

Implementing Quality Management Techniques into a Dental Office for Improving Performance of the Operations.

*Hector H. Peña Pons
Manufacturing Engineering
Rafael A. Nieves, PharmD
Industrial Engineering Department
Polytechnic University of Puerto Rico*

Abstract — *The objective of this research is to improve operations of a dental office by the application of Quality techniques. In this research, the performance of the actual process was evaluated and categorized to achieve a desired improvement by the application of Lean techniques and Six Sigma tools to overcome a defect. A survey was handed to 48 patients to measure satisfaction and to collect feedback related to the process; other survey was handed to the dentist to collect additional data. The use of field observations and monitoring allowed the base for the development of ideas to solve the defects identified by the quality techniques. Further definition and organization of the process was determined to ensure the process flow with minimum amount of bottleneck that resulted extensive waiting times and increased cycle times. The overall cycle time of the process was reduced by 27% and the patients waiting time reduced by 20 minutes, resulting in an improved customer satisfaction.*

Key Terms — *Dental Office, Lean Techniques, Six Sigma, Waiting Time.*

INTRODUCTION

Continuous improvements are commonly observed in all industries and companies around the world to optimize performance of operations and better customer satisfaction. The dental operations are not an exception, one common concern that companies in that sector have is the waiting times and the scheduling process. The definition of steps inside a process plays an important step for determining and achieving any process improvement.

Waiting times are directly influenced by the flow of patients entering and exiting the premises at a given time, the methods used to assign and follow

up appointments and by the accurate use of resources and policies. The actual process needs to be evaluated in details including customer feedback as a backup data. That is why customer satisfaction has an important role in the success of this research and in the acceptance of the business. The operations need to be better organized and planned to capture the attention of new patients and to maximize the experience of the existing ones. The intent is to improve performance of the operations without financial resources, without drastic changes to the process and with accurate problem solving techniques. It is expected to have a reduction in the waiting time of the service and as a result, a reduction in the overall cycle time of the process. The management, administration and definition of the daily activities of the internal suppliers have an important role in this business, as observed by the customers. An improvement in waiting time and scheduling process is directly proportional to improved customer satisfaction; that is why bottleneck in the process must be evaluated to maximize the patient experience and satisfaction when entering the office premises.

PROBLEM STATEMENT

Dental Clinic A is an office located in Vega Baja that offers service to patients seeking treatments for improving dental health. Services offered by the office are, but not limited to, dental exams, x-rays, full/partial dentures, fillings, cleaning (Prophylaxis), root canals, bridges, crowns, cavities treatment, tooth extractions and dental emergency services. Three employees offers service in the office, there are a certified Dentist and two assistants. The dentist attends the patients using two dental work stations, and the assistants receive patients, fill all the paperwork, schedule

follow-up visits, and facture bills to the medical plans. Some problems exist in the office in the way of handling and scheduling the appointments that result in not having the expected quantity of patients for service, high/low number of patients at a time, and not guaranteed patient's assistance to appointments. Other problem that exists emerges from the daily duties assigned to the assistants that results in having periodical non-value added activities. Any optimization in the management of the process and improvements on how the appointments are scheduled are beneficial to the overall performance of the office. The implementation of Quality Management techniques to the daily duties will overcome the deficiencies and thus improve the office performance.

RESEARCH DESCRIPTION

This research will assess the actual performance of a dental office to determine how activities can be rearranged for improving the performance output by the use of Lean philosophy and DMAIC methodologies. Since the opening of the dental office in 1994, the assistance of patients to appointments is not regular and results in abundant waste time or excessive work due to the inaccurate scheduling process. Evaluation of the actual routines and duties of the assistants and the investigation of the actual scheduling techniques will determine the current baseline that will provides the quantification of the improvement.

RESEARCH OBJECTIVES

Implementation of a "Pull" service by the use of accurate planning of prescheduled appointments. Improve and handle the dental assistant's daily activities by the use of Quality Management techniques. Organize daily tasks for improving the assistant performance on the scheduling process. Determine optimum manpower necessary to perform the following tasks: receiving patients in the waiting room, the documentation process, scheduling appointments and medical billing. Implement an effective follow-up method for

appointments. Evaluate the best method for appointments, first in-first out (FIFO), or by preset appointments.

RESEARCH CONTRIBUTIONS

Waste of resources and lack of accurate schedules affects the overall performance of the return of investment (ROI) of the business. As a result, the optimization to the service time offered by the office, and the improvement to the dental assistant's performance on daily activities will provide quality service and greater revenues by ensuring patients assistance for service. Increment of assistance to a preset appointment will be obtained for avoiding idle time or overtime during the working day.

LITERATURE REVIEW

To let the research have the background necessary to understand the topic that will be investigated, is important to know the services that are commonly offered by a dentist and the services client seeks. Now that companies are beginning to awaken in their intention to work on methodologies for operational excellence, there are concerns to make decisions about which Lean or Six Sigma method is the best and most convenient to achieve the desired state of the service.

One of the most popular strategies is Six Sigma. Six Sigma methodologies provide a tool, DMAIC, which will be used to define, measure, analyze, implement and control the problems identified when the research starts. Numerous well-established quality management methods and statistical tools are used within DMAIC to drive process improvements by identifying and eliminating the root causes of defects. In the other hand, Lean will guide the researcher to improve the flow of the services by creating more value with fewer resources. Lean can be applied in every business and every process. It is not a tactic or a cost reduction program, but is a way of thinking and acting for the benefit of an entire organization. The benefits generally are lower costs, higher

quality, and shorter lead times. Figure 1 describes the powerful union between Lean methodologies and Six Sigma [1].

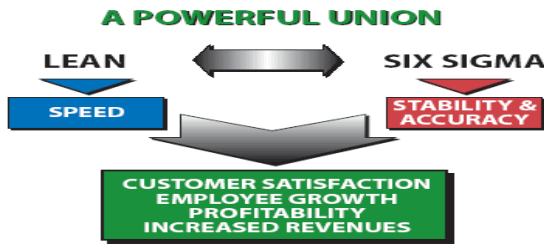


Figure 1
Lean and Six Sigma

METHODOLOGY

An accurate implementation of DMAIC methodology and Lean techniques will guide the researcher to identify the roots causes and solutions available to overcome the existing problems for the improvement of the overall performance of the services offered by Dental Clinic A. DMAIC is a useful 5-step methodology that will be used to increase productivity. Each of these phases are interconnected with one another as well as interdependent. Figure 2 shows the DMAIC phases [2].

