# INSTITUTO TECNOLÓGICO Y DE ESTUDIOS

# SUPERIORES DE MONTERREY

**CAMPUS MONTERREY**
**DIVISIÓN DE INGENIERÍA Y ARQUITECTURA**
**PROGRAMA DE GRADUADOS EN INGENIERÍA**



**Estrategia para Reimplementar Seis Sigma en KEMET CBU**

**TESIS**

**PRESENTADA COMO REQUISITO PARCIAL**
**PARA OBTENER EL GRADO ACADÉMICO DE:**

**MAESTRO EN CIENCIAS CON ESPECIALIDAD**
**EN SISTEMAS DE MANUFACTURA**

**POR:**

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Los miembros del Comité de Tesis recomendamos que el proyecto de Tesis presentado por la Ing. Gabriela Macías Almaraz sea aceptado como requisito parcial para obtener el grado académico de:

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## DEDICATORIA

A mi mamá por haber luchado para hacer de mi una persona de bien.
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Siempre te he admirado.  Eres una gran persona y amiga, gracias por
tu apoyo SIEMPRE.  Te quiero.

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# INDEX

# 1. INTRODUCTION

This thesis is written in an attempt to define the problems that KEMET, a capacitor manufacturing company, faced while implementing Six Sigma. There was research performed to find the theory which supports the known roadblocks and the way to approach the problems in order to improve the implementation in this company.

The information contained in the following pages flows as outlined below.

- ❖ Background related to Quality systems and models through the years
- ❖ Six Sigma Philosophy and known roadblocks to the implementation
- ❖ Background on KEMET and the current situation
- ❖ Problem definition and justification of the research
- ❖ Methodology used to find support information: survey applied to KEMET employees and analysis of results
- ❖ Breakdown of roadblocks in 3 factors: Leadership, Human Resources and Technical
- ❖ Detail related to:
  - ✓ Leadership factor – roadblocks involved and potential solutions
  - ✓ Human Resources factor – roadblocks involved and potential solutions
  - ✓ Technical factor – roadblocks involved and potential solutions
- ❖ Recommendations for KEMET to use in the reengineering process of Six Sigma and for further investigation

The first thing as shown in the outline is to verify which are the main causes for failure identified by different experts. Once, those are found and clearly described, an assessment should done in KEMET to define which of those roadblocks, if any, were present when the Six Sigma implementation was carried out. A survey can be used for this purpose. The survey shall be distributed among KEMET employees who were or should have been involved in the Six Sigma implementation/deployment process. Once the surveys are collected with the participants' response, the results should be analyzed in order to determine

which are the main roadblocks that KEMET encountered and finally propose feasible solutions.

This thesis only approaches the problems encountered in the Ceramic Business Unit at KEMET. A separate discussion and investigation should be done to assess the implementation of Six Sigma in the other business units if desired.

The main question that this investigation tries to answer is related to what are the possible causes of the failed implementation of Six Sigma in this organization. It is believed that if the reasons for the incomplete or failed implementation are understood, unsuccessful implementation of other methodologies or programs can be avoided. That is why it was considered as important to perform this investigation and assessment.

## 2. BACKGROUND

Quality has been continuously changing in the past decades. The vision of what quality means or needs to be evolves as new quality methodologies and statistical tools are introduced. All these new methodologies have been adopted in the industry, not only to try to improve processes and products, but also to improve cost and financial performance.

This investigation is based in KEMET Electronics in Mexico. KEMET as a global company has not been an exception in terms of evolving quality visions

### 2.1 Quality Models: continuous improvement and innovation

Quality is no longer a competitive advantage as it used to be in the 70s and the beginning of the 80s. Today, every customer demands perfect quality in the products they buy. It makes no difference if they are final customers, original equipment manufacturers or contract manufacturers; they expect nothing less than perfect performance of what they use as a product or raw material.

Quality becomes more important once the manufacturing systems start high volume production. When production is in great quantities, quality control needs to be tighter and more effective. It is due to the high cost related to raw materials, production and inspection that many companies started looking into ways to implement quality at the source. When mass production became the rule for many industries, the belief that quality does not mean inspecting products, but manufacturing good products since they are born was more popular.

All this leads to the fact that if variation in the process is controlled and minimized, the cost of poor quality can be almost zero. This is just logical thought put to work. If a product has already been finished or is semi-finished at the time defects are found, it is more expensive to inspect it or scrap it. Whereas

if the defects or source of defects are detected early in the process, raw materials, production costs and time will be minimum.  Also, that finding the source of the defects decreases the cost of poor quality in the sense that manufacturing more defective parts can be avoided.  The number of defects can also be minimized when practicing quality at the source.

Finally, the most important quality model currently is to design quality into the products.  More and more, the big and important manufacturing companies are focusing their efforts in designing a product and processes which are defect free.  What they are trying to do is to prevent incurring in those costs of poor quality due to poor design of a process.  This includes from the raw material selection to the manufacturing method.  It is known that if the sources of variation are reduced the product will perform much better and the probability of having defective product is almost eliminated.

Quality Systems Models are usually oriented to support continuous improvement of the product, process and system performance and to satisfy and exceed customer satisfaction[1].  Examples of Quality Systems Models are ISO/TS (international quality systems standards), quality awards (i.e., Malcolm Baldrige Award, Deming Award and Mexican National Quality Award), and Six Sigma Methodology.

### 2.2 Six Sigma Philosophy and Main Roadblocks for a successful implementation

Six Sigma is a philosophy which requires the use of quality principles and techniques that have already been working for years in a strict, focused and highly efficient manner[2].  The philosophy simplifies the concept of quality and takes a reduced number of quality tools which have proven effective in improving

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[1] National Institute of Standards and Technology *Baldrige, Six Sigma, & ISO:  Understanding Your Options.* Baldrige National Quality Program, CEO Issue Sheet.  Summer, 2002, p. 1
[2] Pyzdek, Thomas.  *The Six Sigma Handbook, Revised and Expanded.*  Chapter 1 " Building the Six Sigma Infrastructure", page 4.

production processes.  It is important to note that Six Sigma is based in finding ways to provide customers and shareholders with more value.  This methodology is a very well structured way of thinking through a problem to obtain the best and optimized solution.

Implementation of Six Sigma is a process which requires much planning and a big part of it relates to the training of a select group of people in statistical tools which will be the basis of problem solving and the new language of every organization that decides to take on the adventure of going into Six Sigma.  The system supporting Six Sigma introduction also needs to be very strong in terms of the human resources structure and project selection and implementation.

The methodology is divided in 5 major steps:  Define, Measure, Analyze, Improve, and Control (DMAIC).  Each one of these steps has a set of data that needs to be gathered and analysis that needs to be completed in order for the project to develop and be implemented successfully.

Many authors that have experience with Six Sigma and managers that have worked in implementing the methodology agree that in order to successfully implement Six Sigma, a conscious decision needs to be made to complement or base the quality model of the company in this new methodology.  It requires a lot of effort, investment and time to be able to have a successful deployment.

