

**Implementation of DMAIC roadmap methodology on a sales distributing company for logistics improvement: a case study of SUCAF****Loick Heye-Issaka**<sup>1</sup>School of Management, Shanghai University, Shanghai, P.R China**Abstract**

Challenges of business expansion or gains of new territories in business operations, enhancing customers loyalty and the business competition in Central African region has been a concrete issue, which numerous organizations have considered to establish business strategies and differentiate their products and services in the competitive market. This study focuses on the logistics of a big company in Central African Republic, Sucaf. The stock-refilling process of the logistics center is the most important aspect in the logistics management of the company. This key process determines the performance of a part of the whole logistics process, and has a great influence of the profit and the reputation of the company. Therefore, this study aims to perform a comprehensive analysis of the current status of the process, find out the weakness and propose strategies and actions that can help improve the performance of the whole logistics. To achieve our targets, this study explored the DMAIC methodology in Six Sigma management to analyze the processes. The DMAIC procedure implements the Define, Measure, Analyze, Improve and Control steps sequentially to reduce variations in a certain process, by which to improve the process performance and increase Customer satisfaction. To conclude the study, we point out the key benefits and advantages of using DMAIC methodology for logistics improvement in Sucaf. We also summarize the experience of this study to serve as information to academic researchers and practical managers. The application of DMAIC methodology in the logistics centre of Sucaf provides a good reference for other companies or establishment that plan to implement DMAIC roadmap methodology.

**Keywords:** DMAIC methodology, Stock-refilling process, supply chain, Logistic center, Distribution

**Introduction**

Globalization and the deregulation of markets has led to an increased competition within markets and further pressure on the system of business operations all around the world. The highly dynamic marketing, operational, technical, as well as financial requirements of customers have forced contemporary companies to make some decisions of integrating their intricate supply chain networks for increasing competitive advantage Dedhia, N. S. (2005). More importantly than product and market development, the organizational ability can often be assessed by the performance of work processes such as procedural efficiency, product quality and cost savings. Therefore, many businesses consecrate substantial resources to constantly improving their processes to enhance competitive advantages.

Distribution and logistics functions, like other business functions in the supply chain, have been under assault to reduce costs, streamline inventories, and respond more effectively to customers. However, most companies invest considerably money and labor in marketing, manufacturing and selling to enhance the efficiency of their supply chain, while ignoring crucial logistics operations or problems that are also a part of business situations. Significant resources, such as manpower, materials and time, are wasted as a result of inefficient or ineffective logistics procedures. Meanwhile, the cost of excess inventory or shortage penalties weakens the performance of management. Additionally, the bad efficiency of logistics operations also reduces customer satisfaction in most cases.

In the Central African region, distribution and direct sales operation are a huge and intensely competitive market. After more than 20 years of operations, the distributing industry in the region has reached an annual production value of 3billions of US dollars. A research by Communauté économique et monétaire de l'Afrique Centrale (CEMAC) Trade Commission indicated that 280 companies are legally registered and that more than 5 million persons had participated in this market. In the objective of increasing their competitiveness, many distributing companies make strenuous efforts to improve service quality of distribution and customer service. For example, distributing

companies often establish some service centers to serve their customers in the neighborhood. They replenish products to these service centers daily for satisfying the demand of their customers. Distributing companies also offer a generous product of error compensation process that customers find much simpler and a customer complaint process to encourage distributors to buy or stock products aggressively and massively. Distributors may be allowed to return products for any reason and at no charge. However, most distributors and customers have found that the stock-refilling process and error compensation process are very inefficient and risky. For example, distributors often complain that they can't get sufficient products which they need or service centers complain that they have many inventories which customers do not want. The efficiency of error compensation process is low and vouchers that distributors get from distributing companies have shown records of many errors. As a result, the good and kindly service can quickly turn into an embarrassing situation.