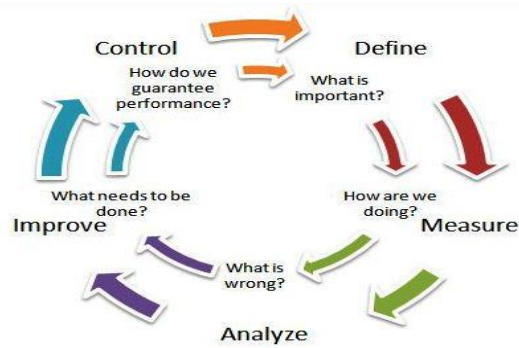


Figure 2
DMAIC Phases

Define Phase

In this phase, the business goals and customer demands are identified. The purpose and goals of the project are defined. The leader of the research makes a charter document which includes the scope, goal, duration and problem. The team defines the problem and then sets about finding the root cause and finding ways to eliminate that cause.

- The project charter [3] is used to define the customers and requirements (CTQ's). Defines what needs to be accomplished and decide how the project is going to proceed. The purpose, goals, risks, limitations, resources and indicators of success for this research should be defined. In this step, roles and responsibilities will be distributed across the affected parties, including available resources.
- A Project Schedule (Gantt Chart) [4] will be developed to graphically represent the duration of the tasks against the progression of time for this research. Allows the researcher to plan, organize, schedule and monitor the progress of tasks to meet the expected completion date.
- The SIPOC Diagram [5] is used to identify all relevant elements involved in the process to be improved before the research starts. The tool name prompts the researcher to consider the Suppliers (the "S" in SIPOC) of the process, the Inputs (the "I") to the process, the Process (the "P") the research is improving, the Outputs (the "O") of the process, and the Customers (the "C") that receive the process outputs. The diagram supports the definition of the process flow map required on the Measure phase of this DMAIC.

Measure Phase

The business process is measured for a better performance and the problem is quantified. The feedback of people who offer and receive the service, and the way the service is offered are all measured. All relevant data, important to the service, and the processes followed to complete the service are collected at this stage. This phase focuses on measurement system validation and gathering root causes.

- A process flowchart is used to define defects, units, metrics and opportunities; should guide to the identification of unnecessary delays in the process, unnecessary steps, unnecessary involvement of people and allocation of resources in the process. A Value Stream Mapping (VSM) is used in this step, to define

actual flow of activities per period of time. The process flowchart helps to define the primary process for then, in the Analyze Phase, analyze the bottlenecks in existing procedures. Very useful to understand the interaction of activities to realize how a step influences others.

- The voice of the customer will be used to obtain feedback of the service. On this research will be captured by observations and field reports.
- A Survey, as a Data Collection Plan, will allow the researcher to gather specific feedback from a sample of customers in order to determine opportunities for improvement within the process.

Analyze Phase

This phase helps the researcher to analyze and learn the root causes of the problem. It is important to analyze the feedback given by customers, as they are the end users of the service and the service needs to fulfill their needs. In this phase, the root causes of the problem are identified.

- The Pareto Chart [6] will guide to the sources of variation in the process. These charts are based on the Pareto Principle which states that 80 percent of the problems come from 20 percent of the causes. Used to identify those factors that have the greatest effect on the system, and thus exclude the less significant factors in an analysis. Ideally, this allows the researcher to focus attention on a few important factors in a process.
- A Root Cause Analysis (Ishikawa Diagram) [7] will be used to visually identify the many potential causes for a specific effect or problem, and to structure a brainstorming session that will be held in the improve phase of this research. It is expected to identify all the possible reasons why the process is having difficulties, problems, or breakdowns.
- A Process Chart [8] is a graphical representation of the sequence of steps or tasks (workflow) constituting a process, from raw

materials through to the finished product. It serves as a tool for examining the process in detail to identify areas of possible improvements. A process chart helps the researcher in understand where the process has opportunities to improve.

Improve Phase

Once the defects have been analyzed, measures are taken for eliminating the defects. The current process is improved by the application of corrective actions. The process chart helps the team in redesigning the process, after elimination of problems. A complete new process chart is then created, which highlights the changes and improvements to be incorporated, in order remove defects.

- A Brainstorming [9] is a popular tool that helps generate creative solutions to a specific problem. Works by focusing on a problem, then deliberately coming up with as many solutions as possible and by pushing the ideas as far as possible.
- Future State VSM helps to design a new process for the primary process, without bottlenecks identified in the Measure and Analyze Phase.

Control Phase

This step controls the future process for an excellent performance. In the last phase of Six Sigma DMAIC, there is control mechanism set up. The mechanism ensures that there are no changes on quality and the process does not go back to where it all started. The three main steps in this phase are development, documentation and implementation. Improvements are made on different levels namely staff improvement, schedule improvements and service control. After the new process is designed, the organization replaces the old process for the improved one. The researcher closely monitors the effectiveness and performance of the new process and ensures that the new service is defect free.

- Develop Standards Operating Procedures (SOP) of the process as a set of written instructions that documents a routine or repetitive activity followed by an organization. The development and use of SOP's are an integral part of a successful quality system as it provides the users with the information to perform a job properly, and facilitates consistency in the quality and integrity of a service or end-result. Lean Processes [10] are currently being promoted as a new approach to speed, simplifying and optimizing business processes in every conceivable area from manufacturing cars to treating patients. Lean is an approach to achieving service or manufacturing excellence based upon the continued elimination of waste.

All process performed within the DMAIC process directly influences the Lean methodology by reorganizing the process, as shown in the improved VSM. Originally was a “Push” process and by the use of implementation of DMAIC, the flow changed to “Pull” by the accurate use of schedule to reduce the waiting lines at the office. With the re-organized process flowmap, the patients should arrive Just In Time (JIT) with the “Pull” schedule. Lean Process characteristics where determined, “Bottlenecks” and “Wastes” where identified in the Measure and Analyze Phase of the DMAIC. The improved VSM shows short cycle times, quick changeovers and multi-skilled employees at all stages of the entire process. Figure 3 shows the process required to achieve a Lean Structure in a business [11].