Starting Six Sigma requires a big investment in training and, sometimes, in consulting to develop the best deployment plan for each organization.  It is estimated that implementation of Six Sigma could take approximately 2 years after the start-up; the organization can expect improvements of 10X every 2 years.  In terms of quality, it is usually measured in defective parts per million produced.  The fact that this methodology is basically targeting the quality system does not mean that the financials are not improved.  On the contrary, Six Sigma exhibits the very particular characteristic of tying manufacturing, quality and cost

in a very logical manner.  Actually, in order to generate valid Six Sigma projects, one needs to calculate the financial impact of improving a process.

Because the implementation of this philosophy has already been proven in many companies, there is information regarding well documented factors that need to be part of a successful Six Sigma deployment.  Certain steps are critical as a minimum to ensure that Six Sigma is deployed throughout the organization efficiently.  Six Sigma needs to be "a way of life in the organization," a new culture is implemented when Six Sigma is embraced.  The steps[3] are:

1. Commitment from Upper Management:  the decision needs to come from upper management to change the organizational culture.  Providing training to senior leadership is critical to ensure the understanding of what Six Sigma implementation means and requires.  This also unveils the need to undergo a thorough planning step for deployment.  It may lead to the creation of the human resources infrastructure needed for Six Sigma to survive.  When one has senior leadership buy-in the whole organization is pointed in the same direction, resources area more likely to be allocated correctly and the new language of the organization will be statistics.

2. Communication systems:  these should be developed in order to establish the right communication among all channels involved.  This includes suppliers, employees (organization), and customers.  The systems need to ensure that the organization will obtain valuable input from all the parties.  This information helps when analyzing the current situation of the organization and creating a gap analysis.

3. Adequate training:  assessment of the needs has to be done in order to select the correct training and supplier of the service.  In most cases, the consultants participate in developing the implementation strategy, training and deploying.  Training should be done in all the organization, from

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[3] Pyzdek, Thomas. *The Six Sigma Handbook, Revised and Expanded.*  Chapter 1 " Building the Six Sigma Infrastructure", page 21.

senior management to the machine operators. All the organization should know Six Sigma and what it is about.

4. Definition of relevant business metrics: this supports continuous improvement and will be the first question we need to ask ourselves, "Do we know what the relevant or important-to-customer metrics are?" "Are we measuring the right things in the right places?" The metrics need to be aligned with the organization's strategic goals, drivers, and key business processes.

5. Correct selection of processes to be improved: the focus processes need to be selected based on a real process/customer/business need. Projects need to be generated in the critical processes to improve performance linked to measurable financial results and strategic objectives. In order for a good selection knowledge of the processes, constraints, and objectives is very important.

6. Resource appointment: ensure that the correct resources are assigned to the projects and implementation of the deployment. Projects are conducted by individuals and teams lead by Black Belts and Green Belts assisted by Black Belts.

Related to the main steps that need to take place in order to ensure a good Six Sigma Philosophy implementation, there is record of different roadblocks identified by many authors which prevent successful deployments. Some authors and experienced consultants refer to it as success factor, others call them roadblocks. Below are a few of the areas that some authors recommend to focus on to achieve a nice, smooth implementation.

According to Mike Carnell, the savings promised are usually not accomplished the first year after the implementation or ever. However, the vision is that as long as Six Sigma provides an acceptable Return on Investment (ROI) and leaves a stand-alone program, it can be considered a successful one. He also mentions in his article, *"Understanding Six Sigma Deployment Failures,"* that there is

always some level of failure in a Six Sigma deployment in one way or another. This can mean that there are always things that could have been done better and improved in the implementation. In this article, he mentions the most common deployment failures in two levels: individual participant failures and company/culture failures. They are listed below.

**Master Black Belt, Black Belt, and Green Belt Failures**
- Not severing themselves from their old job, at least through training
- Treating it as an academic exercise
- Failing to appreciate the complexity of dealing with people
- Failing to recognize Control as the most difficult phase to implement effectively
- Not transferring ownership of the solution to the team as the project progresses (the solution becomes personality dependent)
- Spending too much time on the computer and not enough time in the process
- Not communicating effectively with management – they speak the language of money
- Presenting results as if it were a science project – using things such as ANOVA tables to convey results (graphical representations convey more information faster – you are communicating an idea)
- Avoiding resistance – when you know it is present you have to deal with it
- Creating an exclusive club attitude around the program
- Not sharing the credit for the solution with the team
- Taking credit for work accomplished by another initiative or an ongoing project
- Focusing on certification rather than the team project and the company's results
- Not providing the team the opportunity to share the spotlight (have them attend a management presentation or better yet use them in the presentation)

- Generating false data
- Not getting at least a basic understanding of the tools required to do an analysis
- Including special effects in the presentation to cover a lack of content
- Using a large number of slides to cover a lack of content in project reviews
- Running to the Champion to break a roadblock before the try themselves
- Not taking a roadblock to the Champion after they have tried themselves

**Management and Company Failures**
- No concept of customer expectations
- No vision related to customer expectations
- No follow-up on the annual operating plan
- Lack of alignment (horizontal or vertical)
- No visible leadership at the executive level
- Business executives do not show for report-outs (conveys a lack of priority)
- Deploying Six Sigma without a goal (reason for deployment)
- Deploying Six Sigma with a goal but without a plan on how to get there
- Abdicating the deployment plan to a consulting company
- Trying to change the organization without a detailed change process
- Not having metrics in place for management participation
- No metrics for Champions
- Champions do not show for report-outs
- Having metrics in place but no feedback (or limited feedback annually, semi-annually, quarterly)
- Not having multiple projects queued up for each MBB, BB, or GB (so when they complete a project the next one has already been selected)
- Not communicating deployment plans effectively throughout the organization
- No rewards or recognition program
- A rewards or recognition program that does not recognize teams

- No retention program for trained personnel
- Trying to use contract type agreements to retain MBBs and BBs
- Projects selection process does not identify projects related to business objectives
- Middle management operates with their own agenda (feel support is optional)
- No accountability
- Champions do not break roadblocks
- No buy-in at the Process Owner level
- Process Owners believe they have the option to not buy-in
- Supply base supplying poor quality material
- No consequence for suppliers sending bad material (typically because of price)
- No plan to deploy into the Design and Marketing functions after Operations has launched
- Believing a single initiative can/will solve all your problems
- Using BBs for fire-fighting
- Buying cheap software to save money on the deployment
- Training BBs without providing a computer

Bruce Hayes also touches on the importance of focusing in the success factors in order to have an effective Six Sigma program implemented. In his article, *"Six Sigma Critical Success Factors,"* he mentions that some organizations even scrap the whole program after putting time an effort in the start-up because they do not see as high savings as they expected. According to him, the lack of attention to the Critical Success Factors, for a sustained period of time, creates a management vacuum around the program. Equally, the lack of alignment between people, strategy, customers, and processes can derail any initiative and divert the attention of management. From this, it is clear that management needs to be committed and there needs to be a clear objective and path to follow while implementing Six Sigma. The Critical Success Factors are divided in three

categories: Executive Engagement, Communications, and Projects. The following are the things that are considered critical when deploying any initiative, including Six Sigma.

