

# **Design of a global sourcing strategy to reduce assembly components cost: A case study.**

**Teresa Verduzco-Garza**

Engineering & Technologies Division, Department of Engineering  
Universidad de Monterrey  
San Pedro Garza García, NL, 66238, Mexico  
[teresa.verduzco@udem.edu](mailto:teresa.verduzco@udem.edu)

**Marcos Cisneros**

Industrial and Systems Engineering Department  
Universidad de Monterrey  
San Pedro Garza García, NL, 66238, Mexico  
[Marcos.cisneros@udem.edu](mailto:Marcos.cisneros@udem.edu)

**Francisco Lopez**

Industrial and Systems Engineering Department  
Universidad de Monterrey  
San Pedro Garza García, NL, 66238, Mexico  
[Marcos.cisneros@udem.edu](mailto:Marcos.cisneros@udem.edu)

**Daniela Santiago**

Industrial and Systems Engineering Department  
Universidad de Monterrey  
San Pedro Garza García, NL, 66238, Mexico  
[Marcos.cisneros@udem.edu](mailto:Marcos.cisneros@udem.edu)

## **Abstract**

Nowadays customers' requirements demand higher quality and better products but at a lower and more competitive price, such as the agricultural enterprise in this case study. The company defined a global goal of cost reduction for all its facilities to continue being competitive and a leader in the agricultural market, so the opportunity was set on the hydraulic sub-assemblies components and parts. The present case study was developed at the strategic sourcing department, looking to reduce the hydraulic components cost supplied by different providers due to the scale economy through the global supply chain without affecting the quality delivered in their final products and facing the demand growth. The methodology used to accomplish the goals at the present study and research, was divided in four different stages such as a diagnosis of the current situation, the design of the new sourcing strategy, implementation of the strategy and monitoring and control of the results and key process indicators, also based on the Design for Manufacturing and Assembly methodology (DFMA) and Kraljic's global sourcing strategy to accomplish the expected target on the total cost reduction.

## **Keywords**

Strategic Sourcing, Design for manufacturing and assembly, hydraulic components, Kraljic's Portafolio Matrix, assembly cell.

## **1. Introduction**

Today companies are facing difficult challenges in order to become global competitors, starting with their production operations and manufacturing systems. Nowadays manufacturing approaches had been improved their performance through optimization in costs, so the enterprises need to focus their attention in a higher level attending

needs through the whole supply chain. A very important link is known as *sourcing* supported by the *purchasing* activities, but the traditional purchasing function only was to support the operations providing materials on time and with the quality required to meet the assembly expectations. As we know, supplied materials represent an important percentage of the total product cost, so this research approach is focused in a strategy based on supplies' cost reduction not for only one facility but as a global strategy in all the factories of the firm. Being a corporate project, the purchasing role is converted from tactical to strategic, intervening as a global agent of change in the way of supplying materials to the different plants, taking advantage of economies of scale and reducing input prices through higher-level volume negotiations. By now purchasing department become a decisive department for attaining competitiveness (Faber, Lamers, & Pieters, 2007).

## 2. Literature Review

For the firms it is important on the procurement function to response to the operational requirements and policies in order to save monetary resources and attaining on time (Padhi, Wagner, & Aggarwal, 2012). According to Monczka (2009), one of the main objectives of the purchasing organization is to satisfy the operational requirements of the internal company customers, meet the requirements of physical distribution centers and also support the new product developments and the outsourcing of key processes, providing an uninterrupted flow of high quality goods and services. That is to acquire by buying products and services at the right price and right quantity, from the right source, meeting the users' needs and specifications, receiving them at the right time, selecting competitive suppliers and developing new ones, all of them supporting organizational strategies.

The fundamental purchasing process is supported by 8 strategic stages summarized by Faber, Lamer and Pieters (2007) in their research as the MSU Purchasing model of Monczka show in Figure 1.