In Central African Republic (CAR), the 1992 general democratic election has systematically changed the political, social, cultural, international, and economic outlook of the country. The business perception of CAR has improved significantly. The transition to democracy has allowed CAR to return to the international arena, which consequently exposed its market to international challengers. This situation has forced local organizations to change business practices in order to cope with international demand and challenges of gaining new territories in business operations, as well as to achieve an edge in the local market. This is true for Sucaf Company, which is a leading manufacturing company in Central Africa that produces variable products such as of sugar (76.000 tons/year), plantation of sugar cane, some alimentation products, whole meal flours, sweets derived from sugar and many other related products. To occupy the market and expand the sales, Sucaf also deploys a sub-branch company operating exclusively in a direct sales distribution. The great performance of Sucaf in term of its turnover amounting at 80 million US dollars over the years in the region has made the company a model of successful achievement in sales distributions when the company was still operating product sells in only few service centers.

With the rapid development of the company, Sucaf creates many new service centers not only in some cities in the country but also in almost all the countries surrounding CAR. Therefore, the company would deliver products for firstly local self-sufficiency and also to some surrounding countries according to the demand. Table 1.1 lists the articles that delivered annually beyond the borders. However, with the expansion of its distributions network, Sucaf begins to face more difficulties in its business operation singularly with the explosions of customer's complaints and the weak performance registered.

**Table 1.1 Sucaf products deliveries**

Cameroon	12.000 t/year
Republic of Congo	19.300 t/year
Sudan	5.000 t/year
Democratic Republic of Congo	3.500 t/year
Uganda	2.000 t/year
Chad	2.000 t/year
Equatorial Guinea	1.000 t/year

As one of the main problems that Sucaf is faced with, customers often complain that they cannot get sufficient or right products they have ordered for. Another major problem is that customers bring many vouchers of damaged goods with numerous errors on them. This problem is closely related to the stock-refilling process process. This processe among several logistics processes in Sucaf Company has considerably weakned and lowered the performance of the logistics operation. Though Sucaf has embarked on numerous quality improvement programs to achieve operational and service excellence, such as Total Quality Management, Quality Circle and Just in Time to enhance the process, the process is far from satisfactory. This motivates us to carry out this study with Sucaf Company as our research object, investigate what really affect the performance of the process, and propose solutions to the existing problems.

The research on a case study of Sucaf distributing company has been made specially for its encountered difficulties on a weak performance of the sales operation after expanding distributing network with numerous service centers and also for its big challenge to satisfy its customers demands in the hard-facility or situation of the business operation in Central Africa. These crucial problems that the company is facing is mainly due to an inefficient logistics operations registered over the past years which result in a complaint of almost all the service centers that were lately created nationally and internationally.

For service centers, they can not receive appropriate items or products at any adequate time for the sales and demands. For distributors, they complain that they can not get products they have ordered for and receive rather other types of products accidentally. These have weakened the business processes. All these are also and not-ignoring facts due to the geographical position which has been a source of many problems the company has faced for not giving the highest satisfaction standard level for its customers. Some geographical factors like enclosure situation of Central Africa has lead to a difficulty on shipping products in a various and large quantity for those overseas service centers at once and for a good period of time, resulting in a huge cost of transportation for every three days to service centers. Problems of bad road condition sometimes that has often lead to delaying the re-filling process on time, which is also a factor source of problem of the unaccuracy replenishment process without railway network. Problem of slow and inefficient information system has conducted the company to face problems of considerable lost of money in the logistics processes, such as the return of goods by a service center which has received wrongly a given good due to the computer information errors.

Sucaf company has registered some difficulties for stock-refilling processes after having opened numeral service centers in not only Central Africa but also in different countries. The logistic center has received simultaneously many orders from Bangui, Bambari, Birao, Obo, Bangassou, Sibut, Ndélé, Bossangoa, Gabon, Cameroon, Tchad, Equatorial Guinea, Rep of Congo, Sudan, Sao Tome and Uganda service centers. Some factors determining problems are shown as follows :

- ⇒ Factors like coupeurs de route which means phenomenon of people with guns attacking vehicules with goods in some region of the country,
- ⇒ Factors like wrong information system (poor communication method, poorest quality of internet resulting to some buggings, crashing of the IT system more often) resulting to a deregularisation of logistics function,
- ⇒ Factors like carelessness of staff members from the global logistics center and service centers due to the ritual behavior and poor education has resulted to wrong distributions mechanism to different service centers according to each demand,
- ⇒ Factors like numerous confusions situation about mails reports, postings, mobile communications from service centers after expansions has conducted the re-filling mechanism to a wrong business of operation system in term of unlocalised adresses of customers for sending vouchers for example,
- ⇒ Factors like slow distributions due to bad conditions of roads for trucks specially conduct easily to breackdowns,
- ⇒ Factors like low air distributions have led to insatisfactions of customers in term of the waiting since air distributions are planned once in a week due to the high cost and unavailability of cargo planes.

