Implementation of Six Sigma quality system in vegetable oil industry to reduce the cycle time of filling process(a case study)

Hussein S. H., El-Barbary O. M., El-DifrawyE. A. and Shaltout O. E.
Dept. of Food Science, Fac. of Agric. Saba Basha, Alex.univ., Egypt

ABSTRACT

Six Sigma Quality System (SSQS) had been implemented in the Derivative Oils and Products Company in Alexandria to reduce the process cycle time in the filling unit during 2010-2011 fiscal year. The customer survey and statistical analysis indicated that there were a lot of problems and complains due to delaying in delivery time which caused very low market share for company products. At the start of the study, the initial delaying in delivery time was 18% of the total delivery orders with initial Sigma level of 2.53 representing a revenue loss of about 1.34 million Egyptian pounds per year. With implementation the system, the delaying in delivery time became zero % and the Sigma level increased to more than 6.00 and achieved extra profits of 1.21 million Egyptian pounds per year.

Keywords: Six Sigma; Quality System; vegetable oil; cycle time; filling process

INTRODUCTION

There are many meanings of the word "quality", two are of critical importance to managing for quality:

"Quality" means those features of products which meet customer needs and thereby provide customer satisfaction. In this sense, the meaning of quality is oriented to income. The purpose of such higher quality is to provide greater customer satisfaction and, one hopes, to increase income.

"Quality" means freedom from deficiencies, freedom from errors that require doing work over again (rework) or that result in field failures, customer dissatisfaction, customer claims, and so on. In this sense, the meaning of quality is oriented to costs, and higher quality usually costs less (Juran, 1999).

The quality revolution in the West was slow to follow, and did not begin until the early 1980's when companies introduced their own quality programs and initiatives to counter the Japanese success. Total quality management (TQM) became the centre of these drives in most cases (Williams, 2001).

Total quality management (TQM) is amanagementphilosophythat seeks to integrate all organizational functions (marketing, finance, design, engineering, and production, customer service, ...etc.) to focus on meetingcustomer needs and organizational objectives TQM encourages participationamongst shop floor workers and managers (Elnaasany, 2003).

The ISO 9000 series of quality standards was developed by the International Standardization Organization (ISO) in 1987, and has since become the international quality standard. This standard identifies the basic attributes of a firm's quality management system and specifies practical procedures and approaches to ensure that products and services are produced in accordance with the standards specified by the firm (International Organization of Standardization, ISO 9000, 2008).

In the past few years we have moved quickly from believing that managing quality just means conformance to specifications and requirements. Quality also means meeting and even exceeding the needs and expectations of customers. Quality includes having the right features, correct documentation, and error-free invoices. It also includes the proper functioning of critical business processes, on-time delivery, friendly and accurate technical support, and no failures. Quality involves reducing all the costs of poor quality (Juran, 1999).

Six Sigma can be considered as an extension of the other quality improvement initiatives such as Deming's statistical quality control and total quality management (TQM). These models consider a multi-stage manufacturing process with the opportunity to improve quality (scrap and rework rates) at each of the stages. Six Sigma is the process management tool that has yielded the greatest results in comparison with other quality systems and ranked much higher than other process improvement techniques (Dinesh et al., 2008).

Quality comes in two flavours; potential quality and actual quality. Potential quality is the known maximum possible value added per unit of input. Actual quality is the current value added per unit of input. The difference between potential and actual quality is waste. Six Sigma focuses on improving quality (i.e., reducing waste) by helping organizations produce products and services better, faster and cheaper. One reason why costs are directly related to Sigma levels is very simple: Sigma levels are a measure of error rates, and it costs money to correct errors (Pyzdek, 2003a).

Six Sigma was first introduced by Motorola Company in 1987 and was taken up by Allied Signal in 1991. In 1995, Jack Welch, the chief executive officer (CEO) of General Electric successfully established and published Six Sigma system. He implemented Six Sigma in many processes and documented significant gains in process and financial results.The simplest definition for Six Sigma is to eliminate waste that create value for customer (Chao-Ton and Chia-Jen, 2008).

Applications of the Six Sigma methodology emphasize the phases that are integrated in conducting a project, which include define-measure-analyze-improve-control (also known as the DMAIC methodology). With Six Sigma methodology, the benefits of an organization include not only higher levels of quality but also lower levels of costs, higher customer loyalty, better financial performance and profitability of business (Chao-Ton and Chia-Jen, 2008).