**Figure 1: MSU Purchasing model of Monczka (Faber, Lamers, & Pieters, 2007)**

The traditional purchasing function is evolving instead of being transactional to become strategical, obtaining the name of Strategic Sourcing. The new approach focuses on commodity products to centralize the supply and distribute multinational, obtaining a spent consolidation, cycle time reduction and standardization (Miszczak, 2014). In the other hand, Engel (2004) defines Strategic Sourcing as an organized and collaborative approach looking forward to leverage the defined targeted spent across the firm's locations selecting the suppliers that are prepared to create value and improve their knowledge through the customer-supply interaction.

The first, second and the third processes of the model in figure 1 are supported and complemented by the Kraljic's Portfolio analysis matrix (KPM).

For a long time, the usage of the ABC analysis as a tool to classify the supplied items differentiating them into important to less important purchases was the most common way (Prester, 2018). ABC analysis is based on Pareto's principal 80/20, where the main supplies listed in "A" classification represents the high importance items but very



On the second quadrant items classified as *Leverage* the focus is on the price because the supply risk is low but the profit impact is high, so there is no dependency on a particular supplier and the products are bought in large batches. The purchasers often negotiate volume discounts in a high competitive market.

The third quadrant named *Strategic* are those high value components with high supply risk and high profit impact, represent a very important products and if they fail their performance the customer could reclaim his money and the product could not be sell (Faber, Lamers, & Pieters, 2007), there are lack of suppliers and the purchasers should negotiate long-term contracts including mutual trust and commitment. Is also important to develop a co-operation with the suppliers to improve product and service quality levels and forward the cost reduction (Caniels & Gelderman, 2005).

The fourth quadrant classified as *Bottleneck* or critical are those products very difficult to get. There is a possibility of only one supplier with specified materials and could be scarce. The high risk of failing production is latent and the purchasers should work on find items that are easier to get or negotiate them as a priority with the supplier sometimes paying a higher cost than the competitors to get the advantage of prior sourcing. As a contingency to keep extra stocks is permitted, and the purchasers and suppliers are not highly involved (Caniels & Gelderman, 2005). Those items require very specific market analysis and decision models.

On the phase 2, the companies should work hard on the market analysis looking forward to balance the power of it suppliers versus their power as a customer, evaluating the supplier's capacity utilization. If the usage of capacity is high the risk of supply could be an important risk issue if there is a fluctuation on demand, but if the capacity utilization is low the cost negotiation could be complicated because the supplier could not offer a lower cost. In the other hand, if there is only one supplier makes harder the opportunity to find a different one to force the competition, and the potential fail in quality could be very risky. In that case the firm would need to increase their inventory levels and it safety stocks to mitigate the risk (Springtide, 2018).

The next phase 3, the firm should identify opportunities on the items positioned as strategic on the KPM, evaluating the supplier strength and the company strength on the criterion of supplier capacity, market growth, cost and price structure, the technological stability of the products and the logistic situation among others.

Phase 4 implies the definition of the purchasing strategy, volume, price, material substitution, inventory policy, supplier selection to mitigate the risk, sometimes searching for alternative suppliers or materials and think about developing an in-house production strategy.

In sum, the categories in KPM represent four basic power-and-dependence positions (Caniels & Gelderman, 2005).

## **2.2 Design for Manufacturing and Assembly (DFMA)**

When firms make a decision to produce the supplied materials in-house, there is a very important phase to develop the manufacturing process and the guarantee the assembly of the components, but decision making during this phase could impact in production cost downsizing the benefits acquired to build in-house (Back & Ogliari, 2000). That is because the tooling designed for production could be affected if the designed components don't fit or if the designed tooling could not assure the quality requirements. Also if it could make the process more complex and with delays that could increase production costs.

The Design for Assembly (DFA) methodology analyzes and evaluates the components conditions to facilitate the assembly making it simpler, with fewer components and as a consequence could result in assembly time reduction (Stone, McAdams, & Kayyalethekkel, 2003). The firs approach of the method was developed by Boothroyd and Dewhurst (1984) proposing a steps sequence to analyze the product comparing the efficiency through the current assembly time versus the ideal total assembly time.