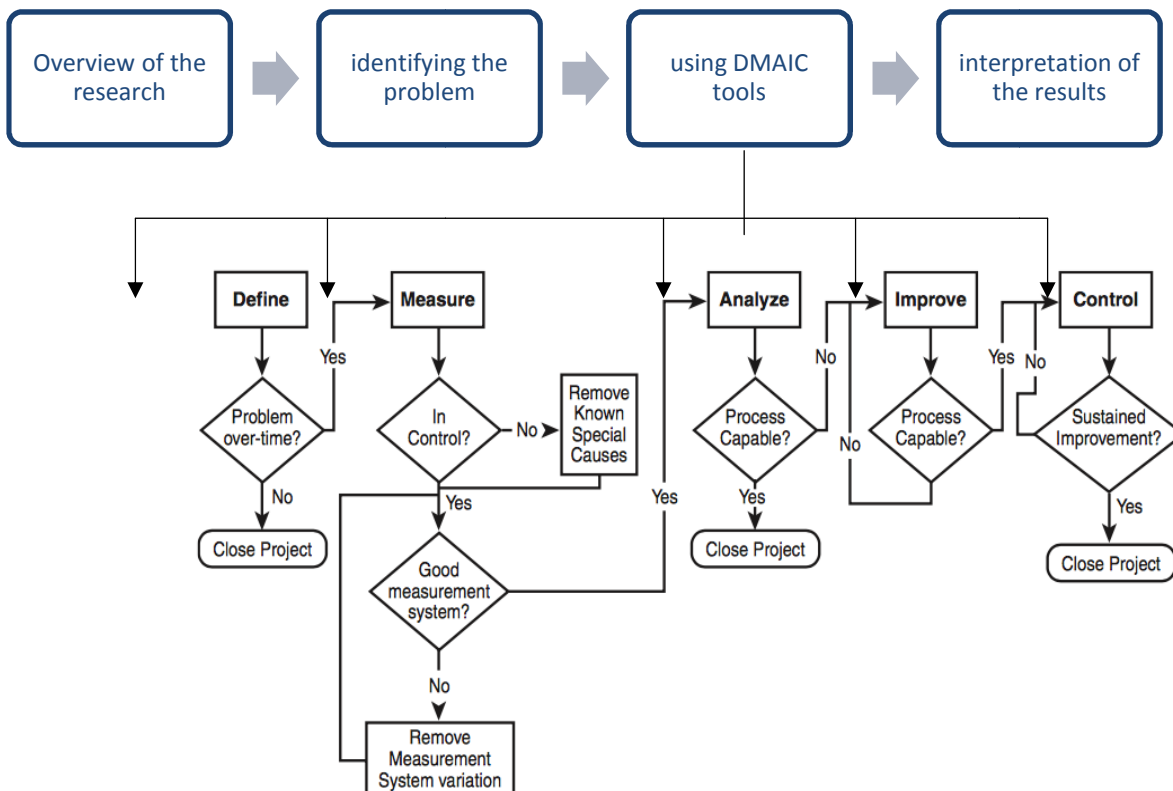
To accomplish this task, we exploit the powerful DMAIC roadmap. The DMAIC methodology is considered a powerful improvement tool that uses a well-structured continuous improvement logical framework to reduce process variability and eliminate waste within the business processes using effective application of statistical techniques. In other terms, the DMAIC is strategically a business improvement mechanism used to optimize profitability, remove waste from processes and to meet or go beyond customer requirements and expectations. Numerous organizations have reported significant benefits and improvement today as a result of DMAIC methodology implementation (Banuelas et al., 2005). Although the DMAIC is typically first implemented to improve manufacturing process and organization improvement processes, the method can also be employed in processes, such as product

design, administrative support process, supply chain management and customer service process (Wei et al., 2010; Chakrabarty and Chuan, 2009; Antony, 2006). The wide application of the DMAIC methodology is due to the fact that organizations can obtain the benefits of DMAIC presented in financial returns by linking process improvement with cost savings.

