etc., assigning costs based on a coefficient in the price of products and services that are performed during a certain period.

Another solution would be to change the technologies they use with more efficient ones. This solution is hardly agreed by company management, as it involves investments. In addition to equipment and installation will be a cost with re-qualification of personnel. These involve large investments and duration, in terms of return on investment and technology implementation.

Reducing direct costs is a last solution; this category are included the costs with: raw materials and materials, wages, equipment and machinery. This solution is not accepted by all stakeholders directly involved. Reducing labor costs will affect company employees, reducing the cost of materials through the use of substitute materials (cheaper) and thus will affect the quality of the products/services. Reduce maintenance costs of machinery and equipment would mean a premature wear accelerated of them.

This research is conducted in a postdoctoral research project and aims to provide solutions to optimize the supply chain. Obtaining an optimal ratio between efficiency and effectiveness in the supply chain involves achievement of the goals in a short time and with minimal costs.

Organization of small and unique production is characterized by a broad classification of products and unstable, it required a series of conditions and principles. Machinery, equipment, process equipment must be universal, providing a high flexibility of the manufacturing process and labor must be highly qualified.

System flexibility is an internal attribute which provide elasticity of the business, able to adapt their production system without much human and financial efforts, according to the diversity of products required in quantities required, the time required, at a price imposed by the market and recorded in the quality standards and contracts. [1]

II. Basic concepts of the Supply Chain

Supply Chain can be defined as a sum of actions, both with the economic environment and with the components elements of an enterprise, for the purpose of purchasing the goods necessary for the production of products and services at competitive prices. In this category of goods may be included: raw materials, equipment, machinery, consumables etc.

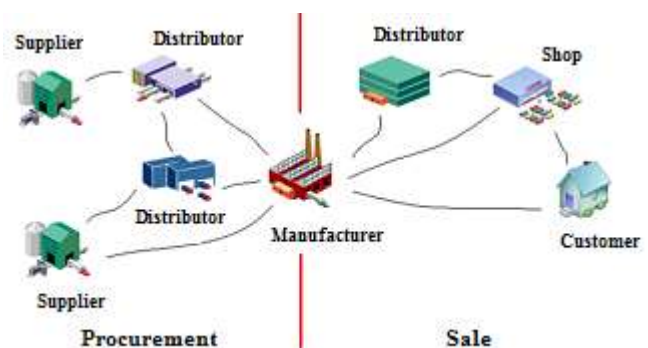


Figure 1.1. Identify supply chain

The procurement process is consists of several steps:

- identifying and planning to necessary procurement of goods;
- search and selection of suppliers;
- negotiation and purchase of goods;
- transporting and receiving goods purchased;

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- storage and their consumption in manufacturing.

The ideal case to getting a minimum price is the existence of as few intermediate entities between raw material suppliers and manufactures, and between manufactures and beneficiaries. All entities that we find in a supply chain should have aim to make a profit.

Because the supply is growing in report with demand for products and services, the price of products is required by the market in a growing percentage. So, the enterprises are forced to reduce their costs by eliminating or continuous optimization activities theirs. By eliminating activities that do not bring added value to the product and/or are not effective, is trying find a solutions through collaboration with other companies, outsourcing, etc.

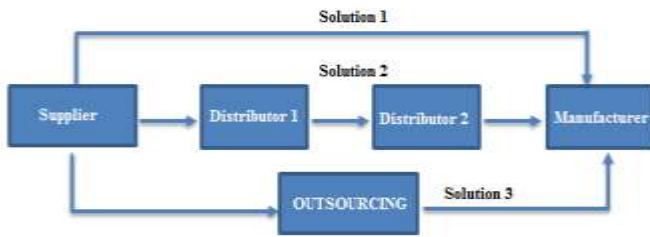


Figure 1.2. Possible variants for supply

Should be noted that companies which performs outsourcing services (e.g. accounting, human resources and logistics) and widened scope offering services for to procurement. Services for the procurement consisting in: identification of suppliers, negotiation and distribution at to beneficiary.

The advantage multinationals in the field of procurement is direct negotiation with suppliers and distribution at international level of goods, directly to the customer. The discounts obtained for quantities distributed can reach to 40%, depending on the category of goods purchased and the price per unit of measure.

Genpact, Accenture (outsourcing services) etc. [2], are becoming a growing threat for regional and local distributors. The volume (quantity) of traded goods is much higher, so can get the biggest discount for price.