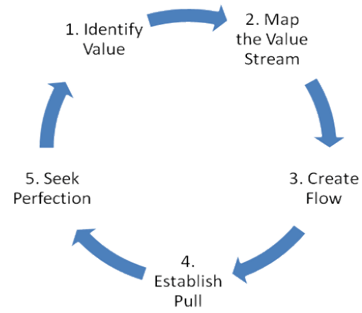


Figure 3
Lean Structure

RESULTS AND DISCUSSIONS

To begin with the DMAIC required on this investigation, on the Define stage, the researcher developed a Project Charter to manage the initiation and planning stages to ensure a future success. The business case, problem statement, the scope, and the goals with its objectives and limitations were identified. The team and roles were identified and dates were assigned to each step in the research to have a plan for execution.

A SIPOC diagram, on Table 1, was created to determine the suppliers of the services offered by the dental office, to have a clearer view of the responsible persons for each service, and to have a big picture of the entire flowmap of the process.

The necessary steps to offer the service and the responsible person are identified; the researcher will investigate which steps can be related to the project objectives for working on those selected. This diagram provided valuable information that will narrow the investigation to concentrate the efforts on those steps inside the process that affects the attendance of the patients for the appointments.

Process: Dental Service in Clinica Dental del Norte.				Revision: -
Purpose / scope: Determine the suppliers, customers, inputs and outputs related to the service offered.				Revised by: HHP
SIPOC				
Supplier(s)	Input (s)	Process	Output(s)	Customer(s)
Secretary #1	Schedule visits	Dental Service	Appointment	Patients
Secretary #1	Receive patients		Patient on waiting line	Patients
Secretary #1	Patient's data		Data in the system	Dentist
Secretary #1	Collect information in hard copy		Archive information	Dentist
Secretary #1	Schedule next appointments		Patients with appointments	Patients
Secretary #2	Phone calls		Answer calls	Patients
Secretary #2	Follow-up prescheduled appointments		Confirm appointments	Patients
Secretary #2	Facture Plan		Service payment	Dentist
Dentist	Provide dental service		Dental service offered	Patients

Table 1
SIPOC Diagram

In the Measure Phase of this research, a VSM is created to understand how the process is executed and to determine which steps may need an improvement, and to have an idea of the approximate lead time of each activity. To have accurate lead times for each activity, field reports and two surveys were created, it helped the researcher to measure the customer satisfaction and to collect suggestions.

The first survey was addressed to the patient and 48 surveys were collected. The main purpose of the survey was to measure the overall satisfaction of the service, collect information about the waiting times, measure how effective is the appointment process, and last, to measure how proactive is the service provided by the secretary. As a summary of results and findings, 98% of the patients feel comfortable in the office while waiting for service, 79% of the respondents are satisfied with the overall service received while 21% have some satisfaction with the service. With respect to the satisfaction, the 48 respondents provided comments about the overall service which resulted in having 50% complaints about the time spent in the room waiting for service, 21% have complaints about the available time for the appointments. Other responses in the survey that provided valuable information is that 65% of the respondents did not attend the prescheduled appointments, the complaints about the availability of the appointments can be directly related to the number of respondents that did not attend the prescheduled appointment.

Based on survey results, 40 minutes is the average lead time of the overall waiting time of patients in the office, this is 53% of total visit time, including the time waiting to be attended by the secretary plus the time waiting to be assisted by the dentist. Of the 48 respondents, 46% indicated that they wait 6-10 minutes in the waiting room prior to be called by the secretary to provide the personal information, 48% of the respondents waits more than 16 minutes in the room to get the same service, the other 6% waits 5 or less minutes in the waiting room. Approximately 67% of the respondents

spent an additional 21-30 minutes waiting to receive the service from the dentist after the secretary collected the personal information, the other 23% needed to wait 6-20 minutes in the room, while the remaining 8% needed to wait more than 31 minutes in the waiting room. This may contribute to the other main complaint that the patients have with respect to the overall service, further analysis will be performed to address the waiting time in the office. Of the 48 respondents, 60% spent more than 41 minutes in the office since the time of arrival to the time of departure, 38% spent from 21-40 minutes and the remaining 2% spent less than 20 minutes in the office. A high percentage of the respondents, 94%, desire to spend from 11-20 minutes, 6% desire less than 10 minutes and none of the respondents desire to wait more than 20 minutes waiting to get the dental service. With respect to the diligence of the secretaries to the patients requests, the survey revealed that 65% of the respondents consider diligent, 25% indicated that the secretary is some diligent, and the remaining 10% indicated that the secretary was not diligent.

With respect to the appointments, 67% of the respondents received the follow up card via mail, and 37% did not receive the notification. Some comments with respect to the follow-up appointment method are that 60% of the respondents receive the notification card two weeks before the appointment and then forgot the date or lose the written notification, 21% of the respondents did not receive mail and the remaining 19% did not provide any comments. When asked about the preferred method to receive notifications, 52% of the respondents prefer to be reminded by phone, 30% prefer by email and 18% prefer conventional mail. Questions about the frequency of notifications were asked and 63 responses were collected; 11 of the 48 respondents had multiple selections on the survey question. 6% of the responses prefer to be reminded 1 month before, 25% prefer 1 week before, 19% prefer 1 day before, and 49% of the respondents prefer all the previous options. When asked about if whether the patient

agrees or not agrees to have a penalty if he/she missed the appointment, after the implementation of an efficient follow-up method, 77% agrees paying a fee and 85% agree to pay \$10 for the penalty.

The second survey was designed to be completed by the dentist to measure satisfaction with the service received by the secretary and to measure how comfortable he/she is performing the daily work. As a summary of responses, the dentist feels comfortable attending 15-20 patients per day if he/she reports to work from 8:30-12:00 AM and 2:00-5:00 PM from Mondays to Fridays except Wednesdays. In average, the dentist attends 3 emergencies per day; this data will be confirmed with the field observations that will be presented after this survey. The facture process in the office takes approximately 6 hours/week and it is performed 2 times, Tuesdays and Fridays, respectively. When asked about the satisfaction of the service received by the secretary, the dentist have some satisfaction but he/she thinks that the time must be used more wisely, more dedication/less talking. The dentist is in agreement to have a restructuration of handling appointments, and in the reorganization of the daily activities performed by the secretary if the quantity of work assigned is not exhausting.