## Methodology

In this study, we apply the DMAIC methodology to identify and solve problems in stock-refilling process in a sales distributing company, Sucaf. Firstly, some assumptions are described for the process. Although this study only focuses on the sales distributing company, the findings of this study can provide a good reference for other similar companies that plan to improve their current processes. Secondly, the logical map of DMAIC for improving the logistics process is presented in details for the stock-refilling process and the error compensation process, respectively. The feasibility of the DMAIC logical map is also clearly presented in details (See Fig 1).

Factors that have impacts on the critical to quality characteristic (CTQ) of the process are identified. Project charters can be established in the project definition phase. In the measure phase, we map the current process and establish metrics that describe the critical output factors of the two processes in order to narrow the problems to its major factors or 'vital few' root causes. Tools, such as input and output map (I/O map), cause and effect matrix (C&E matrix), failure mode and effect analysis (FMEA), fishbone diagrams are employed to examine the relevant factors, and as well as the determination of how to control them better. Some statistical techniques, like Balanced Analysis of Variance (Balanced ANOVA) and hypothesis test, are utilized to verify the correlation between the input factors and output factors and understand the sources of variation in the two processes. A number of improvement actions are discussed and implemented. We also provide suggestions, including redesigning the computer system program and developing control plans individually, to sustain and enhance the performance of the improved stock-refilling and error compensation processes in the future.



**Figure 1:** Improvement steps of DMAIC

## Results

To apply the DMAIC roadmap in the case of the stock-refilling process of Sucaf, we detail the five phases as follows.

### *Define Stage*

The first phase in a DMAIC project is the define stage. This stage defines the goals and boundaries of an improvement project in terms of customer requirements and the process delivering. We employed a tool called “Voice of the Customer” (VOC) to identify the critical factors to the needs of customers and to define appropriate objectives of the project. The customers of the stock-refilling process were also defined as all service centers and distributors as service centers use to complain about product as well. After analyzing, the VOCs, that are also the objectives of the project, include “providing appropriate refilling frequency and volumes” and “reducing shortage rate”. Given the aforementioned characteristics of the sales distribution industry and the policy of the company, we hope that Sucaf can offer distributors remarkable customer service and to prevent a high shortage rate. After participation in a brainstorming session of the company, we identify CTQs based on the VOCs. A term “KPOVs” (key process output variables), namely “big Y”, are the CTQs, which are defined as the most important characteristics of the refilling process from the perspective of the customers. The KPOVs includes “the appropriate replenishing of items and volumes”, “proper arrival time”, “adequate refilling frequency” and “reasonable inventory at service centers”. The crucial delivery of the define stage is a project charter. The project charter summarizes the define stage from VOCs to KPOVs. The charter also cascades down the project description, scope, goals, potential financial benefits and expected schedule. Predicted difficulties were also discussed to enable preventive measures to be undertaken. The charter also includes required resources and support. Table 1.2 presents parts of the project charter.

### *Measure Stage*

In the measure stage, we point out current processes and establish metrics that describe the KPOVs and input factors of the process. We underline the process mapping that provides a pictorial illustration of the refilling process to identify input variables (Xs), critical output variables (Ys) and the relationships between Xs and Ys. Moreover, process mapping helps the research to identify all value-added and non-value-added process steps in the replenishment process. These input variables were identified during a brainstorming session that I took part of, using a fishbone diagram and associated with five principal considerations : manpower, information system, environment, method and management. The refilling process consists of six sub-processes with a total of 24 steps. The six sub-processes included inputting refilling data and making the refilling plan, modifying the refilling plan, outputting refilling reports and carton stickers, picking correct items and volumes, delivering them to service centers and receiving goods by service centers that role should be accomplished. In this project, 22 variables were identified, constituting the inputs of the data collection plan on which subsequent works were based.

To clarify the inputs that affect the KPOVs, we have constructed a C&E matrix. The KPOVs were rated according to their importance, while the inputs were scored in terms of their influence on the KPOVs. Table 1.3 presents parts of the C&E matrix.