**Executive Engagement**
- ✓ Visible, consistent support and an active role in communication and reward
- ✓ Assuring linkage of Six Sigma to corporate strategies
- ✓ Clear prioritization (relative to other initiatives, programs and priorities)
- ✓ Requiring the use of facts and data to support actions at all levels of decision-making
- ✓ Creating accountabilities, expectations, roles and responsibilities for the organization
- ✓ Conducting and attending regular reviews to assure and verify progress

**Communications**
- ✓ Creation and communication of a Human Resources plan to support Six Sigma roles
- ✓ Regular written communications on Six Sigma news and successes
- ✓ Development and dissemination of communications aids to management
- ✓ Advocating and creating a "common language" based on Six Sigma
- ✓ Communicating pertinent facts about Six Sigma in every company meeting

**Projects**
- ✓ Establish a documented 1-year Six Sigma project inventory (and refresh regularly)
- ✓ Assure linkage of Six Sigma projects to critical business and customer needs
- ✓ Establish projects of appropriate scope and size (significant savings and achievable)
- ✓ Assign a Champion and Black Belt to each project (and hold them accountable)
- ✓ Implement a project tracking system to facilitate replication and reuse

Other authors also state the basis of the program's success in their books. Paul Keller is one of them and he ranks those factors in order of importance as:

1. Support and participation of top management: Six Sigma must be integrated into the business strategy. Executive Leadership must not just support the effort but lead it. Top management must create the right infrastructure to sustain Six Sigma, including the introduction of a career path for Black Belts and retention programs for trained personnel.

2. Sufficient resource allocation to improvement teams: usually a mature Six Sigma organization has about 1% of the employee population committed as Black Belts. Teams must also be ready to implement the projects generated and lead by the Black Belts. Line managers need clear signals (like budget in money and people) that upper management not only authorizes this reallocation of resources, but requires it for the successfulness of the program implementation.

3. Data-driven decision making: there should be no reacting to a crisis, understanding of special an common causes of variation should happen in order to make good, conscious decisions that will affect the business as a whole positively.

4. Measurement and feedback of key process characteristics: the key processes characteristics need to customer expectations. There need to be clear metrics of what the critical to quality characteristics are as well as how they impact the customer in a positive or negative way.

Six Sigma for Managers, a book by Greg Brue, mentions the DO's and DONT's of Six Sigma. The following are the most important ones:
- ✓ DO keep the focus on results
- ✓ DO embrace customers
- ✓ DO plan for success
- ✓ DO communicate the commitment company-wide
- ✓ DO demonstrate the commitment of company leaders

- ✓ DO empower your key human resources
- ✓ DO provide on-site mentoring for black belts
- ✓ DO choose an implementation partner who will actively assist in screening and selecting Six Sigma projects
- ✓ DO establish projects baselines and goals
- ✓ DO get advance buy-in from your controller
- ✓ DON'T make Six Sigma a massive "training" exercise
- ✓ DON'T focus resources on reworking training material
- ✓ DON'T skip steps (when implementing the program)
- ✓ DON'T be afraid to learn and use statistical tools

There are many more examples of recommendations by different authors to ensure successful deployment. Finally, The Six Sigma Way mentions these 6 Six Sigma Ingredients:

1. Genuine Focus on the Customer: understand what the customer needs, wants and expects, Six Sigma begins and ends with the Voice of the Customer
2. Data- and Fact-Driven Management: do not base business or operations decisions in *gut-feeling* or unfounded assumptions
3. Process Focus, Management, and Improvement: mastering and improving processes (which are the means to meeting customer requirements) is an essential step toward building competitive advantage by delivering value to our customers
4. Proactive Management: management should set and track ambitious goals, establish clear priorities, reward those who prevent fires, and challenge the way things are done instead of defending the old ways
5. Boundaryless Collaboration: increased collaboration outside the department and employee belongs to or in a responsibility that is not necessarily ours
6. Drive for Perfection, Tolerate Failure: expertise of risk management and openness to try new things and not get lost in being apprehensive for perfect performance all the time

Even if many of these lists make reference to Success Factors all aim to the fact that there are a few critical things to look out for when implementing Six Sigma in order to be successful. All of them can be put in categories which refer to management, their commitment and understanding of the philosophy; infrastructure which relates to the training, organization and compensation structure, and new career paths; and, project selection, implementation and tracking.

### *2.3 Current situation in KEMET*

KEMET Electronics is a company which participates in the electronics industry. This industry is a very demanding market. The search for better quality is always a must, but also, in order to be competitive in this industry, cost is critical. Survival is dictated by being a very high quality products producer with very low costs[4]. Prices in the electronic component manufacturing sector are always decreasing and competition has become very tight in the past years. There are many Asian companies that are now producing components at a very low cost and that have grown to do a very good job in terms of quality.

Due to this type of competition and the nature of the electronics industry (decreasing prices), it is critical to always aim for continuous improvement. There are different metrics that can be analyzed to determine if continuous improvement is demonstrated. The metrics can be internal or external, depending on what is being measured. A metric which is very easily identified in a manufacturing process is Defects per Million Opportunities (DPMO) or defective Parts per Million (PPM).

KEMET Electronics is one of the largest producers of capacitors in the world. KEMET is the number one supplier in the tantalum capacitors market and is in the sixth place as a ceramic capacitor supplier. KEMET provides a wide varierty

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[4] CEO Quarterly Review, Internet Broadcast meeting with employees 1QFY06

of capacitors for many different applications, including communication systems, data processors, PCs, all types of automotive systems, military and aerospatial applications. KEMET capacitors are sold to customers in many different locations of the world. KEMET's customers include OEMs, distributors and contract manufacturers.

KEMET's main focus is quality, along with service, and cost. The quality systems are focused in continuous improvement and search for customer satisfaction. This is stated in the Corporate Vision: **"To be a valued and trusted partner to our customers by providing reliable, quality products with superior service, performance, and on-time delivery."** This vision refers to KEMET as the best in quality and service. The Quality Policy supports this vision and reads as follows: **"KEMET exceeds customer expectations through operational excellence and continuous improvement."** This policy is supported by the following principles: Zero Defects, 100% On-Time Delivery, Technology Leader, Six Sigma Capability, and World-Class Cycle Time Efficiencies.

KEMET is an American-based company which has its headquarters in Greenville, South Carolina in the United States. The manufacturing facilities for the capacitance products KEMET offers are spread through the United States, Mexico, China, Portugal, Italy, Finland, India, and some other countries. The employee group in KEMET worldwide exceeds 6,500 people, inlcuding its sales force.