The procedure starts with a given designed assembly and separating it in parts questioning if the part is necessary, if it could be combined with other or could be eliminated.

On the second step, the current assembly process should be measured in assembly time.

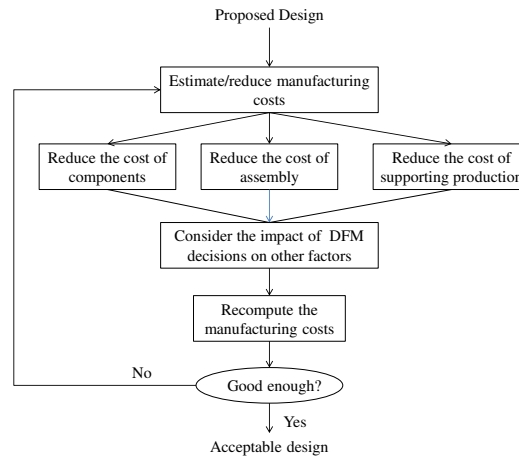
The third step of the procedure is to calculate the DFA index with the current assembly time

Fourth step requires identifying the assembly issues that could forward be a quality or manufacturing problem.

(Kuo, Huang, & Zhang, 2001).

In the other hand, the Design for Manufacturing (DFM) is in charge to design a low cost assembly system to reduce the delay, selecting the appropriate manufacturing processes based in the part attributes and the process capabilities (Kuo, Huang, & Zhang, 2001).

According to Dauksz and Torkellson (2014) the DFM process could be summarized in five iterative steps provided by Ulrich and Eppinger (2012): reduce the cost of components, reduce the cost of assembly, reduce the cost of supporting production, consider the impact of DFM decisions on other factors and recomputed the manufacturing cost. The figure 3 represents those five steps:



**Figure 3: The five iterative steps of DFM process (Dauksz & Torkellson, 2014) (Ulrich & Eppinger, 2012)**

The combination of DFM to maximize the use of manufacturing process in the designed components and the DFA to maximize the use of components in the designed product develops the DFMA method for analyzing the proposed designs from the assembly process perspective (Edwards, 2002) through simplification of the product structure, the best materials' combination, product geometry and cost-effective manufacturing methods making simpler the manual assembly tasks (Caputo & Pelagagge, 2008).

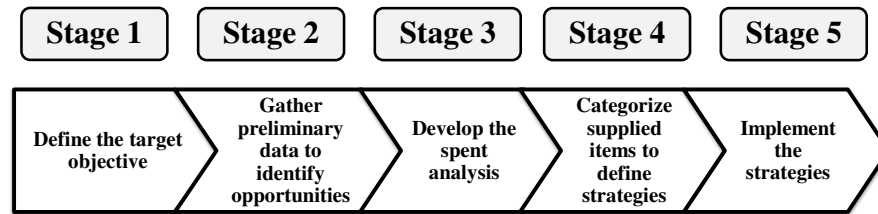
CAD/CAM systems are very useful to simulate the manufacturing and assembly of the products.

### 3. Methodology

The proposed approach to define the procurement strategy is to align strategic sourcing goals to company's goals, supporting by clear objectives.

- (1) Define the target objective: The main corporate goal is the cost reduction, and one of the most representative product costs depends on the supplied materials costs and the purchasing negotiation, inventory levels, ordering size batch, lead time consistency and the policies defined for supply.
- (2) Gather preliminary data to identify opportunities: Once the cost target is clearly defined, the next step is to identify the savings opportunities, gathering the data to find them and using the Pareto principal for the greatest impact supplied parts.
- (3) Develop the spent analysis: Finding the savings source opportunities this stage pretends to calculate the possible spent reduction and make a projection of annual savings. At this part of the analysis, there is a clear optic of where to focus the purchasing efforts.
- (4) Categorize the identified supplied items to define strategy per component: Using KPM to the supply base analysis execution by classify each item through the four quadrants and then define the proposed action road for each supplied part based on the category strategies.
- (5) Implement the strategies: Once the strategy is selected, the next stage is to put them in practice to obtain the forecasted savings, and work in negotiations if needed.