In the matrix, we select four KPOVs of the stock-refilling process in the top row and weight 7 and 10 according to their importance to customers and strategic business goals. The correlations of all Xs (variables) with the four KPOVs were then evaluated, where we indicate 9 as a strong correlation and 0 indicates no correlation according to the research evaluation result. The correlation numbers in each X were cross-multiplied by the importance numbers of each Y and summed across each row. Particular key process input variables (KPIVs) with high priority scores were selected ; these included “the completeness of the information offered by the replenishment system”, “the reference period for calculating replenishment quantities”, “the available space for stock at each service center, trends in new product sales”, “the changes in sales of promoted products” and “the professional knowledge of stock-refilling planners”. These KPIVs will be used in further analysis, such as FMEA, hypothesis test

and other statistical analysis to detect the potential roots cause of the weak logistics performances.

We analyze the root causes of the problems in the stock-refilling process and we point out a clear understanding of the factors that affects the process, including KPOVs, KPIVs and the sources of their variation. We employ the FMEA to analyze root causes of failure modes of the KPIVs. A failure mode means a way in which a specific process input fails, if it has not been detected and either corrected or removed, will cause effect to occur. Then, the failure modes of these KPIVs, effects and causes of the KPIVs' failure modes and current control plans against the KPIVs' failure modes were discussed. The severity of effects, the occurrence frequency of causes and the detection ability of these current control plans were also rated. The Risk Priority Number (RPN) of each cause of a KPIV was calculated by multiplying the severity, the frequency of occurrence and the current detection ability ratings. Table 1.4 presents the FMEA before improvement. For example, the severity of the effect of the failure mode, "information system cannot provide sufficient information for good replenishment planning", is 10. The occurrence probability of the cause is 7 and the detection ability of the current control method is 10. That means that the effect is very serious for customers if the refiling system cannot provide sufficient information for good replenishment planning. The occurrence probability of the cause is high. Furthermore, the research has noted that there was no any detection method to control this problem in the current process. Then,  $10 \times 7 \times 10 = 700$ . The RPN of this failure mode is 700. All failure modes of KPIVs were discussed and measured their severity of effects, the occurrence probability of causes, and the detection ability of current control methods. By using the same principle, the RPNs of all failure modes were calculated. We then have developed some recommended actions to eliminate the causes of KPIVs with high RPN or reduce the impact of these causes such as redesigning the stock refilling system, the department of inventory management should provide requirement to redesign the system and draw a mechanism to monitor available space at service centers.

The Fishbone diagram for stock-refilling process demonstrates in which way the refilling method, planning, manpower, environment and the information system have made a serious failure in refilling products to each service center. The inadequate supervisions of staff to ensure the schedule and plans to refill each service center according to each type of demand result to complaints of customers on products they receive which are totally different than what they have ordered for. Furthermore, the carelessness of staff to respect each ordered product to be refilled is a part of a big mistake the company has registered. Additionally, the geographical condition of the region has not facilitated the refilling process, along with the old information and communication system that have lowered the stock-refilling process, leading to an unsatisfaction of customers. Figure 2 shows the Ishikawa diagram of the stock-refilling process.

### **Analyze Stage**

The objective of the analyze phase is to include the analysis of roots cause of problems, process inefficiencies and defining improvement opportunities (Furterer and Elshennawy, 2005). We divided a month into three periods of ten days. Distributors generally make extra effort in the last third part of a month, and so sales volumes rise in that period. On the other hand, we find that the sales volumes of some products are stable, but the sales volumes of other products are more variable. We classify the products based on their average sale volumes in the preceding three months. We divide all products into three categories.

- 1) Category A of product: general items. The sales volumes of these items are stable. About 30 items are in this category. They include nutriments, vegetables, Sugar, cereal powders. Based on average sale volumes, in the preceding three months, these products represented 90% of the total sales volumes of all items.
- 2) Category B of product: slow-moving items. Sales of these items are highly variable and uncertain. More than 50 items are in this category. They include product advertisements, distributors training CDs and materials, C sugar and combustible derived products. Based on average sales volumes over the preceding three months, they represented less than 10% of all sales. □

- 3) Category C of products: new products. A new product is the one that has been on sale for no more than two weeks such as news shapes of sugar quality and tastes. □ We doubt that various service centers would have various features that would influence their sale volumes of some particular items that are not often sold out.

In fact, we construct these following major concerns :

- Do sales volumes vary with time each month ?
- Do mean sales volumes vary among service centers ?
- Are the average sales volumes of diverse products indifferent service centers the same ?
- Is there any difficulty for organizing the sales of different items and reorganize the communication between service centers and the logistics center ?