Field reports recorded in the dental office from March 26, 2012 to April 19, 2012, includes the average in/out time of the dentist, the quantity of patients attended per day, quantity of patients that attended the prescheduled appointment per day,

quantity of emergencies received per day, and the time used to perform each of the dental services. In average, the dentist is at the office from 8:20 AM to 12:15 PM in the morning shift and returns to work in the afternoon from 2:05 PM to 5:20 PM. In average, the dentist attends 18 patients a day. After verification of data, high volume of patients is expected to be received on Mondays due to the fact that the office is closed 3 Saturdays a month and on Sundays.

Field observations provide information about the patients that assisted to the prescheduled appointment and the number of emergencies in the timeframe specified, averaging 10 and almost 3 respectively. Table 2 shows the Time per Dental service.

Table 2
Time per Dental Service

Service	Average Time	Time for improved scheduling process
Diagnostic	10.3 mins	10 mins
Preventive	5.4 mins	5 mins
Operative	15.4 mins	15 mins
Removable Treatment	28.6 mins	25-30 mins
Fixed Treatment	43.6 mins	40-45 mins
Surgery	42.6 mins	40-45 mins
Periodontics	20.4 mins	20 mins
Emergencies	24.1 mins	25 mins

Figure 4 shows the resulting VSM of the actual process, the cycle times for a common process was determined and the cycle time of the patient in the office was determined by the survey. The VSM shows in red the steps of the process the patient is at the office and the cycle time reflects the overall time of the patient in the office. The cycle time of service per patient can be estimated to be 1 hour and 45 minutes, and the cycle time of the patient in the office is 1 hour and 15 minutes.

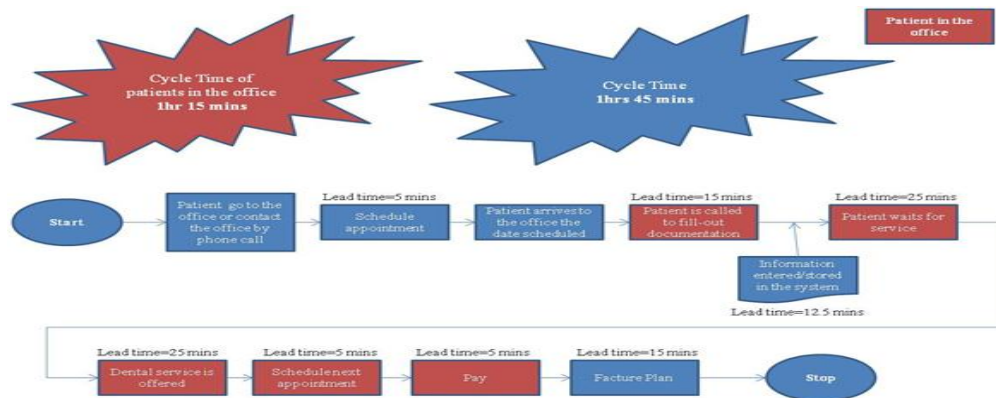


Figure 4
VSM of Common process

Delays and bottlenecks identified in the process can be pointed to the steps in which the patient waits to provide the information for the secretary and the time the patient waits after for the dental service. An indirect bottleneck the actual process has is the time patients wait for the service while the dentist is attending other patient. The three steps together add 1 hour and 5 minutes to the overall waiting time of the patient. The scheduling process, the waiting times and the daily tasks will be analyzed by the use of Pareto charts, and Fishbone diagrams to get to the root causes of the defects.

Comments in the survey revealed several facts that are relevant to the investigation. The plan is to categorize and determine the frequency of repetitiveness, the comments have for determining, in a Pareto Chart, which of the causes are directly

related to the problems the office is having. The researcher will determine which of the causes are contributor, likely contributor and non-contributor to the problem that needs the improvements. Responses in the survey that are not beneficial will be considered as defects, example with respect to office comfort, responses different than excellent comfort is classified as defect. Figure 5, shows the results of the Pareto chart.

Below Pareto Chart revealed that the 82% of the problems are within 7 defects which can be related to waiting time and handling of appointments, if categorized by similarities in the comments. The waiting time and the handling of appointments are direct contributors to the problems while the diligence of the secretary is a lightly contributor; the rest of the defects can be categorized as non contributors.