In order to develop the present intervention, the methodology approach is illustrated in the next roadmap in figure 4:



**Figure 4: Methodology approach for improving sourcing costs**

In next section of this document the proposed methodology approach will be disseminated in the different stages through an exploratory case study, and the empirical application.

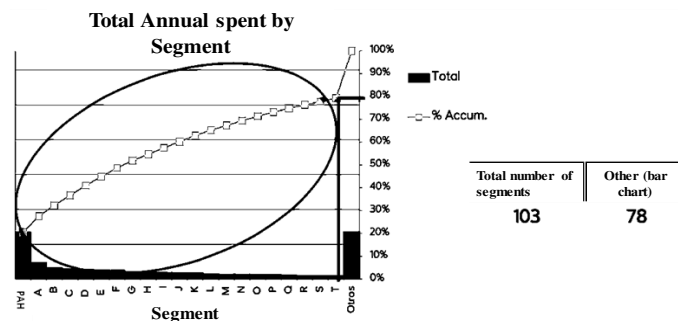
#### 4. Problem statement and improvement approach application

In order to describe the situation of the case study, it is important to mention that the main products manufactured by company under study are forestry and agricultural machinery and equipment. The company has global presence and is one of the most important firms in the segment it serves.

The agricultural machinery represents almost the 50% of the firm's production per year and is projecting an interesting growth and expansion for the next future years.

The goal for the project was to reduce 1% the supplied materials costs as a part of the total finish good cost reduction based on the total cost decrease defined by the company.

In order to achieve the 1% of reduction, the next step was to obtain the data to identify materials cost reduction opportunities. And after that, the spent analysis was executed. The analysis of the 103 segments displayed in the figure 5 that the hydraulics components supplies were the most representative in this case.



**Figure 5: Total annual spent by supplier**

To continue with the analysis on stage three, the different segments and products of hydraulic component supplies were identified, measuring the impact of each in the annual total supply cost. The spent was divided in four different segments represented as follows: Hydraulic Kits 47%, Sub-assemblies 32%, Hoses 17% and Lines 4%.

Only improving the costs in kits with 17 sku's and sub-assemblies with 13 sku's, the supplied products goal could be achieved, so the decision was to improve these two segments in hydraulics.

**Kits:** Composed by the different lines, hoses, valves, metal clamps, connectors, screws and machined parts, all in a box with the ID label.

**Sub-assemblies:** Composed by different hoses, lines, metal clamps, connectors, rings. These were assembled by one outsourced firm so there is an additional cost for headcount and margin.

In order to define the strategies for the 30 sku's, the categorization of supplied parts were done using the Kraljic's Portfolio Matrix, using a quantitative criterion for the profit impact (sku cost) and a qualitative appreciation for the

supply risk axis using a 1 to 10 scale, where 1 represented low risk and 10 the highest risk based on the score. Then the final score for risk is calculated as a weighted average for the results of the following aspects:

- What is the risk of product complexity?
- What is the risk of product performance?
- What is the risk of the market to acquire the product or service?

The resultant matrix is illustrated in figure 6:

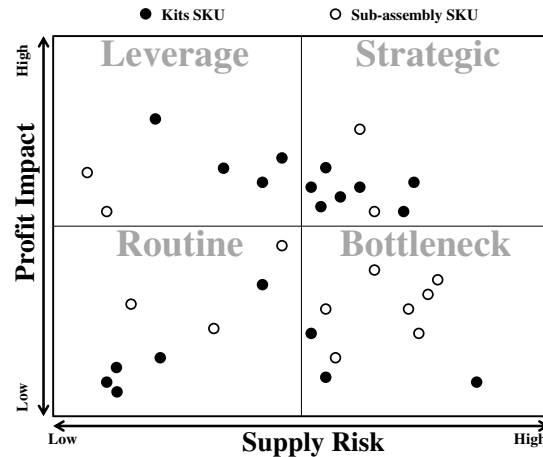


Figure 6: Supplied parts classification in KPM

The results of the classification matrix are displayed as follows:

**Routine:** The products in this quadrant are most of the screws, even for the hydraulic kits and for the sub-assemblies, so the strategies proposed by Kraljic were to aggregate suppliers looking for better cost negotiation based in competence and increasing the supply efficiency.