Type of products, period of the month and service center are chosen as the factors for a three-factor Balanced Analysis of Variance (Balanced ANOVA). The product types are divided into the aforementioned categories A and B. Since product category C concerns new products on which no historical sales data are available, it is not considered. The sale period had three levels: (1) the first ten-day period; (2) the middle ten-day period; and (3) the last ten-day period of a month. Finally, all the service centers are considered. We collected historical sales data from the last 12 months for analysis. Balanced ANOVA was carried out at a 5% significance level and 5% power. The statistical software, Minitab, was applied. Table 1.5 presents the test results.

Based on the results, product and center respectively have important values on the total of the SS and the interaction of period\*period, product\*center and period\*center are less significant. We can say that since all  $p$ -values for the three main factors were significantly lower than  $\alpha$ , we conclude that the sales volumes varied significantly with the various product type, period and service center. Additionally, main effect plots were employed to compare the means of sales volumes at different levels of the three critical factors, with a reference line drawn at the overall mean of the response data. The main effect plots (Figure 3) demonstrates that the all three main factors significantly affected sales volumes.

The effects of the interaction between the product type and the time of the month factors and between the product type and the service center factors were also significant. Based on these results, we need to establish refilling rules according to the sales volume of each product type in each period within the month and for each service center.

According to the research findings, we suggest that the refilling system needs to take in consideration the factors of product type, the time of the month, and service center. Additionally, the creation of organizations-association project with the objective of putting efforts together by investing money from each of the associated organizations including the local government for example to create a man-made river or open a fluvial shipping way for not only facilitating logistics processes in the country but also to facilitate some issues intimate for the government, a consideration of creating a railway for a better and accurate logistics is much necessary for solving a wide range of the logistics problem that affect business operations and lead to some deregularity in both management and business sales strategies without forgetting the customers satisfaction as well. Due to the significance of statistical analysis on the interaction between the product type and the time of the month factors and between the product type and the service center factors, it is also suggested that a new stock-refilling rule should be established in the system for considering these interactions.

### ***Improve Stage***

After verifying and analyzing the KPIVs, the research has moved on to the improve stage. The objective of the improve stage is to eliminate the causes identified in the above phases. A number of improvement actions were implemented for the better improvement.

- 1) Refilling products based on different rules for the A, B, and C categories
  - a) Product category A : Since the sales volumes of category A products were stable, the managers should calculate the inventory level of such products by inventory-holding-days. If the inventory level of an item at a service center is lower than its reorder point (ROP), the logistic

center will supply the item to that center. The ROP for each item at all service centers were established by simulation. However, the inventory level of each item at each service center after refilling may not exceed five weeks of sales volume for that product. To prevent any increase to the shortage rate, the safety stock of Bangui center for example of two days was established, because of space limitations and the frequent refilling of this center, while at the others centers was three days to check considerably more often.

- b) Product category B : The sales volumes of category B products are very uncertain. Accordingly to the research, we decided to calculate the inventory level for each of these products. If the inventory level of an item in a service center is lower than its ROP, then the logistic center will refill the item to the service center by using more than 7 trucks and 3 daily cargo according to the sales volume and demand instead of minimum distributing service that was set. The ROP and safety stock levels of all items in each service center were also established.
- c) Product category C : The refilling quantity of a new product is determined by the forecast made by the marketing department. After seven days of sales, the new product is classified as belonging to category A or B. Its ROP and safety stock are thus decided.

The refilling system is redesigned to suggest automatically refilling plans for all service centers based on the rules for categorizing products in order to avoid providing some goods by error. Then, service centers can provide sufficient inventory to distributors and reduce the shortage rate.

## 2) Analysing the space available for stock at service centers

Staffs should analyse how to evaluate space available for stock at each service center. The available stock volumes of the racks plus the volumes provided by each warehouse equals the total available space for stock at a service center. This space was calculated in units of inventory-holding-days. We summed the inventory levels and calculated the average number of inventory-holding-days at their centers. The usage rate of inventory space at a service center is the present average number of inventory-holding-days of all products divided by the total available space for stock at the service center. Finally, for lightening the work load of employees of service centers, the total available space for stock and the maximum volume of stock at each service center will be reviewed every a half year.