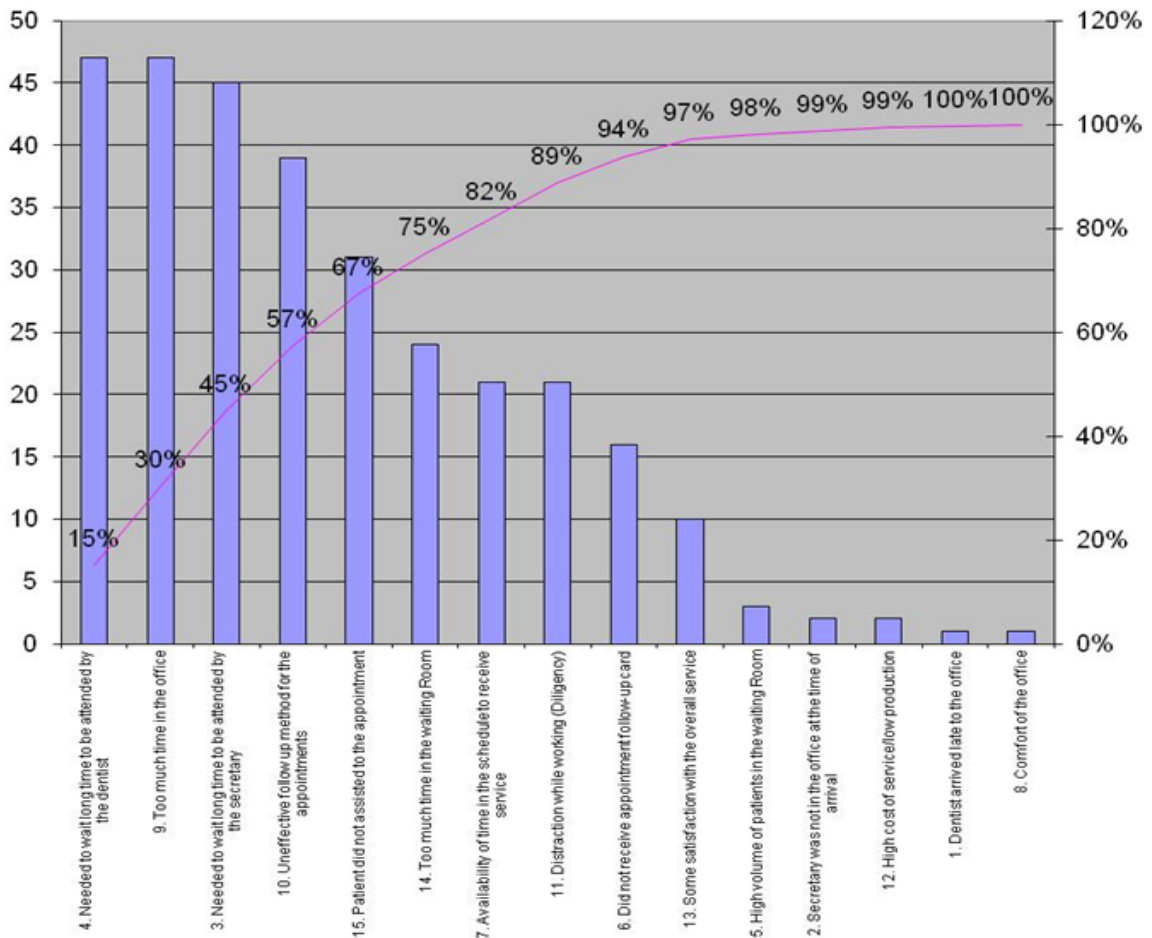


Figure 5
Pareto Chart

The researcher must evaluate defects in a Fishbone diagram to confirm which of the defects contributes or not contributes to the existing problem, to concentrate effort on those that contributes. The Fishbone Diagram shown in Figure 6 was created to evaluate how the management techniques were affecting the overall performance of the operations. The diagram was developed using the P's categories of Service industries: Procedure, Policies, Product, Price and People, identified as the most common categories for the problem to be improved. Each major defect is assigned to a category for further cause and effect analysis. Availability of the dentist and secretary, the high number of patients in the office, and the patient not attending to the appointment are classified as "People" driven defect. The defect related to the high pay/low production of the secretaries is assigned to the "Price" category. Customer satisfaction is assigned to the "Product" category, and no attendance to the prescheduled appointment is classified as "Policy" driven defect. Not receiving the follow-up card and the time

waiting to be attended by the secretary and by the dentist are categorized as a "Procedure" driven defects. A number of 8 root causes for each defect were identified in the diagram, related to time definition for each service offered, ineffective appointment method and process, no appointment follow-up method defined, daily duties and tasks not defined, mostly FIFO method to serve patients, and undefined in/out time of the suppliers. Several root causes are repeated within defects as being the direct contributors to the problems. Root cause number 7 was divided in two sections to facilitate the improvement, the working time of both suppliers are determined by results of the field observations and the working hours of the dental clinic. The root causes can be listed as: not having an effective appointment method and process, no existing time definition of the dental service offered by the office, no policies defined, no definition of secretaries daily tasks and responsibilities, patients attended FIFO most of the time, and lastly, no defined in/out time of the suppliers.

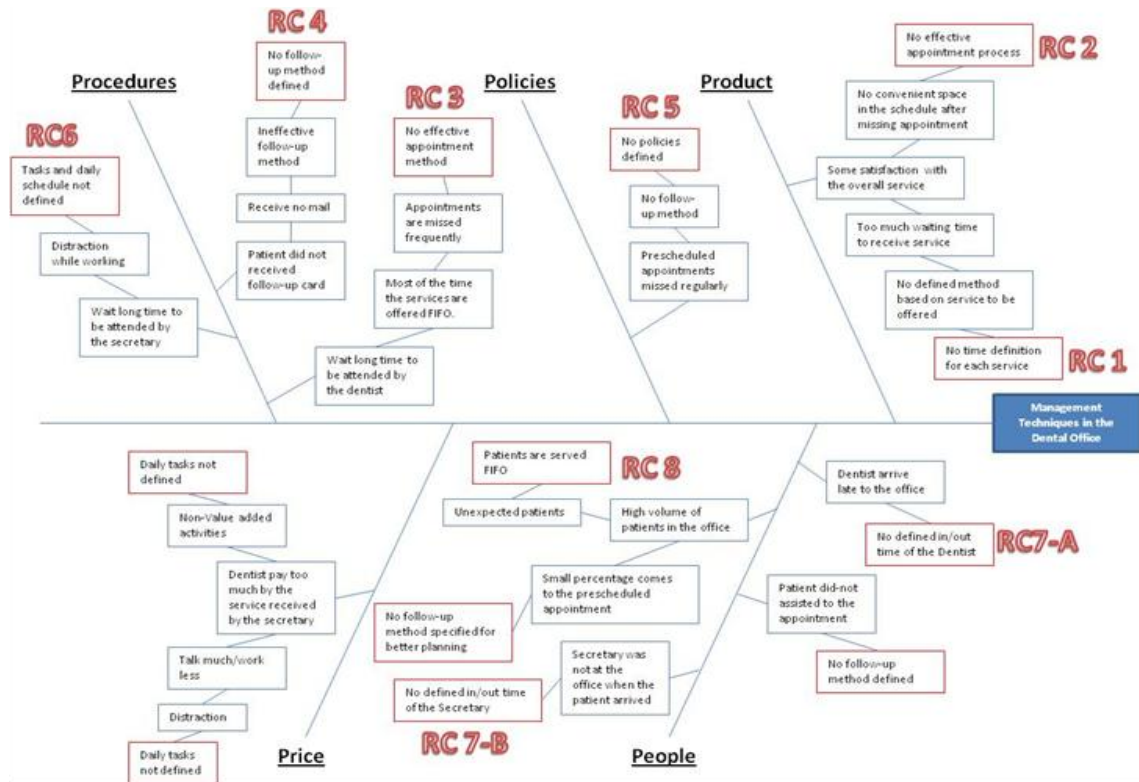


Figure 6
Fishbone Diagram of Management Techniques

A process chart of the actual process for scheduling appointments and follow-up method is created to analyze how the process is executed to investigate what is causing problems identified in the Fishbone diagram and Pareto Chart. Some root causes identified are assigned to the steps in the actual processes the researcher is investigating. In the Improve phase of the DMAIC, a brainstorming session will guide to corrective actions for the root causes and further definition to the improved VSM of the new process.