KEMET established "maquiladora" type manufacturing sites in Matamoros, Monterrey, and Victoria for several reasons: labor is very well qualified and cheaper than in the United States, infrastructure is adequate in Mexico for transportation and communications, and there is a great advantage related to the proximity to the United States. Even, when the major operational advantage was the decrease in manufatcuring cost, being efficient is an every day race in the electronics industry. Price of passive components like capacitors decrease a

minimum of 10% yearly.  The only option KEMET has is to ensure that the manufacturing costs decrease at least in the same percentage.

The Quality Model in KEMET is based mainly in the ISO/TS standards.  The standards are supported in continuous improvement.  According to the norm, there should be projects related to corrective and preventive actions, as well as continuous improvement.  This involved much Quality Planning.  Following that model, the main drive to assign projects is comparison of the most important business metrics to the goal planned for the year.  For KEMET's management group, the main measures of performance of the business which are related to quality and cost are:  number of complaints received per month, defective parts per million, scrap, cycle time and cost per thousand parts manufactured.

In calendar year 2004, KEMET decided that implementing Six Sigma would be of great help to improve the performance of the business.   The Quality Model was and is still based in ISO/TS, however, when Six Sigma gained popularity and everybody in the industry realized the benefits of it, the KEMET organization wanted to implement it too.  Management in KEMET believed that introducing Six Sigma would help in improving the processes and that could lead to significant savings and a better product.

In general, many authors agree in that the start-up of the implementation of Six Sigma is very strong and it was not the exception in KEMET.  However, in this case the author believes that the deployment was not properly conducted and successfully completed.  Next the main roadblocks for successful deployments are described as a basis to understand what went wrong in this specific case study.

## 3.  PROBLEM DEFINITION

KEMET attempted the implementation of Six Sigma to support the Quality Model. There is not a record of what the goal was in terms of number of projects and savings expected each year.  However, one of KEMET's Key principles, which supports the Quality Policy, is to have Six Sigma Capability.  After analyzing the processes and the main quality metrics defined by KEMET, it was observed that this objective has not been accomplished yet.

The number of processes improved, defective parts per million and process capability have not reached six sigma levels 3 years after the Six Sigma program start-up.  The percentage of processes improved using Six Sigma Methodology is less than 60%.  The PPMs at one of the main electrical tests (Board Mount Test) are at roughly 3,500.  That number of defects represents 4.22 Sigma, it is far from reaching six sigma capability yet.  Also, Cpk's are only monitored in 6 out of 10 major processes and none of them have reached six sigma levels. Additionally, only less than 20% of the Black belts trained got the certification and the Green belt waves to be trained got interrupted in the middle of the second group.  The average savings generated per project in the first year was less than $80,000.

The following hypothesis arises based on the problem definition and the data mentioned above:  It is possible to generate a re-implementation in KEMET CBU which will revitalize the initiative.

The preceding data leads to the main questions of investigation:  "What are the factors that prevented the Six Sigma deployment to be successfully completed in KEMET?"  From this question also derives the need to understand what can be done to improve the deployment and make Six Sigma work for the organization.

## 4. OBJECTIVES AND JUSTIFICATION

The main objective is to identify the causes of the failed deployment of Six Sigma at KEMET. Based on the identification of the causes, potential solutions can later be defined for each of the roadblocks encountered during the Six Sigma deployment at KEMET. A proposal will be developed with several actions that can help eliminate the problems found in the implementation. This should enable a better use of Six Sigma and help improve the performance of the organization.

### Specific objectives:

- To define and name the characteristics of a successful Six Sigma deployment.
- To create a survey based on the success factors of implementations to gather the perception of the Six Sigma Community in KEMET regarding the deployment.
- To analyze the roadblocks that were experienced by KEMET during the implementation of Six Sigma. (Based on the results obtained from the questionnaire.)
- To generate specific actions to eliminate the roadblocks of the implementation in KEMET.

The importance of learning and defining how the Six Sigma implementation process failed at KEMET will help in improving the organizational metrics. The definition of actions and implementation of countermeasures can make Six Sigma worth what KEMET has already invested in it in terms of time, training, money, and resources.

Additionally, this type of analysis and work can help to prevent incurring in the same type of system errors while trying to implement other methodologies, cultural changes, quality models, or business philosophies. Given the amount of time available for this research work, implementation of the actions proposed is

not possible.  However, all of the actions listed throughout this thesis are feasible and, with proper planning, can help the organization turnaround a failed implementation to a better use of the tools and, in consequence, improvement of the processes.

## 5. METHODOLOGY

To support the investigation based on the fact that Six Sigma was not successfully deployed and understand why this happened, information research was performed. Along with the information obtained in books and articles a questionnaire to gather information from the participants was created in an effort to understand their perception of the Six Sigma deployment in the organization. It was then distributed among them and their responses were recorded for analysis. The questionnaire was sent to a total of 54 people and 30 responses were received and analyzed.

The questionnaire is a collection of 12 questions aimed at gathering general information related to the position of the individuals, their role in Six Sigma, how and where they were trained and what their perception is as to why the deployment failed. (A copy of the questionnaire is provided in Appendix A for reference.)

The questionnaire was divided in 3 sections. Section one (General Information) provides information regarding the type of work that the employee had when trained and what his responsibilities are now. Section two, Six Sigma-Deployment, helps to determine if Six Sigma is still useful in the employee's current responsibilities, and if the perception is that the organization really adopted the philosophy. These sections will clarify the successfulness of the implementation and its validity and use today.

The questions of these sections are as follows:

**I. GENERAL INFORMATION**
1. **What is your current position?**
2. **Is your position different from the one you held while being trained in 6-Sigma?**
3. **What is your role in 6-Sigma with the company today?**
4. **How did you get involved in the 6-Sigma Program?**
5. **How & Where did you get trained?**

**II. SIX SIGMA – DEPLOYMENT**
6. **Are you using 6-Sigma methodology now?**
7. **How do you use 6-Sigma?**
8. **In your opinion is 6-Sigma still in use throughout the Business Unit?**
9. **In your opinion was 6-Sigma successfully deployed?**
10. **What would you have done differently?**

The main draw from these two first sections of the questionnaire is that out of the total people who responded to the questionnaire 73% (22 people) thought that Six Sigma was still in use throughout the organization in one form or another. Some comments were that Six Sigma was still in use mainly as a problem solving technique. Also, in addition to the author's opinion, more than 86% of the population believes that the Six Sigma deployment was not successfully completed.

The next section presents the different roadblocks mentioned by several authors as preventing successful Six Sigma deployments. It was designed in as the opportunity for the participant to define what they perceive as the main problems in the implementation of Six Sigma. This section is what helps answer the main question of this investigation: "What are the factors that prevented the Six Sigma deployment to be successfully completed in KEMET?"