## 3) Setting the reference period for calculating refilling volumes

The original stock-refilling rule was very simple and did not consider the variation of sales with the time in the month, the new stock-refilling rule for an item is based on its average sales volume in the preceding three months. For example, if planners want to refill an item to a service center from 4/1 to 4/7, they can determine the refilling volume of the item from its average sales volume over the corresponding periods in the preceding three months 1/1 to 1/7, 2/1 to 2/7 and 3/1 to 3/7 at the service center. The sales volume of the preceding week is also noted as a reference.

The system automatically suggests a refilling plan for each product based on these new reference periods. If the suggested volume of a product for a specific service center is smaller than the available volume for stock at the service center, then the system will specify the suggested volume as the refilling volume. Otherwise, it will set the available stock volume at the service center as the refilling volume.

## 4) Reducing frequency of refilling and make the adequacy refilling process to different centers

According to the characteristics of the direct selling industry, the company must ensure that it is never out of stock. Therefore, the inventory levels of service centers are high. However, since the shipping time from the logistic center to all service centers is less 3 days and all service centers had much available space for stock were plentiful, this study has elucidated that if the logistic center provided right items and sufficient of the items to the service centers, then shipments from the logistic center to the service centers need not be made daily since the transportation cost is also higher in that daily case. The research can show that the managers should begin to try to reduce the frequency of stock-refilling of the service centers in the redesign of the system. Initially, they should decide that the logistic center did not refill to the service centers on a specific day. Then, they should determine for example that the logistic center refill Boda, Birao, Bambari and Bangui



centers three times a week. Consequently, the employees in service centers indicated that the workload of them also was lightened.

5) Generating a low inventory warning report

The low inventory warning report can provide planners with information regarding products which inventories require special attention, to enable emergency measures to be taken. This report lists items whose inventory levels are lower than safety stock levels. The refilling system can provide low inventory warning reports on a specific item or all items, and for one service center or all service centers. The report is very helpful in preventing increased shortage rates when the frequency of stock-refilling is changed.

6) Investigating trends in new product sales

In most of the cases, sales of a new product decline gradually. The refilling volume of a new product for each service center on the first day of sales is determined based on a forecast made by the marketing department. Then, stock-refilling planners must determine how many units of the new product should be supplied to each service center after the first day of sales. Since the demand for new products is very hard to estimate, but the frequency of new product launches is low, the research has collected historical sales data on the first seven days of sales of many new products, and investigated trends in those data. Based on these data, refilling planners should establish some decrease rates for sales of various product types during the first seven days of sales. Refilling planners can use these decrease rates of the same product type to predict the demand for the new product from various service centers during the promotion period and modify the refilling volumes based on actual sales conditions.

7) Plans for stock-refilling training

According to the FMEA, the knowledge and experience of stock-refilling planners are critical. The research proposes a training program that covered information system functions, basic statistical tools and plots, new product sale trends and the characteristics of products and service centers. A checking system can also be established to examine the effectiveness of the training. Examinations were conducted to help people to improve performance.

### **Control Stage**

A DMAIC project is not only about focusing largely on improving process performance, but also maintaining those improvements over the long-term without any possibility of running out. A control plan attempts to implement ongoing measures and actions to sustain improvements by monitoring, standardizing, documenting and integrating new processes daily. The control plan in this project helps to ensure that the improved refilling process actions became institutionalized by redesigning the refilling information system for a shortage rate and reducing transportation costs, establishing a mechanism for determining the available space for stock at service centers, sending a product promotion schedule report from the service centers to the logistics center, and providing adequate training on all standard operation procedures (SOP).

For the refilling process, some service centers, such as Birao, Bambari and Obo, Cameroon, Tchad, Equatorial Guinea, Republic of Congo, Sao tomé, Ndélé should be refilled two times a week. We can say that the logistic center has to refill other service centers two times per week because of the long and inconvenient distance for a daily stock-refilling. The logistics center should replenish these distant service centers once and with important quantity of products to avoid shortage as well. Transportation fees were thus reduced substantially. Additionally, the urgent shipping rate decreased from 0.75% to 0.51% within three months after the project had been settle. Although the frequency of refilling of service centers was reduced, number of abnormal shipments did not increase, but decreased. All supervisors of service centers must believe that the refilling items and quantities meet the demands of customers and reduce inventory levels. Furthermore, when the information system is redesigned, the average time taken by a planner to plan the refilling of a service center is reduced from 14 hours to less than 6 hours.