Analyzing survey results, using conventional mail to follow up appointments is not effective to some of the patients. Development of technology allows the use modern methods for the follow up of appointments, including email reminders and periodical phone calls follow ups in addition to conventional mail. The average time patients wants to be in the waiting room from the arrival until called to receive the dental service is 20 minutes, a corrective action to have a 50% reduction in waiting time in this steps needs to be brainstormed in the Improve phase.

After monitoring the actual in/out time of the suppliers, the working period for the secretary is from 8:00-12:00 PM and from 1:00-5:00 PM, and the working time of the dentist is from 8:30-12:00 PM and from 2:00-5:00 PM. Appointments must be scheduled considering these time periods and considering the number of patients the dentist is willing to attend daily and the expected number of emergencies. A plan for the new process of assigning appointments will be determined in details on the Improve phase. Analyzing the dentist feedback, the researcher will define the working schedules and daily tasks of the secretary to have a reduction of non-value added activities to overcome the defect. As collected in the survey at the Measure phase, improvements handling the secretary schedules and daily tasks are to be determined in details including the distribution of work and policies among both.

In the Improve Phase, the researcher needs to determine corrective actions to the defects identified in the measure phase and the root causes

determined in the analyze phase. A brainstorming session guides to possible solutions for the problems this research is trying to improve. It is necessary to list the defects and root cause for determining possible solutions to each for then selecting which may have a better outcome on the performance of the overall process.

- Corrective Action for Root Cause 1: A new document is created and is accessible to the secretary with the average time of each dental service offered, to better accuracy of handling appointments and less patient waiting time. Secretary must store the document in a visible location for easy accessibility when providing appointments.
- Corrective Action for Root Cause 2: Appointments will be assigned considering the times of the document from corrective action of root cause #1 to better accuracy in time and less patient waiting time. The availability of appointment will be based on the dental service requested. If the patient confirms the appointment and do not attends at the scheduled time, the patient will be contacted and proposed a new time, during the same day, to receive the service. The secretary must schedule a maximum of 15 appointments per day, to allow time for attending unexpected emergencies and new patients. This decision prevents overwork and fatigue of the dentist.
- Corrective Action for Root Cause 3: The follow-up of the appointments will be performed by phone call, email and by conventional email. Patients will be asked the preferred method for the follow up based on needs and availability. An outlook account is created to manage appointments, all patients' information is recorded in an electronic database and paper documents will be scanned electronically to a data collection hardware/software. Outlook needs to be programmed to remind when to follow-up and to which patient. Secretary must monitor and follow up those reminders in a daily basis and perform the follow up as necessary. Since the

preferred method, from the survey, is by phone calls and emails, financial resources avoided in paper and mail postages can be relocated or saved as income. Data entry process will be fully automated to reduce consumable materials like papers, folders, ink, etc. The action reduces inventory and financial resources can be relocated. All documents needs to be scanned and stored accordingly in a patient's electronic folder, to reduce the use of consumable material ink and paper as well.

- Corrective Action for Root Cause 4: In addition of the corrective actions from root cause 3, appointments will be reminded 1 month after the appointment, then 2 weeks before the appointment, and lastly two days before the appointment. If the patient cancels the appointment in any of the reminder notifications, the reserved space is cleared from the system and made available for other patient. If the patient misses the appointment time, will be contacted to offer other period of time the same day.
- Corrective Action for Root Cause 5: Patients will be notified about the new policies related to appointments. In summary, the patient will have a 10 dollar charge for not attending to appointment after the follow-up of the dental office. In details, if the patient cancels the appointment before the appointment day, there would not be any charge associated to the reschedule and the secretary must provide an alternate date. If the patient misses the appointment time the same day, will be contacted by the office and propose a new time the same day. If the patient attends the same day, if there is a period of time available, would not have any charge. If the patient does not attends the appointment the day, will have the monetary charge in the office account. No service will be offered without a previous appointment, except for emergencies and new patients; the only way an existing patient will be offered service without appointment is if there is available space in the schedule and if

the space does not affect the waiting time of others. Changes will be effective immediately after a notice is sent to existing patients.

- Corrective Action for Root Cause 6: The secretary will facture plans from 8:00-8:30 AM on Mondays, Tuesdays, Thursdays and Fridays. Take lunch at 12:00 PM and return to work at 1:00 PM. Will facture plans from 1:00-2:00 PM, the same days. In addition, the secretary must attend phone calls and perform the respective procedures stated in corrective actions 2-4. The payroll will be 24 hours/week plus 4 hrs/month to one secretary and 32 hours/week to the other secretary. This results in a 4 hour/week reduction in payroll. First weeks after the implementation of the corrective actions, the secretary #2 is assigned to enter all patients' information in the electronic database.
- Corrective Action for Root Cause 7: The office working hours are from 8:00-12:00 PM and from 1:00-5:00 PM. Dentist hours are from 8:30-12:00 returning 2-5. Office opens the first Saturday of each month from 8:30-12:30 PM. The patients will be notified about the office new working hours.
- Corrective Action for Root Cause 8: No service will be offered without a previous appointment, except for emergencies and new patients; the only way an existing patient will be offered service without appointment is if there is available space in the schedule and if the space does not affect the waiting time of others. Attend patients without appointments, FIFO, causes bottlenecks, excessive patients in the office and increased waiting time.

The next step in the improve phase of to create an improved VSM incorporation corrective actions and avoiding defects. The reduction in lead time and cycle time is visible when waiting for service; the improved VSM of a common process of a service is shown in Figure 7 with its improved lead times and cycle times. Improvements are incorporated into the schedule appointment step

and lead time on the overall waiting time of the patients was reduced. The initial cycle time of the overall process was 1 hr and 45 minutes and the waiting time of the patients in the office was 1 hr and 15 minutes, with the improvements, it is expected to reduce this time to 55 minutes and 1 hr and 25 minutes. A reduction of 20 minutes can be achieved in both cycle times if the corrective actions are followed to the letter. The time waiting to be called to fill out the documentation is reduced by 10 minutes or 67% and the time waiting for service is reduced by 10 minutes or 40%. It is expected to have the steps flow in the process with fewer bottlenecks by the improvements, and analyzing the overall reduction, the process had improved by 27% in the patients waiting time and 20% in the overall cycle time. The appointment method and process is now robust by the application of the corrective actions. Figure 8

shows the improved flowmap of the appointment follow up process.