The options given to the employees who answered the questionnaire were the major issues listed in different articles and books which discuss Six Sigma implementation and the areas that need to be considered for a successful deployment. The roadblocks can be separated in three main factors that are part of the Six Sigma Methodology and Implementation: Leadership, Human Resources, and Technical. The Leadership factor consists of everything that has to do with Senior and Upper Management supporting the strategy and their role in the implementation. It also should take in consideration the leadership role of the Six Sigma Deployment Leader to plan, push and evaluate the implementation. Human Resources has areas as the use of human resources (Champions, Master Black Belts, Black Belts and Green Belts) and the

infrastructure needed to sustain Six Sigma in the organization (e.g., pay structure, organizational structure, retention programs, rewards programs, etc.). Finally, the Technical Factor includes everything that has to do with the training and the actual action related to Six Sigma, the projects.  For this investigation this area focuses on project selection and correct tracking as well as planning for the implementation.

The roadblocks listed in the questionnaire as options are listed below.  There is also a reference as to the category or factor that they pertain to in Table 5.1.

| Roadblock as mentioned in questionnaire | Type of Factor |
|---|---|
| Lack of commitment from upper management | Leadership |
| No alignment with customer expectations | Leadership |
| Lack of communication of the objective, strategy, and plan | Leadership |
| Lack of alignment of 6-Sigma with Organizational Objectives | Leadership |
| There was no clear plan for the deployment | Technical |
| Lack of the correct Human Resources Infrastructure | Human Resources |
| Poor training for Upper Management, BB and GB | Technical |
| No clear metrics to monitor performance and implementation | Technical |
| No clear involvement of financial department in training, deployment, and projects | Technical |
| Incorrect selection of the BB and GB candidates | Human Resources |
| Incorrect focus of the Champions, BB and GB | Human Resources |
| Incorrect method for project selection (lack of good projects list) | Technical |
| Poor follow-up of the projects initiated | Technical |

**Table 5.1 Roadblocks classification by type of factor**

Each of the options given to the employees as roadblocks encompasses a few ideas. The description of them follows for better understanding of the details.

**Lack of commitment from upper management:** This means that the upper management is not really buying into the implementation of the new philosophy; therefore, problems like priorities conflicts and resource assignation arise. This can be reflected in such things like business executives not showing up for projects reviews or report-outs, no active role in the communication of the Six Sigma strategy and the development of the new compensation plan, incorrect or unclear prioritization of the objectives and tasks to be performed by middle management, engineering personnel and operators, no clear accountabilities, expectations, roles and responsibilities created in the organization.

**No alignment with customer expectations:** This reflects a need for the company to understand that one of the steps in the implementation is to understand what the customer wants and needs from our company and products. If we start our Six Sigma journey with no understanding of the critical to quality factors which will actually add value in the customer's perspective.

**Lack of communication of the objective, strategy, and plan:** Not only should there be an objective, strategy and plan to meet that objective, but also, there needs to be a good communication channel through which the whole organization will know what those are. Six Sigma is a cultural change and it implies involvement of every single person in it.

**Lack of alignment of 6-Sigma with the Organizational Objectives:** The implementation of Six Sigma, in the beginning, and the Six Sigma projects need to be in sync with the objectives of the organization. There needs to be support of Six Sigma as a Company strategy and tool kit to achieve the goals established by the organization every period. There should not be any Six Sigma projects which are not tied to the main objectives or company policies.

**There was no clear plan for the deployment:** Part of the assessment to get started with any implementation will include establishing a goal or objective and a plan to get to it. As part of the plan a goal needs to be spelled out and strategic

and tactical activities need to be identified to get to the goal.  Action without a plan will get a company nowhere.

**Lack of the Correct Human Resources Infrastructure:**  There are several changes that need to take place when implementing Six Sigma, and one of them is in the organization's infrastructure.  According to several authors, the right Human resources infrastructure includes a rewards or recognition program for GB and BB, a retention strategy to avoid loosing resources that are key and already trained in Six Sigma, clear new career paths for employees who are part of the Six Sigma organization within the company, and the creation of a new pay structure which links compensation to results.

**Poor training for Upper Management, BB and GB:**  This includes incomplete or incorrect training for the group of people that will be more involved in the deployment.  This comprises general training so that Senior and Upper Management know what the philosophy is about, understand the statistical language and the very detailed tools review for the black belt certification.  For the training to be classified as good, it needs to design a custom training plan depending on the level of knowledge of statistics and tools.  Training is critical for management to understand what the task they are undertaking is about.

**No clear metrics to monitor the performance and implementation:** It is a must to have very well defined and known metrics to evaluate the progress of the implementation of the program and the performance of what has already been implemented.

**No clear involvement of financial department in training, deployment, and projects:** Six Sigma is very much based in costs and how through costs everything can be evaluated to indicate success or failure.  The financial department plays a big role in the Six Sigma program.  One of the objectives when implementing Six Sigma is often given in terms of money, also, the objectives to be achieved when doing a project need to be quantified in money most of the time.  When Six Sigma is deployed the employees that are part of the financial department need to understand the main ideas of the philosophies and get trained to be able to assist in the projects and do projects themselves.

**Incorrect selection of the BB and GB candidates:** This means that the organization may not be selecting the right people related to one or more of the following: skills, characteristics, knowledge and level in the organization. There needs to be a special political skill to be able to sell as a Black Belt, and of course, the level of knowledge and expertise is very important to end up with good projects that are actually implemented.

**Incorrect focus of the Champions, BB and GB:** Some authors mention this as using BB for fire-fighting which would be like daily activities and problems that do not require a high level of expertise and training. The organization needs to understand that once a BB and GB are trained they need to be used to the maximum. Actually, BB are usually separated from their old jobs so they dedicate their time to look for opportunities to implement Six Sigma projects and win in time, money, scrap, etc.

**Incorrect method for project selection (lack of good projects list):** This is a very common problem according to several authors like Mike Carnell, Bruce Hayes and Tom Pyzdek. If the project selection is not good, the Six Sigma savings objectives cannot be accomplished. There needs to be a list of projects that are doable in a year to have a pool to pick from once a Six Sigma project is completed. Following one of the roadblocks mentioned before, the projects need to be tied to organizational objectives.

**Poor follow-up of the projects initiated:** This means that there needs to be a formal method of review of the projects. It includes a formal, periodical presentation to management and the group involved in the implementation. Also, it means that there is follow-up until a project is completed. There does not need to be a drop-off of projects along the way unless it is truly believed that it does not support the organizational objectives any more.

As the responses of the questionnaire were received, they were recorded and analyzed. A very basic division was made to identify which were the factors or roadblocks that were mentioned the most by the employees. Table 5.2 shows

the number of times (from highest to lowest) each one of the roadblocks was mentioned as a problem for KEMET in the surveys.

| Roadblock | # of occurrences | % related to  population |
|---|---|---|
| Poor follow-up of the projects initiated | 20 | 67% |
| Lack of commitment from upper management | 19 | 63% |
| Incorrect method for project selection (lack of good projects list) | 18 | 60% |
| Lack of alignment of 6-Sigma with Organizational Objectives | 17 | 57% |
| There was no clear plan for the deployment | 14 | 47% |
| No clear metrics to monitor performance and implementation | 14 | 47% |
| Lack of communication of the objective, strategy, and plan | 13 | 43% |
| Incorrect focus of the Champions, BB and GB | 12 | 40% |
| Lack of the correct Human Resources Infrastructure | 11 | 37% |
| No clear involvement of financial department in training, deployment, and projects | 8 | 27% |
| No clear involvement of financial department in training, deployment, and projects | 8 | 27% |
| Poor training for Upper Management, BB and GB | 7 | 23% |
| Incorrect selection of the BB and GB candidates personnel | 5 | 17% |

**Table 5.2 Survey results for roadblocks arranged by number of times mentioned**

More than 50% of the total of people who responded this question believe that poor follow-up of projects, lack of commitment from upper management, incorrect method for project selection and lack of alignment of Six Sigma with the organizational objectives are major issues.