In a free market economy, the enterprises are forced to adapt constantly to changes in the external environment, a "trump card" important to ensure survival and development is obtaining a competitive prices for the products/services performed. Among the most important indicators that we can remember: the price of product reported to quality, the price of product reported to specifications, etc. if we make a brief analysis relating to indicators, the price is found in most indicators.

Also through a brief analysis of the term "price", this term can be defined as a sum of costs + profit for each entity in the supply chain.

The best solution to get a product/service at to competitive price is reducing the cost of procurement and sale. This solution is accepted by most entities involved (the management, employees and customers).

In conclusion, the purpose of the supply chain is the same in every organization, but it is conducted differently depending on the category to which it belongs and how it works. Through this research I decided to identify various alternatives / solutions for enterprises carrying out small and unique series production (to order). Possible solutions in the identification, selection and classification of suppliers, solutions to obtain the lowest price in the procurement and transparency process, solutions to determine the minimum cost on supply chain (mathematical model and tool).

According to an earlier applied research, by questioning the target group (enterprises which performs a small and unique series production) were identified as follows:

- Most enterprises use their own vehicles in the supply chain;
- The enterprises do not have a tool to help them in making decisions (choice of provider and the route on which carriage performed to obtain the minimum cost of supply chain);
- The most important criteria in are choosing the supplier: price, availability of stock, financial facilities, delivery time and quality;
- A particular case, when the procurement is made from several suppliers with the same vehicle, choosing the shortest route becomes a problem.

In the next chapter, I will try to present some solutions that could streamline the purchasing process.

III. Use of ERP solutions

ERP is a complex software tool that integrates all departments of an enterprise in a common computer platform, organized by client-server structure, having a single database, for more efficient management of all resources within an enterprise.

The purpose of an ERP system is to ensure transparency of data, eliminating redundancy, providing information in the "real time" decision-making process and facilitate access to any relevant information depending on the degree of permissiveness in the activity.

The ERP system requires a high performance IT infrastructure and network architecture type "Server – Client". In addition to this requirement is necessary a specialized personnel for the maintenance of equipment and for the safety and security of data.

Solution in the Cloud is an opportunity for a company to relieve the requirements for implementing and maintaining a resource planning system (ERP). Also, these solutions provide a high level of security and privacy. Data security is achieved by using a Secure Sockets Layer protocol (SSL) and data safety by using multiple servers operating in "mirror" that are synchronized with each other at certain time.



Figure 3.1. ERP solution in cloud

Among the most important features offered by dedicated module to management of supply chain is:

- Define delivery orders;
- Determination the required of purchasing;
- Definition and classification of suppliers
- Creation and monitoring of purchase orders;
- Reception and inventories depending on options chosen;
- Creation and monitoring consumption, etc.

In terms of Cost and Risk, Cloud solutions are more effective than traditional ERP solutions. The only impediment that might influence to using at maximal capacity is internet connection (transfer speeds and bandwidth).

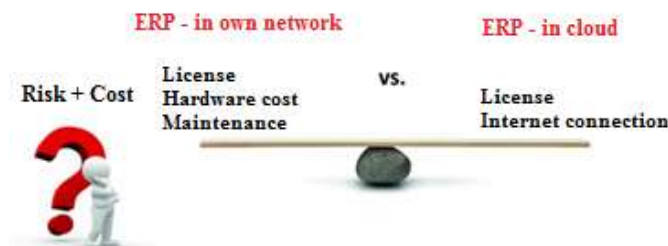


Figure 3.2. Cost and risk tools

Hardware cost - consists of the sum of all the elements necessary to building an internal network (servers, server software licenses, cables, switches, etc.). The cost of maintenance is the sum of expenditure with installing, maintaining, safety and storing data.

In conclusion, the solutions “Cloud platforms” is more efficient because the costs of achievement and maintaining of internal network are removed and operating expenses of platform will be minimize because the expenses will be allocate the number of businesses that use it.

IV. Mathematical solutions to identify the shortest path and minimum cost of supply

Modeling is a scientific and technical research that is an exact reproduction of the system investigated in the form of mathematical equations or other forms, to study the properties and transformations taking place within the analyze.

Currently, the problems in the supply (and other fields) are extremely complicated and their resolution is based on the abstraction and simplification of reality in terms of restrictions and conditions that must be met by the mathematical model.

A. Determination the shortest path for supply

The case study approach is to identify the critical path for the procurement process in the following conditions: the company has its own fleet to transport raw materials; quantities necessary of goods for manufacturing is not available in all stock from a supplier. This supply will be made from several suppliers as having priority criterion shortest duration. Determination of minimum road can be done by several methods for this scenario was chosen two methods of graph theory (Kruskal's algorithm and Prim's algorithm).