**Leverage:** For the leverage products quadrant the products displayed were connectors and lines for both hydraulic kits and sub-assemblies, and also some kit clamps. The strategies recommended by Kraljic were to use an effective buying power in order to reduce the unit price, also with formal and tactical negotiation with suppliers.

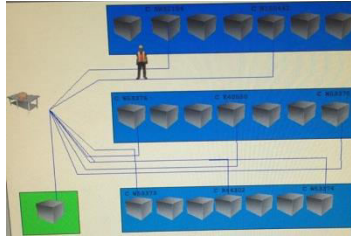
**Strategic:** In this quadrant are displayed the specially machined parts, specific materials hoses and clamps made of high resistant materials, most of them for kits, so the strategies were to develop new local or regional suppliers in order to move into leverage quadrant, and also to review parts specifications. The most important strategy was and the **decrease the total cost of ownership (TCO)**. This strategy is possible because of the high volume of these products and the supply for many different finish goods of many of the company's facilities. The suggested proposal was to build the kit in-house to provide them to the different firm's manufacturing facilities.

**Bottleneck:** For the bottleneck classification, the more recurrent products are the sub-assembly parts, many of the special material hoses and high durability material valves. The proposed strategies are to guarantee product availability using safety stocks to avoid supplier variability and guarantee the availability of the purchased parts, but the most important strategy proposed was the **consideration of make-or-buy options**, so the decision was to design a cell to assembly them in-house and avoid the outsourcing variability, negotiating and developing regional suppliers to move some parts into routine quadrant and create a safety stock of the parts and in cell Kanban.

## 5. Implementation and Results

To implement the strategies for strategic supplied parts, the quotation of the separate materials with regional suppliers was done, comparing the current cost with the materials provided in kits and the cost of each part plus the overhead cost to make the picking to combine the kits' parts.

The suggested layout for kits includes the location of the kit table, the new screw containers, and the finish good new container, with 1 picking operator. The entities used for the simulation in Promodel™ were screws stations, packaging, hoses stations, stamps and machined parts stations. The variables in the model were the counters of each supplied part. The picking sequence was defined to reduce the in transit time and distances, and was documented for standards. The figure 7 illustrates the Promodel™ layout.



**Figure 7: Picking Promodel™ simulation layout**

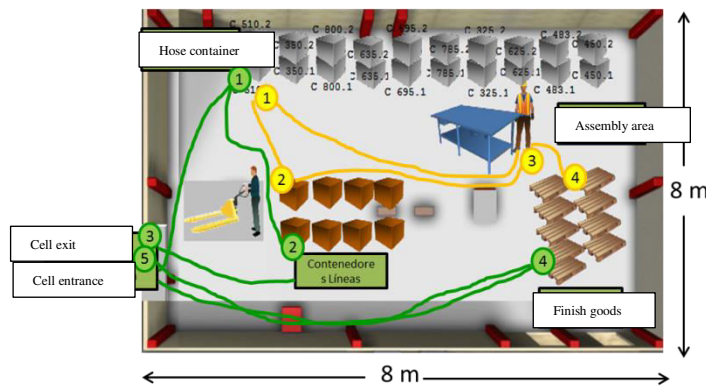
The picking simulation results were a total system time of 280.16 seconds and in average the processing time per piece was 16.2 seconds. The operator percentage of usage was 52% and the percentage in transit was 35.6%. The operator was inactive for 12% of the time.

For the bottleneck products, the proposed strategy was to run in-house.

To design the sub-assembly cell the DFMA methodology were executed to reduce the manufacturing costs and the assembly costs. The simulation was a very useful tool for the new assembly process test.