In an attempt to identify the importance of each one of these roadblocks to the participants, an analysis of the most mentioned roadblocks as the main 3 problems for KEMET was made based on the responses given to question 12 in the questionnaire: Name the 3 main problems that prevented KEMET from having a perfect 6-Sigma deployment. Please provide them in prioritized order starting with the most important one. Results of this question are outlined in Table 5.3.

| Roadblock | % of times mentioned (out of 28) |
|---|---|
| Lack of commitment from Upper Management | 36% |
| Incorrect method for project selection (lack of good projects list) | 21% |
| Lack of alignment of 6-Sigma with Organizational Objectives | 11% |
| There was no clear plan for the deployment | 7% |

**Table 5.3  Roadblocks by percent times mentioned as the number one problem KEMET encountered in the implementation**

According to this analysis, the main three problems are contained in the first four roadblocks when ordered from most times mentioned to least. It was observed that the roadblock Poor follow-up of projects was only mentioned once as the most important problem when implementing Six Sigma at KEMET. There were five more issues mentioned as important roadblocks with only one vote.

In addition to the prioritization of the roadblocks this last question gave the participants a chance to introduce new roadblocks or problems they considered important. They are all included below as they were mentioned, however, it is important to note that some of them can be associated with one of the thirteen roadblocks provided as options for response in question 12:

- Elimination Master Black Belt position (we don't care about 6S)
- Demand the use of 6S methodology only for cost saving projects

- Lack of commitment of employees
- Trying to use Six Sigma in "Do it" projects and on out of control processes
- Lack of a plant Champion or Master BB to assist engineers and continue to drive training and communication
- Cost reduction projects are not based on variation reduction, but in changing methods, and raw materials with poor quality
- The different KEMET departments are not aligned on the same objectives
- People need to be trained more in the science of statistics first, then six sigma. People understand how to use Minitab$^{TM}$ but they do not understand what is behind the software.
- Six sigma leader must know the process and product also have experience doing BB projects
- Try to implement a methodology without enough/adequate resources
- Engineers were told to use 6 sigma, and not to stop and make sure the science backs up the results
- Not having a baseline (with some repeatability) to use as a base for six sigma trials
- Improper use of Six Sigma which gives us a bad taste and will result in stopping the use of it, which is not the correct approach
- No follow-up of critical process improvement needs using 6-sigma methodology
- Lack of mid level (plant management) leadership to use trained resources to improve manufacturing performance
- Too much focus on 6 sigma as the objective versus a means to accomplish the objective (objective = profitability)
- Disagreement on the deployment appropriate strategy between various levels of management
- Trained too many people too fast (de-focused the organization)
- It was a fashion not adopted as a way of life
- Black belt training no longer available (internally)

- 6 sigma expert no longer available for consulting (MBB left the company)
- Confusion over the "scope" of our 6Sigma initiative. Old CEO wanted to adopt a GE model of 6Sigma; current CEO wants to avoid the GE model but failed to recognize the value of 6Sigma as an engineering methodology.

In analyzing the number of times each one of the options were mentioned as a problem that KEMET experienced, it was noted that even when there is no obvious way to determine the importance from this classification the occurrences can be divided in 3 major groups in terms of occurrences. Group division is shown in Table 5.4 below.

| Roadblock | # of occurrences | Group |
|---|---|---|
| Poor follow-up of the projects initiated | 20 | A |
| Lack of commitment from upper management | 19 | A |
| Incorrect method for project selection (lack of good projects list) | 18 | A |
| Lack of alignment of 6-Sigma with Organizational Objectives | 17 | A |
| There was no clear plan for the deployment | 14 | B |
| No clear metrics to monitor performance and implementation | 14 | B |
| Lack of communication of the objective, strategy, and plan | 13 | B |
| Incorrect focus of the Champions, BB and GB | 12 | B |
| Lack of the correct Human Resources Infrastructure | 11 | B |
| No clear involvement of financial department in training, deployment, and projects | 8 | C |
| No clear involvement of financial department in training, deployment, and projects | 8 | C |
| Poor training for Upper Management, BB and GB | 7 | C |
| Incorrect selection of the BB and GB candidates personnel | 5 | C |

**Table 5.4  Roadblocks classified in groups based on number of times mentioned**

It is important to note that all of the roadblocks will be explained in the next chapters and solutions will be proposed for every one of them.  However, group A will be approached with more detail, in many cases, emphasizing different ways to solve these problems.

## 6.  LEADERSHIP FACTOR

*Six Sigma is not a product you can buy.*
*It is a commitment.*
- Dennis Sester, senior vice-president of Motorola

As mentioned before, this factor focuses on how leaders (mainly Senior and Upper Management) influence a smooth, successful implementation of Six Sigma in an organization.  There are different types of leaders in the organization who help introducing new programs like Six Sigma.  Implementing Six Sigma implies a change in the organization as to how it works (infrastructure) and how things are done.  It is clear that if the CEO and Senior Management do not start the trend or totally buy into the program it will not have the strength needed for it to survive.

Tom Pyzdek names four specific roles which are critical for change to take place successfully.  These roles are the official change agent, sponsors, advocates, and the informal change agents.  All of these people can be considered as leaders at different levels with tasks which will have an impact in the implementation of Six Sigma.

The change agents, who are also known as Champions too, usually are designated as responsible by the management team to plan and manage the implementation.  The sponsors are senior managers who have formal authority to legitimize the need for the introduction of a program or philosophy needs to be implemented to help in the improvement of the processes, products, organizational culture, employee performance, etc.  No major change (like adopting Six Sigma) is possible unless it has a Sponsor who can make it a company goal.  The advocate is someone who sees the need for the change or implementation of a new philosophy and sells the idea of how it will be beneficial

to go through the change.  The advocates may or may not hold top management positions, but ideas for change usually are more successful when they come from senior managers.  Finally, the informal change agents are like volunteers who truly believe that the change is needed and would be very helpful for the organization.