We have also pointed the importance of the risk priority numbers (RPN) of all KPIVs after implementing the improvement actions using FMEA. The severity of effects, the occurrence probability

of causes, and the detection ability of the improved process were measured. We have found that the RPNs of all failure modes of KPIVs have been reduced (Table 1.3). For example, they must redesign a refilling system to help the planers to decide correct refilling items and calculate the refilling volumes of these items. Additionally, Department of Inventory Management must provide their requirements for redesigning the refilling system. After the system redesigning, we have measured the severity of effects of the failure mode “system cannot provide sufficient information for good refilling planning” was still 10. However, the occurrence probability of its causes, and the detection ability of the improved process were both 1. Then, the RPN of the failure mode was decreased from 700 to 10. That is the proof that the feasibility of the improvement action is verified.

Defects of service can also cause an increase in costs. The DMAIC improvement methodology can reduce the number of defects ; therefore, it can reduce costs. Beyond defects, the company suffers losses due to cost of poor quality (COPQ).

### **Discussion and Conclusion**

This study demonstrates the benefits after implementation of the DMAIC project. For the stock-refilling process, we propose to change the information system according to the DMAIC procedure. The new information system provides sufficient information for making good refilling plan, the system calculates refilling volumes based on correct reference period, service centers provide correct data on available spaces for stock after integrating the new technology system. In addition, the implementation of the methodology for training can reduce the company's COPQ, by teaching personnel how to create a repeatable, reproducible system of quality improvement. After the implementation of the methodology, customer satisfaction could be improved substantially. The faster process will give the staff more time for customer service and the level of customers satisfaction will be improved.

Based on the study, it is noticed that many external factors have a great impact on the performance of the logistic operation of SUCAF. Therefore, we suggest the company should concentrate efforts to collaborate with other business giants, including the government, to solve these external problems. First, it is suggested to invest in the railway network for fast and reliable distribution operation. It is not only for the good of SUCAF only, but also benefiting the economy of Central Africa. Second, efforts should be paid to break off the enclosure situation by creating a way of delta river, which can conduct to the nearest sea for quantity shipment for a low cost as a benefit.

Moreover, if implementing concretely, the financial contribution offers continuous power to create more projects and improve the business process. Numerous invisible gains can be received from the implementation of DMAIC methodology project. For example, it can provide customers excellent service, increase customer satisfaction, enhance the reputation of Sucaf, help to train the employees of the company, and establish continuous improvement culture. The implementation of this methodology can change the way employees think by teaching fact-based decision making to all levels. The methodology can also change the way managers and employees think and by improving the management channel by developing management and communication skills in people since people especially in Central Africa are more psychologically limited by what they often do. The truly successful implementation efforts evolve with a focus on providing value to customers and making the company more successful. The methodology of DMAIC clarifies a good platform for discussion and problem solving rather than emotions in critical decision-making which is too simple. Combined with data analysis and statistical verifications, the methodology is useful for identifying the actual causes of problems.

After the implementation of these improvements, there is an examination of the benefits released by DMAIC project :

- The stock refilling frequency is more reliable and faster to each service center, and customers can easily receive products they desire or have ordered for.
- The shortage rate is reduced for not only avoiding excessive urgent shipping costs but also to reduce double labor of the staff to arrange or being occupied again for the matter of urgent shipping. The reduction of the shortage rate significantly improves customers satisfaction.

- A better communication between the logistics center and service centers can be achieved and the timing of planning stock-refilling can be reduced if a new IT system is used.
- The improvement of the the process can save a lot of money of SUCAF considering the high frequency of the stock-refilling and on mailing operations annually.

During the implementation of the control actions, a continuous communication with the employees can reduce the resistance and produce valuable suggestions. In addition, the DMAIC project needs to be well documented to ensure that outputs can be delivered and objectives can be reached in every phase. The implementation of the DMAIC methodology in Sucaf can help the company to considerably elaborate the logistics performance, which can also serve as a good example for many organizations in Central Africa to improve their own logistics operation.

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