Six Sigma is more comprehensive than prior quality initiatives such as **T**otal **Q**uality **M**anagement (TQM) and **C**ontinuous **Q**uality **I**mprovement (CQI). The Six Sigma method includes measured and reported financial

results, uses more advanced data analysis tools, focuses on customer concerns and uses project management tools and methodology. It may be summarized as follows:
Six Sigma = TQM + Stronger Customer Focus + Additional Data Analysis Tools + Financial Results + Project Management (Kwak and Anbari, 2006).

Although, Six Sigma is most commonly used to reduce defects in the manufacturing process, the same methodology can be used to improve other business process. For example: it can be used to improve on-time-delivery, reduce cycle time for hiring and training new employees, reduce quality or delivery problems with suppliers, improve logistics and improve quality of customer service (Dinesh et al., 2008).

This system has yielded the greatest results (nearly 53.6 %) than other process improvement techniques. This fact is important because none of the remaining quality improvement initiatives have much application outside manufacturing industry. There are a lot of success factors for implementing a six sigma for example: management commitment and involvement, linking six sigma to business strategy, customers, suppliers, human resources and project selection, organizational infrastructure, cultural change, project management skills, training and understanding of six sigma methodology, tools, and techniques.The major barriers to success are the organizational resistance to change and the lack of commitments or supports from the top management (Dinesh et al., 2008).

Research on quality management and project management is surprisingly rare. Utilizing the project management framework identifies three key areas for successful project management: project context (business strategies), project content (project objectives and methods) and organizational behavior (human element). Six Sigma projects can enhance our understanding of effective implementation of project management and project outcome. The fundamental difference between Six Sigma and other process improvement programs (e.g. TQM, Lean, and the Baldrige model) is related to the ability of Six Sigma in providing an organizational context that facilitates problem solving and exploration across the organization. While Six Sigma programs have their roots in the quality movement, they are different from other quality programs (e.g. lean systems or ISO-9000) due to their limited time-frame, measurable and quantifiable goals and the project structure (Parast, 2011).

Despite, there are numerous publications on Six Sigma today that include case studies, comprehensive discussions, and a rapidly growing number of books and websites, the sheer magnitude is compelling, but to date there has been little conclusive empirical research regarding Six Sigma influence on industry, however, it has a lot of benefits and can be applied to any industry (Goffnett, 2004).

The aim of this study was to develop the quality system of the company processes, especially in filling unit for delivery time to meet customer satisfaction and increase market share and profits in food industry.

MATERIALS AND METHODS

Materials

This study was carried out in the Filling unit of Soybean oil of Derivative Oils and Products Company (Damanhour Factory) during 2010-2011 fiscal year in order to reduce the cycle time process and to improve the delivery time to insure that the products have been received at the exact proper time.

Methods

1-General scope

The process steps were following up starting from ordering the raw materials used in the filling unit until the final product reached the customer. The major causes of delays in cycle times like: labor productivity and efficiency, utilization of equipment and space, flexibility, waiting for the next step, excessive or ineffective supervision, over-production, unnecessary transport of supplies or product, unnecessary movement of employees and all other causes were studied, determined and the proper solutions were introduced to solve these problems.

2-DMAIC methodology

A five-step DMAIC (Define, Measure, Analyze, Improve, and Control) methodology was used for implementation of Six Sigma system which is a systematic procedure consists of:

-**D**efine the goals of the improvement activity (D). The most important goals are obtained from customers

-**M**easure the existing system (M). Establish valid and reliable metrics to help monitor progress towards the goal(s) defined at the previous step.

-**A**nalyze the system to identify ways to eliminate the gap between the current performance of the system or process and the desired goal (A). Use statistical tools to guide the analysis, where the data were analyzed using a set of statistical indicators and statistical assistance program (Minitab program).

-**I**mprove the system(I). Be creative in finding new ways to do things better, cheaper, or faster.

-**C**ontrol the new system (C). Institutionalize the improved system by modifying compensation and incentive systems, policies, procedures, budgets, operating instructions and other management systems.

3-Evaluation of customer unsatisfaction causes (consumer survey)

Consumer survey was carried out according to (Nancy, 2004). Alexandria governorate was divided into 3 categories of areas (each category consists of 30 customers) depending on income level of that areas. The complainsof the customers were evaluated and each complainwas calculated.