A figure which very well illustrates the position of the roles in the organizations is pasted below.  This figure was developed by David Hutton and used by Tom Pyzdek for a better understanding of the roles needed for Six Sigma introduction in an organization.
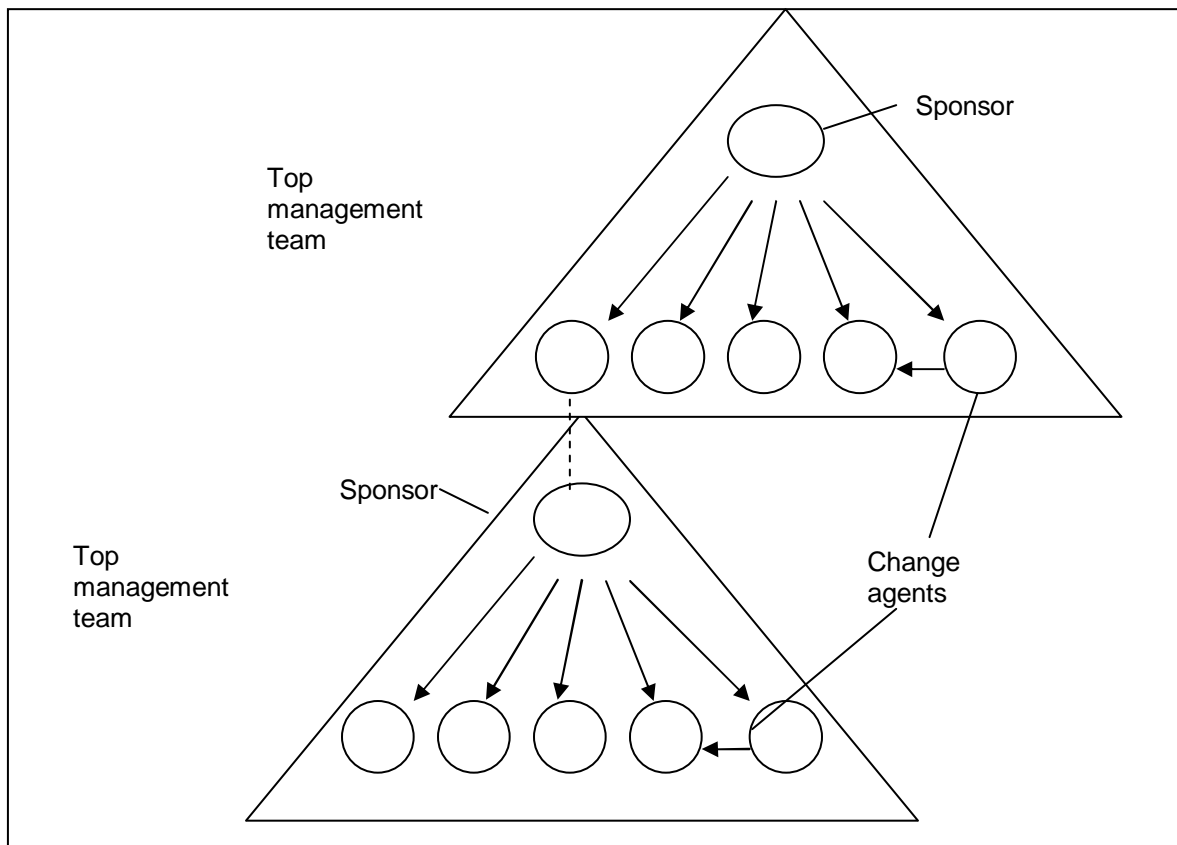


**Figure 6.1 Cascading of sponsorship[5]**

It is important to note that a very important piece in the Six Sigma Implementation is the Implementation Leader or Deployment Leader.  That

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[5] Pyzdek, Thomas.  *The Six Sigma Handbook, Revised and Expanded.*  Chapter 1 " Building the Six Sigma Infrastructure", page 15.

person is considered the most important official change agent.  Leadership (Senior Management) gives this person full responsibility to implement Six Sigma.  He should be the one to manage and plan for the implementation of Six Sigma.  Also, he needs to plan periodic reports of the progress and have very clear metrics to understand how successful the implementation is.

As discussed before and illustrated using Figure 6.1, a key point in the implementation of Six Sigma is to have a well identified sponsor as part of the Senior or Top Management Team.  In most cases, this sponsor is the Vice-president of Quality of Director or Quality; however, there are cases when that sponsor is the CEO.  In KEMET's case, the CEO in 2003 (who joined KEMET from a division of GE) was the initiator of the Six Sigma enthusiasm, and he appointed the Vice-president of Quality the official Sponsor in the top management team.  This was good because one must know that if the CEO is the initiator the company should get pretty serious about it.  But there were two main issues with the change agents and sponsorship, one is that no resource was appointed as the Deployment or Implementation Leader officially and the CEO changed a year later.  Having said this, after the CEO who thought Six Sigma was a good idea left, it was no longer a high priority for KEMET.  Tom Pyzdek says: *"Lukewarm leadership endorsement is the number 1 cause of failed Six Sigma attempts."* [6]

There are a few main elements that are the foundation of the upper management or company leadership responsibilities:  showing determination to make Six Sigma  a new way of life and fully believe that the implementation can be successful; displaying confidence in Six Sigma as a philosophy to improve the business and in the team carrying out the implementation; exhibiting integrity by doing what they say and setting an examples, this promotes loyalty and respect; and, finally, being patient and waiting a reasonable time for Six Sigma to fully

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[6] Pyzdek, Thomas.  *The Six Sigma Handbook, Revised and Expanded.*Chapter 1 "Building the Six Sigma Infrastructure", page 28.

take off and show some significant improvements.  (Leaders need to be careful and not seem slow to realize that the implementation is not going well.)

After explaining what is expected from the leadership team and who constitutes the leaders in the change or Six Sigma implementation, we need to define which of the roadblocks pertain to this category.

- Lack of commitment from upper management
- No alignment with customer expectations
- Lack of communication of the objective, strategy, and plan
- Lack of alignment of 6-Sigma with Organizational Objectives

Each one of the roadblocks mentioned above will be explained and a potential solution provided in this chapter.  However, it is important to point out that Lack of commitment from upper management was the second most selected one in the questionnaire when given all the options of problems to choose from and the first one when employees were asked to give the main three causes for failure.

### 6.1 Lack of commitment from upper management

As mentioned before, when there is no string supporter of a cultural change (like the introduction of Six Sigma) in the leadership group, it is very easily dropped before completion.  There needs to be very good understanding of the implications of the change, as well as buy-in to ensure that the enough and appropriate resources are dedicated to the implementation.

In the beginning of this chapter some main elements are named which will help in showing the commitment from upper management.  Those are showing determination, confidence, integrity, and patience.  If management lets the rest of the organization know that they know about Six Sigma, they really believe in it, and think that it can help everyone's life be easier and provide real value to customers, this feeling cascades down.

In KEMET's case, one of the main issues is that the main sponsor in the upper management team was the CEO who had experience Six Sigma since he joined the company after working several years for GE. When this CEO left the company and a new CEO took control, the priorities changed and Six Sigma was no longer one of the most important ones. The main objective was to survive in the business and Six Sigma was not a thing that the new CEO and team identified as the means to that end. The second most important issue is that no Six Sigma Deployment Leader was formally appointed. If no deployment leader is appointed it is hard to find someone responsible for the implementation and who can be accountable for the results of the deployment and the progress of it. This second issue also shows that there was no real commitment of management to make this implementation a successful one. No specific resource was allocated to carry the plan through.