The first step was to define the general assembly sequence and then run a pilot test, defining the sample size based on a finite population sample size formula resulting in 165 samples. The assembly sequence average cycle time was of 203.7 seconds per sub-assembly and includes the additional manufacturing costs (the cell operation in the shop floor, the racks and equipment, and the returnable containers) the investment in a new lift and the overhead costs. To realize the assembly in-house reduced on 8.21% of each sub-assembly cost.

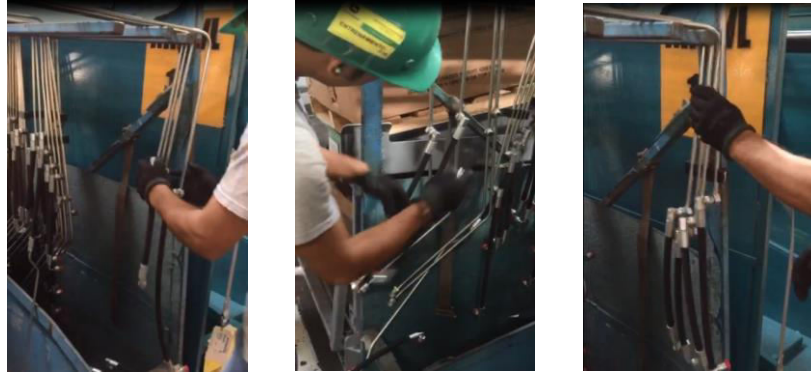
To strengthen the proposal, a Promodel™ simulation was done to recreate the operation of the assembly cell in the shop floor. The location simulated were supplier unload area, returnable hose containers, racks inside the cell, sub-assembly table, finish goods racks and the finish good assembly line (the customer). The resources were 3 freight carriers, lift and lift operator. The entities for the simulation were the hose station, lines station, assembly station, clamps station. The variables in the model were the counters of each assembled part. The simulation layout is available in figure 8:



**Figure 8: Sub-assembly Promodel™ simulation layout**

The simulation results were a total system time of 213.92 seconds per sub-assembly (and the expected takt time was of 270 seconds). The operator percentage time in use was 54.45% and the percentage in transit time was 32.55%. The inactive percentage time was 13%. The figure 9 shows pictures of the implementation.





**Figure 9: Implementation**

To finish the operations, the physical cell was built and the manuals to operate the cell, Kanban calculations, process sequence documents, visual aids, aerial locations, and the containers were developed. In both cases, the cost reduction was achieved.

## **6. Conclusion**

In summary, the supply management is a great opportunity for cost reduction in manufacturing. Classifying the purchased products with the KPM is a very interesting effort that helps the purchasing manager to make clear and good decisions related on how to handle the supplied parts and achieve the company goals with a strategic sourcing approach.

When the strategy is defined, and the products in bottleneck quadrant are identified, the DFMA methodology helps for a good manufacturing process design to continue reducing the total product cost.

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## 7. Biographies

**Teresa Verduzco-Garza** is a Researcher Professor at the Industrial and Systems Engineering School in University of Monterrey (UEM) in Mexico. She received a BS in Industrial and Systems Engineering in 1998, an MS in Business Administration in 2005, and a MS in International Commerce in 2006 at UDEM. At the moment, she is a PhD Candidate in Management focused on logistics and supply chain operations at the Autonomous University of Nuevo León (UANL) in Mexico. Her expertise focuses on Logistics clusters for competitiveness, Operations Management, Supply Chain Operations, and Soft Systems Management. Prior industry experience includes 12 years improving enterprises performance through project management and strategic planning. She is an active member of the American Production and Inventory Control Society (APICS) and The Competitiveness Institute (TCI). She has published and presented her work at international forums like IISE World Conferences, TCI Global Conferences, SISE World Conferences and other regional conferences.

**Marcos Cisneros** is currently a fulltime engineer in a food manufacturer enterprise. He holds a Bachelor degree in Industrial and Systems Engineering from University of Monterrey. He also had developed cost reduction projects in logistics and distribution, as well as projects related to change management and human resources at the company he works for.