4-Prioritization of customer unsatisfaction causes (pareto chart)

This is a bar graph used to study the causes of customer unsatisfaction (defects) of the products. In this chart, the lengths of the bars represent the frequency and percentage of defects are arranged with the longest bars on the left and the shortest on the right. This chart visually depicts the most significant causes. Data were statistically analyzed using the Minitab Computer Program (Grec, 2002).

5-Selecting the best project (decision-matrix diagram)

This is a quantitative technique used to rank the multi-dimensional options depending on their priorities (Pyzdek, 2003a). It is frequently used in engineering for making decisions but can also be used to rank any multidimensional entities.

6-Planning and selecting six sigma team of the project (project charter)

The project charter is a written document issued by the project sponsor. The project charter gives the project team authority to use organizational resources for project activities. This document always include: Business Case, Opportunity Statement, Goal Statement, Project Scope, Project Plan, Team Selection, and signed by the leader of team and the project sponsor (Pyzdek, 2003a).

7-Determination the root causes for delaying in delivery time (fishbone diagram).

The possible root causes for delaying in delivery time were determined by sigma team using fishbone diagram by Minitab Computer Program(Eckes, 2003). These causes were divided into 5 categories starts by M letter called 5 M's included: methods, machines (equipment), manpower (people), materials and measurements.

8-Prioritization improvement ideas to reduce cycle time in the filling unit (nominal group technique).

There were a lot of causes affected the losses in cycle time in this process so, Sigma team selected the biggest five improvement ideas to decrease the loss in cycle time, then prioritizedthem by using nominal group technique (NGT) tool(Pyzdek, 2003b). The NGT is a method for generating a "short list" of the biggest items to be acted upon to decrease the loss in cycle time. By this tool we can know what is the most important idea we should implement firstly for reducing cycle time in filling unit then the second and the third and so on.

9-Adjusting the machine degree to desired filling rate (regression analysis)

Regression analysis (modeling the relationship between one or more independent variables and a dependent variable) are activities of considerable importance in Six Sigma. A regression problem considers the frequency distributions of one variable when another is held fixed at each of several levels. A linear model is simply an expression of a type of association between two variables, x and y. A linear relationship simply means that a change of a given size in x produces a proportionate change in y.

- Linear models have the form:$Y = a + b x$

Where: (a) and (b)are constants.

The equation simply says that when x changes by one unit, y will change by b units.

Data were analyzed using the Minitab Computer Programaccording to Pyzdek(2003,a).

10-Statistical analysis

Production amount and delivering time were statistically analyzed to evaluate the significance differencebetween before and after applying the improvement ideas (2- proportion test, p value at 5%) using the Computer Minitab program (Osama, 2007).

RESULTS AND DISCUSSION

The complains of the customer about the oil company products were evaluated by customer survey,collected and statistically analyzed using Pareto chart by the Minitab Computer Program as shown in Fig. (1).The customers reported that the mostcomplain approached to the process was the delaying in delivery time which represented about 18 % of the unsatisfaction causes.

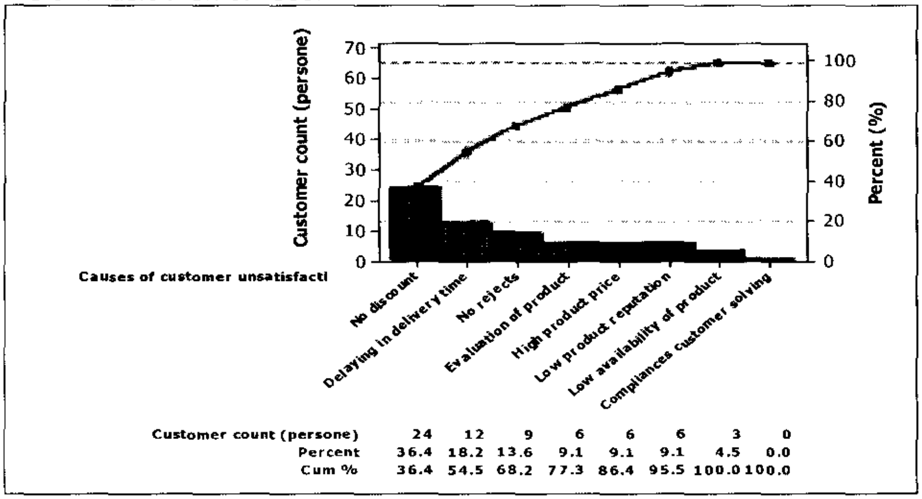


Fig. (1): Causes of customer unsatisfaction (pareto chart) for the company product (soybean oil)

Table (1) shows the decision-matrix method to rank the multi-dimensional options of andto select the best project for filling unit. Data showed that the reducing of cycle time scored the best project (30) of the total project types. Meanwhile, the customer satisfaction scored the most important business objective(27) as compared to other projects.