Kruskal's algorithm is a method that identifies the minimum length tree partly related to a weighted graph. In other words, determine a subset of edges that forms a tree that includes all the peaks, thus obtaining a minimum in terms of duration. If the graph is not connected, then the algorithm finds a partial tree of minimum duration.

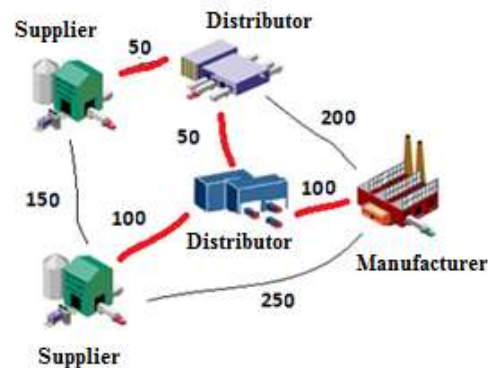


Figure 3.3. Graphic representation of the solution

Prim's algorithm determines the minimum length tree which spanning in a weighted graph $G = (X, U, I)$, in comparison with Kruskal's algorithm does not require that the lengths of the two edges to be different.

Note that regardless of the algorithm chosen the answer is the same: $L_{\min} = 300$ UM. In this case the length of road is 400 UM.

B. Determination the minimum cost of supply

In this case we have the following scenario: To achieve production orders is necessary to procurement "x" of raw materials. These is available in stock to 4 suppliers, at different prices and that are located at different distances. The objective function is to identify (obtaining) the minimum cost of supply consisting of transport cost + value of goods transported (rel. 2.1). To solve the problem we need to know to these are existing in stock at each supplier, transport distances, raw materials prices and necessary to production order.

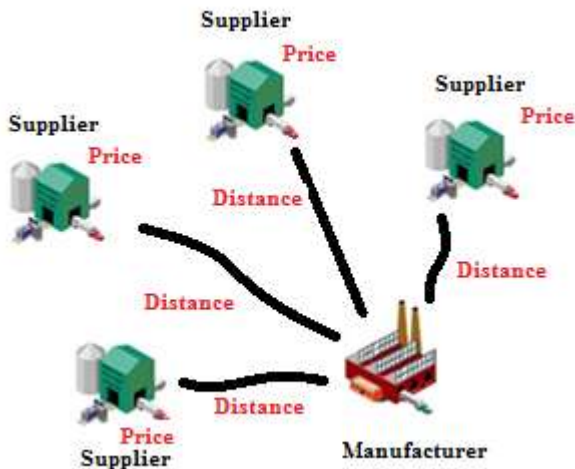


Figure 4.1. Determination the minimum cost of supply

$$\min C_{ij} = T_{ij} * X_{ij} * D_{ij} + P_i \quad (\text{rel. 4.1})$$

$$x_{ij} \leq a_i \quad i \geq 1 \geq n \quad (\text{rel. 4.2})$$

$$x_{ij} \geq b_j \quad j=1 \quad (\text{rel. 4.3})$$

$$x_{ij} > 0 \quad (\text{rel. 4.4})$$

where:

- $C_{i,j}$ = matrix of supply cost from suppliers „i” to „j”;
- $T_{i,j}$ = matrix of transport rate from suppliers „i” to „j”;
- $X_{i,j}$ = matrix of quantity transported from suppliers „i” to „j”;
- $D_{i,j}$ = matrix of distance transport from suppliers „i” to „j”;
- x_{ij} = quantity transported;
- a_{ij} = maximum amount that a supplier can deliver an order;
- b_{ij} = supplying the required amount of the beneficiary „j”;
- P_{ij} = value of goods transported.

Relations (rel. 4.1) and (rel. 4.2) are required for: the quantity purchased is less or equal than the quantity available in stock at the supplier and the quantity transported will be greater than or equal to the procurement required.

v. Conclusion

Among the most important issues that were highlighted in this article I mention: the more accelerated expansion of small and unique series production because the consumer demand is too diversified. The solution accepted by all entities involved (the management, employees and customers) is reducing the costs with supply chain.

Another solution would be to improve the process of procurement using ERP tools. These can be used in home network or in the cloud. Note that these tools are not cheap.

The last part of the article outlines two scenarios where are presenting solutions for the most important criteria: shortest path and minimum cost of supply.

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