After periodical follow-ups by phone, mail or emails, the patients now have chance to notice in advance if not able to attend an appointment, resulting beneficial for suppliers and end users. The reserved space can be reassigned to other patient in case the patient indicates that will not attend the appointment in any of the follow up steps, and the reserved period of time would not be wasted, will be made available to other appointments. The incorporation of a fee to the patient at the last follow up step will indirectly influence their assistance to the office and more responsibility when selecting an appointment time. An Outlook mail account, as a suggestion to electronically manage appointments, will reduce the human effort in performing the new follow-up process.

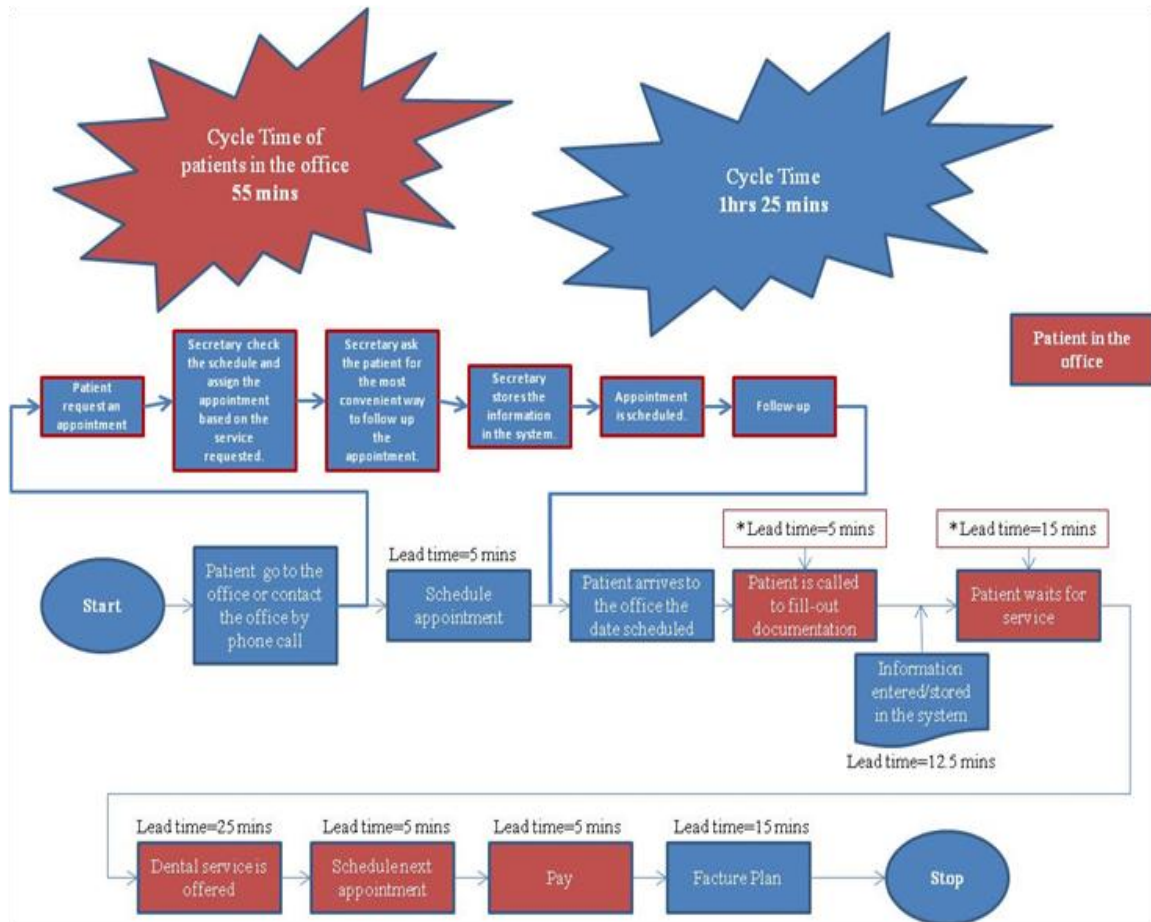


Figure 7
Improved VSM of Common Process

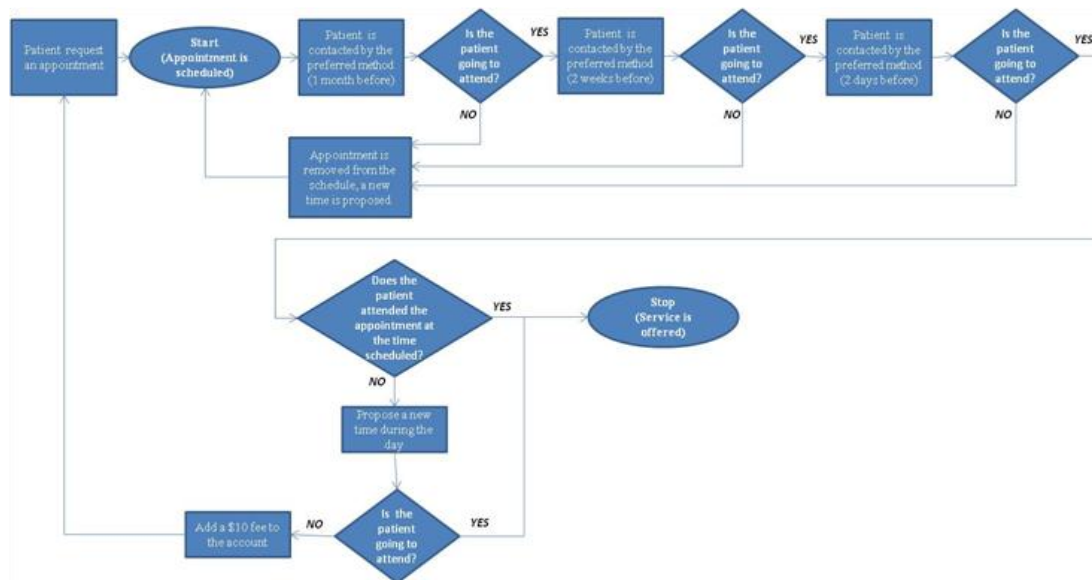


Figure 8
Flowchart of Improved Appointment Follow-up Method

In this phase of the research, Control Phase, it is imperative to ensure that the process remains improved and not returns back to the original state. Two methods will be used to sustain and monitor the process, it is important to monitor the process behavior the first months after the improvement to confirm that the results are as expected. Any deviation from the planned performance must be evaluated and apply corrective and preventive actions as necessary. Standard operating procedures are created for the two main steps of the process, scheduling appointments and its respective follow up method. The appointment process procedure is defined in details to make sure that the secretaries assign the appointments as stated in the improve phase of this DMAIC. The document must include a tabulated average of the time required to perform each dental service and a common visual example of how to assign appointments in the event that new staff is recruited. The dentist must ensure that his/her suppliers does not deviate from the process, and monitor the execution and performance. The office must interview the patients to get feedback about the process improvement and keep monitoring the operations and behavior of the waiting time, new corrective actions and preventive actions must be

determined at all times. Again, the process must be monitored to ensure that the corrective actions were precise at solving the defects. The process needs to be strengthened and robust as time progresses and more data can be collected, continuous improvement to the process must be seek at all times. Employee training is an essential to control any change that is made and should be made part of the action plan.

In addition, policies and procedures must be evaluated, revised periodically and updated as necessary to confirm that the action plans are accurate enough to solve any issue. This evaluation must not only verify the successful completion of the identified tasks, but also assess the appropriateness and effectiveness of the actions taken.

CONCLUSION

After extensive research and analysis on how to improve the operations in the dental office, positive results emerged that helped overcome defects identified thru the DMAIC process. The researcher was able to capture valuable information that resulted in the application of good corrective actions. The effectiveness of the analysis was dependent on the quality and thoroughness of the

information available. A detailed appointment process and follow up method was defined by the accurate use of Six Sigma and Lean Manufacturing tools. The scheduling process was made more robust by the application of steps by step methods and Standard Operating Procedures incorporated into the process. The process improvement solved different issues that were the main cause for performing this work on the operations. The daily tasks of the suppliers were defined since lack of information was available; this includes the definition of the working hours for suppliers, secretary and dentist. It was determined that the office must keep the two secretaries for not