Table (1): Selecting the best project for filling unit (matrix diagram)

Project type	Business objectives				Total of project type
	Financial benefits	Customer satisfaction	Process yield	Employees efficiency	
Reduction defect	•	■	▲	▲	16
Improving the quality	▲	■	▲	•	16
Reduction cycle time	■	■	■	▲	30 *
Total of business objectives	13	27 ∞	15	7	62

Where : ■ = 9 ▲ = 3 • = 1
*** = The Best Project ∞= The Most Important Business Objective**

Table (2) shows the delaying in delivery time (%), defect per million opportunities (DPMO) and Sigma levels before implementation of SixSigma system and the target of the project. The process baseline before implementation was at 2.53Sigmalevel and the target was 6.00.

Table (2): Delaying in delivery time (%), defect per million opportunities (DPMO) and sigma levels before implementation of six sigma system and the target

Measure	Before implementation	The target
Delaying in delivery time/100 contracts∞	18 %	0.00034 %
DPMO¥	180000	3.4
σ level*	2.5	6.0

Where: ∞ = % Loss = the losses percentage of the products
¥ = Defect per million opportunities (DPMO) = the number of defectsexisted per one million of defect opportunities in the products
* = Sigma levels (σ) = a measure of error rates

Calculation oftargeted revenue of the project before implementation

The calculation was carried out according to the official documents of the company at fiscal year 1/7/2009 - 30/6/2010

Revenue loss = (production target tons/year - actual production tons/year) x final productprice/ton x profit percentage

Where: Annual production target = 25008 tons/year

Actual production amount = 20048 tons/year

The price of finaloil product/ton = 5400 L.E.

Profit percentage of the final oil product price for the company = 5 %

Revenue loss = (25008 - 20048) x 5400 x 5/100 = 1.34 million L.E./Year

The planning for improving the filling unit including business case, opportunity statement, goal statement, project scope, project plan and team selection were generated by the Sigma team in project charters as shown in Fig. (2).

Business case This project aims to match the company objectives for reducing the cycle time of the product at the customer requirements.	**Opportunity statement** We currently have a delaying in delivery time to the customer about 18 % from the delivery orders lead to decrease in costumer unsatisfaction, subsequently decreasing in market share and earnings, and represents a revenue loss about 1.34 million L.E./year. Current DPMO¥ for delivery time = 180000 and Sigma level * = 2.53.
Goal statement Decreasing the cycle time of the filling unit by reducing DPMO for delivery time to 3.4 and increasing the sigma level to 6.	**Project scope** Our project starts by request from the warehouse department for a specific filling raw material/s and ends by delivering the final product to the customer.
Project plan Data collection: from 1/11 to 30/11/2010 Define phase: from 1/12 to 31/12/2010 Measure phase: from 1/1 to 31/1/2011 Analyze phase: from 1/2 to 28/2/2011 Improve phase: from 1/3 to 31/3/2011 Control phase: from 1/4 to continued	**Selection of Sigma team** Leader of team: Prof. / Omar Elbarbary Champion: Mr./ Ezz-Eldin Badawy Green belt Six Sigma : Eng./ Shady Hussein R&D# G. M. ∞: Chem./ Aziza Maghawry Quality G. M.: Chem./Mostafa Moafy

Where: ¥ = Defect per million opportunities (DPMO) = the number of defects existed per one million of defect opportunities in the products

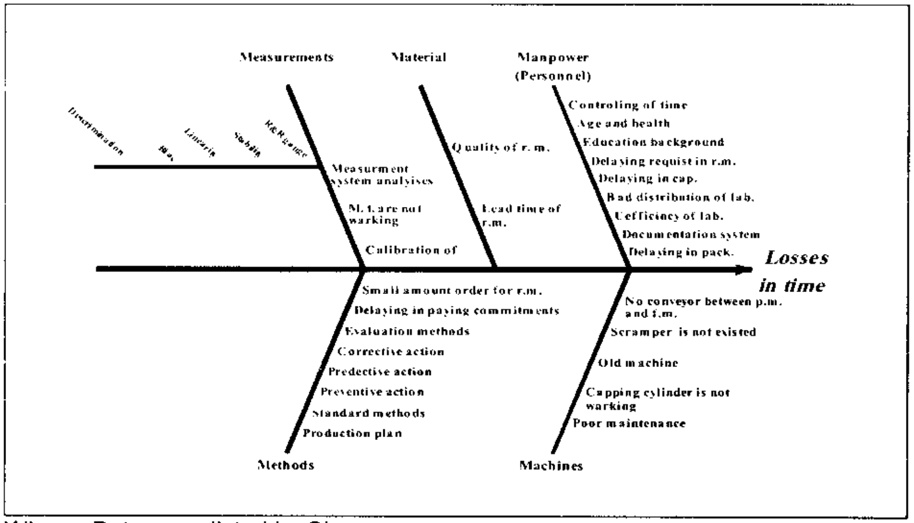
* = Sigma levels (σ) = a measure of error rates

\# = R&D = research and development

∞ = g. m. = general manager

Fig. (2): Planning for improving the filling unit (project charter)

Fig. (3) shows the root causes of delaying in delivery time (fishbone diagram) which reported by brainstorming of Sigma team for all the possible root causes of delaying at 5 categories started by 5 M's as follows: methods, machines (equipment), manpower (people), materials and measurements. These data were collected and generated to fishbone diagram by using the Computer Minitab program.



Where: Data were listed by Sigma team
m. t. = measurement tools r. m. = raw materials
cap. = capping process pack. = packaging in carton
p. m. = printing machine f. m. = filling machine
lab. = the labours in the company
R & R = repeatability and reproducibility measurement system analysis

Fig. (3): The root causes of delaying in delivery time (fishbone diagram)

The most five important improvement ideas for reducing cycle time in filling unit were selected for solving the most five root causes in fishbone diagram and generated to nominal group technique tool (NGT) as shown in Table (3).improvement ideas were prioritized descending as follows:

1- Make realistic monthly plan for raw material and production rate was the first (total score, 17). We applied it by making market analysis and customer survey to know what actually market need in the future and viewing supply chain table before making deal with the customer.

2- Set monthly maintenance schedule for filling machine to minimize stops was the second (total score, 12).

3- No delay in raw material requesting by warehouse was the third (total score, 9). We applied it by setting a critical limit for warehouse department

to start request when the amount of raw materials reaches to 10 % of original amount (manually or computerized).
4- Redesign the process line was the fourth (total score, 7).We applied it by fixing capping cylinder, setting scramper and conveyor between printing and filling machine.
5- Redistribution of labor in the company or increase number of trained labors in filling unit was the fifth (total score, 5) because we found that the filling unit is poor in labours number and there were another departments had exceed laboursthan its needs.

Table (3): Prioritizing of improvement ideas for reducing cycle time in filling unit (Nominal Group Technique tool, NGT)

Improvements	Appraisers*					Total
	A	B	C	D	E	
1- Make realistic plan for raw materials requesting and production rate	4	4	4	1	4	17
2- Set maintenance schedule	3	3	3	2	1	12
3- Warehouse does not delay in the request of raw materials	1	0	2	4	2	9
4- Redesign in process (capping cylinder, scramper, conveyor between printing and filling machine)	2	2	0	3	0	7
5- Redistribution of labors in the factory or increasing numbers of trained labors	0	1	1	0	3	5

Where: Appraisers*= The five appraisers were the Sigma team selected in project charter and evaluated the importance degree of each improvement ideas from 0 to 5.

Table (4) shows the total cycle time of process (supply chain) for every steps to produce 100 tons of final product (days) depending on the official documents of the company.It was important for production, quality and marketing departments to know what time they need to produce the product at all possible conditions when making deals with customers.This would make delivery time more exact. Table (4)also indicates that, the longest possibility to produce the final product when we want to produce a new product (there are new raw materials by new suppliers and we need to extract, refine and package oil), it needed 64.70 days. On the other hand, the shortest possibility to produce the final product when we want to produce the old product and we have enough raw materials in warehouse and refined oil, it needs only 2.70 days.