assigning excessive work to only one secretary and not cause fatigue, in addition, the number of patients attended per day was limited to a maximum of 15. With the details in the researcher side, appointments are now granted and followed up periodically by a defined method. As a result, the overall waiting time for the patients and the process cycle time was reduced by 27 % and 20% respectively. For the accuracy of the improvement, First in First out method for attending appointments need to be avoided at all times, except for emergencies and new patients. The assistance of the patients to the appointments was regulated and some policies were implemented to manage the concern. A robust follow up method is to be used at all times to ensure and control assistance for not having an excessive or reduced number of patients at a time. This fulfilled the objectives of this research since the initial plan was to improve the office operations by defining and rearranging the actual execution of steps in the process without financial support. This new method is expected to be implemented when the suppliers complete their training stage. After this process is completed, the secretary must transcribe the existing patient's information to an electronic database; notify all patients about the changes in policy and methods, then the improvement can be implemented. In order to prevent the process for not returning to the original stage, it is very important to continue educating and training the office manpower, so that

they are willing to maintain and continue improving the process. The process must be monitored periodically after the implementation to ensure results are as expected; any deviation from the planned performance must be evaluated and corrected accordingly.

The improvement was beneficial for both secretaries and dentist since other goal that the researcher had every time in mind was not modify drastically the actual performance, just improve the sectors with defects without financial support.

The following improvements are recommended for future implementation:

- Evaluate and improve the administrative process to reduce even more the waiting time of the patients in the office.
- Development of a Corrective Action and Preventive Action plan (CAPA) to the process.

REFERENCES

- [1] Caseflow. (n.d.). Lean / 6 Sigma Methodology. Retrieved Saturday 11, 2012 from <http://www.caseflow.uk.com/images/lean3.jpg>
- [2] Lean Marketing. (2010 October). Implementing Lean Marketing Systems. Retrieved Saturday 11, 2012 from <http://www.leanmarketinghouse.com/wp-content/uploads/2009/10/dmaic.jpg>
- [3] Ritcher, Linda. (2011, January 27). What is Project Charter. Retrieved Saturday 11, 2012 from <http://www.brighthub.com/office/project-management/articles/5161.aspx>
- [4] Gantt Charts. (n.d.). About Gantt Charts. Retrieved Saturday 11, 2012 from <http://www.ganttchart.com/>
- [5] Simon, Kerry. (2010). SIPOC Diagram. Retrieved Sunday 12, 2012 from <http://www.isixsigma.com/tools-templates/sipoc-copis/sipoc-diagram/>
- [6] Tague's, Nancy R. (2004). The Quality Toolbox. Retrieved Monday 13, 2012 from <http://www.asq.org/learn-about-quality/cause-analysis-tools/overview/pareto.html>
- [7] Tague's, Nancy R. (2004). The Quality Toolbox. Retrieved Monday 13, 2012 from www.asq.org/learn-about-quality/cause-analysis-tools/overview/fishbone.html
- [8] Business Dictionary. (n.d.) Process Chart. Retrieved Saturday 11, 2012 from <http://www.businessdictionary.com/definition/process-chart.html>

- [9] Mind Tools. (n.d). Brainstorming: Generating Many Radical, Creative Ideas. Retrieved Friday 10, 2012 from [http:// www.mindtools.com/brainstm.html](http://www.mindtools.com/brainstm.html)
- [10] Hunt, Brian. (2010). The History and Simplicity of Lean Process Improvement. Retrieved Sunday 12, 2012 from <http://www.processexcellencenetwork.com/lean/articles/the-history-and-simplicity-of-lean-process-improve/>
- [11] Lean Enterprise Institute. (n.d.) Principles of Lean. Retrieved Friday 10, 2012 from <http://www.lean.org/whatslean/principles.cfm>