Table (4): Total cycle time (days/100 tons final product) at all possible conditions for contracting with customer

Process steps	Cycle time of all probable conditions of processing in the Damanhour factory (days/100 tons final product)				
	Con. A°	Con. B^{β}	Con. C^{∞}	Con. D^{*}	Con. $F^{¥}$
1-Inventory request for raw material	1	1	-	-	-
2-Tendering	30	-	-	-	-
3-Supplier prepare utensils	15	-	-	-	-
4-Sending delivery order to supplier	1	1	-	-	-
5-eceiving the raw materials	15	15	-	-	-
6-Extraction process	3.3	3.3	3.3	-	-
7-Refining process	1.3	1.3	1.3	1.3	-
8-Filling process	2.7	2.7	2.7	2.7	2.7
9-Final product to warehouse	-	-	-	-	-
Total cycle time (day)	64.7	19.7	7.3	4	2.7

Where: Data collected depending on the official documents of the company
Con. A° = New product needs new suppliers for all raw materials
Con. B^{β} = Old product and old suppliers but the raw materials (seeds, crude oils and packaging materials) were not existed
Con. C^{∞} = Old product, old suppliers and the seeds were existed but the crude oil and packaging materials
Con. D^{*} = Old product, old suppliers and raw materials (crude oil and packaging materials) were existed
Con. $F^{¥}$ = Old product, old suppliers and all raw materials and refined oil were existed)

As shown in Table (5), from the machine speed (degree) and filling rate (bottles/min.), we createda regression analysis to reduce defects and cycle time where any engineer can quickly adjust the machine degree to the filling rate he wants depending on production plan, where:
Regression analysis: Filling rate (bottle/min.) (Y)Versus the degree of machinegauge (X)

Filling rate (bottle/min.)= - 20.0 + 15.0 degree of machine gauge
or, Y = - 20.0 + 15.0 X

Table (5): The relationship between the speed of filling machine (degree) and filling rate (bottles/min.) at all possible conditions of production rate:

Production rate	Speed of filling machine (degree) (X)	Filling rate (bottles/min) (Y)
Minimum	3	25
Optimal	4	40
Maximum	5	55
Very high	6	70
Regression analysis	Y = - 20.00 + 15.00 X Filling rate (bottle/min) = - 20.00 + 15.00 machine speed(degree)	

Calculation of profits revenue(achieved) of the project after implementation

The calculation was carried out according to the official documents of the company at fiscal year 1/7/2010 - 30/6/2011.
The production amount/year was 24507.84 tons of refined oil.
The percentage of year production amount (actual)/year production amount (target)
= 24507.84/25008 x 100 = 98 %
Revenue loss=(25008-24507.84) x 5400 x 5/100 = 0.13 million L.E./Year
Whereas, the revenue loss before implementations was 1.34 million L.E./Year
Consequently, the total profits gained by implementation of SixSigma system
= 1.34 - 0.13 = 1.21 million L.E. / Year
Percentage of success to achieve target
= 1.21/1.34 x 100 = **90.3 %**

This result is very higher than the average of world success for implementation of SixSigmasystem projects where, it is 53.6 % (Dinesh et. al, 2008).

After applying customer survey for delivery time after implementation the system, the results shows that the customer satisfaction for delivery time raised to 100 % from customers sample. Table (6) shows the percentage of actual and target production and exact delivery time (orders delivered at contract time) before and after implementation of SixSigma systemand applyingsignificant difference analysis (2-proportions Analysis, p value at 5%).
The data revealed that, there are significant difference between before and after implementation of SixSigma system for both production amount/year

and percentage of customer satisfaction for delivery time, that means,there was a positive effect for implementing SixSigma system.

Table (6): Statistical analysis for percentage of actual production from the target and exact delivery time (orders delivered at contract time) before & after implementation of six sigma system improvements

Analysis	Before	After	2-proportions analysis (p value at 5%)	Significance
Percentage of actual production from the target	85.9 %	98 %	0.02	S.D.*
Exact delivery time (orders delivered at contract time)	82 %	100 %	0.0	S.D.

S.D. * = Significant difference

Table (7) shows comparison between delaying in delivery time (%), defect per million opportunities (DPMO) and Sigma levels before and after implementation of SixSigma system. The data showed that, Sigma level increased from 2.53 to more than 6.00. This means, we achieved more than our target.

Table (7): Delaying in delivery time (%), defect per million opportunities (DPMO) and Sigma levels before and after implementation of Six Sigma system.

Measure	Before implementation	After implementation
Delaying in delivery time / 100 contracts[∞]	18 %	0.0
DPMO[¥]	180000	0.0
σ level[*]	2.5	> 6

Where:∞ = % Loss = the losses percentage of the products
¥ = Defect per million opportunities (DPMO) = the number of defects existed per one million of defect opportunities in the products
* = Sigma levels (σ) = a measure of error rates

CONCLUSION

SixSigma has been widely adopted in a variety of industries in the world and it has become one of the most important subjects of debate in quality management. So, we wanted to implement it to derivative oils and products company to decrease customer unsatisfaction for delivery time delaying and revenue losses. Before implementation, the company had a delaying in delivery time to the customer about 18% from the delivery orders and Sigma level was 2.53 and represented a revenue loss about 1.34 million L.E./year. After implementation, a delaying in delivery time to the customer became zero % from the delivery orders and Sigma level became more than 6.00 and representedprofits about 1.21 million L.E./year. These results indicated that the implementation of Six Sigma quality system in vegetable oil industry reduced the cycle time of the process and increased the profits and customer satisfaction.

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الملخص العربي

تطبيق نظام الجودة ٦ سيجما في تصنيع زيوت الطعام لتقليل وقت العملية التصنيعية لوحدة التعبئة (دراسة عملية)

شادي حسين حماد، عمر محمد البربري، انتصار عبد المحسن الدفراوي و أميمة السيد شلتوت

قسم علوم الأغذية، كلية الزراعة (سابا باشا)، جامعة الإسكندرية

يعتبر نظام الجودة ٦ سيجما من أهم الأنظمة الإدارية التي تستخدم لحل المشاكل وتطوير عملية الإنتاج باستخدام طريقة منهجية وأدوات إحصائية تساعد في الوصول لأصل المشكلة وأحسن طرق الحل والتطوير. أجريت هذه الدراسة على وحدة التعبئة لزيت فول الصويا بشركة الزيوت المستخلصة ومنتجاتها بهدف تقليل وقت العملية حتى يتم الالتزام بوقت تسليم المنتج وا رضاء العملاء.

تم في البداية عمل استقصاء للعملاء لمعرفة ما هي متطلباته وما هي أهم المشاكل بالنسبة له ووجد أن نسبة عدم الالتزام بوقت التسليم يمثل ١٨ % ومنها تم حساب مستوى السيجما والذي كان ٢,٥٣ ، هذا أدى إلى خسارة سنوية تقدر ب ١,٣٤ مليون جنية/ سنة . وبتتبع الطريقة المنهجية ديمايك (DMAIC)والتي تتكون من ٥ مراحل: التعريف والقياس والتحليل والتطوير والمراقبة، تم معرفة الأسباب الجذرية للمشاكل ووضع أحسن الحلول لها وتطبيق هذه الحلول وتم عمل استقصاء للمستهلك مرة أخرى لمعرفة هل حدث تأثير لتطبيق النظام أم لا وكانت النتائج كما يلي :

١- أصبحت نسبة تسليم المنتج للعميل في الوقت المتفق علية ١٠٠ % من عينة الاستقصاء.

٢- وصل مستوى سيجما لوقت عملية التعبئة وتسليم المنتج للعميل أكثر من ٦,٠٠ أي أكثر من المستهدف.

٣- تم تحقيق أرباح كلية مباشرة نتيجة تطبيق هذا النظام أكثر من ١,٢١ مليون جنية سنويا كمكاسب مباشرة.هذا بالإضافة للمكاسب غير المباشرة والتي يتوقع الحصول عليها سواء نتيجة زيادة إرضاء العملاء وبالتالي سيحدث زيادة في الحصة السوقية والمبيعات وبالتالي الأرباح أو التي يتم الحصول عليها من تدريب المديرين والمهندسين والعمال على طرق الإدارة والجودة والإحصاء الحديثة وهذا يزيد من كفاءتهم وتقليل الأخطاء والخسارة وبالتالي زيادة في الأرباح عن المقدرة حاليا ولكن نتيجة هذا يحدث بعد سنوات.

هذه النتائج تم الحصول عليها من خلال تطوير خط تصنيع واحد فقط ومن الممكن أن تتضاعف هذه الأرباح بتطبيق هذا النظام على باقي خطوط التصنيع بالشركة أو تطبيقه على شركات أخرى.