Actions to improve in this area are simple but extremely important. If KEMET decides to make Six Sigma a priority, there needs to be a new kick-off of the program. This does not mean that the whole program needs to be initiated, but it should formally be announced as an improvement of the implementation that had already been carried out. The improvement of the Six Sigma deployment can be newly approached by starting with a letter from the CEO distributed via e-mail and also pasted on the bulletin boards in every process area. This letter may include the view of how Six Sigma can help the company, the goal, objectives and expected benefits of implementing the program and what the CEO expects in terms of support from every employee. A sample letter taken from "Six Sigma for Managers" is included in Appendix B.[7]

Additionally, there should be a resource appointed to ensure that the actions to improve the Six Sigma deployment. It can be called a Deployment Leader or a Six Sigma Coordinator, but he will be responsible to ensure that the

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[7] Brue, Greg. *Six Sigma for Managers.* Chapter 4 "Implementing Six Sigma", pages 69-70.

recommendations to inject new life to the program are carried out as well as any other actions that seem pertinent to reenergize the Six Sigma philosophy in the organization.  He can also be held accountable for the follow-up of the projects and the continued success of Six Sigma throughout the years.

Another recommendation is to have top management members (Vice-president of Quality, Quality Director, or Plant Manager) welcome black and green belts to their training groups.  They could open up the training session and spend a few minutes explaining how they are very important and how their training will help the organization.  If top management shows up for a training session, even if it's for a few minutes, the message left to the participants and the whole organization is that the program must be pretty important for them to spend their time welcoming the black and green belts and giving them some background on how Six Sigma is supposed to work in the company.

Last, but most importantly, a very simple way to guarantee that upper management is committed to make this happen and stay committed for successful deployment is to tie this to their compensation.  Some authors recommend that the successful implementation of Six Sigma is part of their objectives and their compensation bonus.  For example, General Electric encourages their executive leaders to support the initiative by linking it to their bonus.  Around 7,000 of their top executive leaders have 40% of their bonuses depending on the successful implementation of Six Sigma.  This sends a message to leadership about the importance to accomplish such task.  Specific objectives to ensure that Six Sigma is "retaken" and kept alive can be added to the upper and middle management MBOs (Management by objectives) which are tied to the percent of salary bonus that is given out each year.

Also, it can be added as an objective in the MBO section of the performance evaluation for employees who do not have access to the annual bonus.  When this is done, it needs to be very carefully thought through.  A nice amount of

bonus "payout" should be tied to this objective in order to emphasize how critical this is. The objective can be measured in terms of savings, improvement in critical performance measures, and/or number of projects successfully finished within one year.

### 6.2 No alignment with customer expectations

Six Sigma is very focused on customer satisfaction. The critical-to-quality concept in Six Sigma allows room to work in improving quality from the perspective of the customer. To do this and ensure that there is real value added to the customer, the organization has to make sure that there is understanding of what the customer wants, needs and expects. That is the basis to customer satisfaction, if this is not well understood, the organization can end up wasting time and resources making improvements that don't matter and missing improvements that are critical to the customer's eyes.

As mentioned above, setting up the base for the focus in customer satisfaction is also a task that needs to be placed in very high priority by the leadership team (upper management). Listening to the voice of the customer will result in the organization knowing what the customer requires and exceeding their expectations. In order to ensure alignment with customer expectations KEMET might need to try following the steps described below:

- Identify who the customer is
- Get in contact with the customer and ask how they view a problem if there is one to resolve or just the product or service that is offered in general
- Establish clear output requirements (features of the final product or service that are relevant to the customer) and the service requirements (subjective information referring to how the customer expects to be treated when doing business with the company and what "after-sale" services will be important)
- Build a matrix describing what the requirement is as named by the customer and link it to an observable (pass/no pass) or measurable characteristic of the product or service.

An example of a matrix is shown below:

| Customer comment | Requirement | Observable/Measurable |
|---|---|---|
| "Our applications require a wide range of capacitance." | Low to high capacitance part numbers. | Cap values (from 10 pF to 22 $\mu$F) |
| "The capacitors will be used at low temperatures." | Low capacitance variation at -55°C | TCC (Temperature Curve Characteristic) |
| "The capacitors should not exhibit any physical damage." | Zero physical defects | Visual inspection |

**Table 6.1 Sample matrix used to ensure alignment with customer expectations**

Another way to ensure the understanding of customer expectations if by using surveys, focus groups, and the House of Quality tools (Quality Function Deployment tools, QFD).

### *6.3 Lack of communication of the objective, strategy and plan*

The top management group is also responsible for setting a very clear objective and strategy for the Six Sigma Deployment, besides fully supporting it. The Six Sigma Deployment leader then has a base to work on to develop an implementation plan. All of this can work well as it is being outlined, but if it is not communicated to the rest of the organization the whole implementation looses credibility. There can be a very clear plan to follow, but if it is not known throughout different levels of the organization it might seem that there is no plan, and, therefore, it's not important to focus on it.

In KEMET, the training started with several black belt training waves that were scheduled. However, an objective of the implementation, strategy, and plan or how it supported the organization objectives was not communicated. Neither the

CEO nor Quality Vice-president used any of the company communication tools to let people know why Six Sigma was being implemented.  Proof of this is that there is no record of a newsletter, intranet announcement or comment during the monthly operational performance review meetings regarding the specifics of the implementation.

A good way to comply with this very important task is to use the already existing means of communication in the company.  A formal announcement with the objective, general plan and timing of the "re-implementation" of Six Sigma can be posted in the Intranet and KEMET webpage.  Also, the kick-off of the Six Sigma reengineering can be done during a Townhall Meeting.  This meeting is held once every quarter and a presentation of business results is made by the CEO and some of the Vice-presidents.  There is always a section about something new and important that is going on in the company.  Six Sigma reimplementation can be in that section one of the quarters and show a general plan to achieve the objective.

To make this information available to even more people, a section on Six Sigma can be added to the monthly Quality Operating System (QOS) meetings and the Business QOS.  During this meeting the most important business metrics are reviewed at the plant and business unit level.  Six Sigma implementation or reengineering progress can be part of that review as well as process capability reviews.

### 6.4 Lack of alignment of 6-Sigma with organizational objectives

Leadership is responsible for the organization objectives to be achieved.  They do that through the unfolding of strategic objectives into tactical objectives.  The development of strategic objectives is the responsibility of upper management and tactical objectives should be developed based on strategic objectives by middle management.  There should be a link between the customer and stakeholder requirements and the Six Sigma projects.

Many leaders who have implemented Six Sigma in their organizations recognize that the alignment of projects to organizational objectives is probably one of the most difficult tasks.  However, it is also pointed out as one of the most important factors to succeed when implementing Six Sigma.  This is the fourth most mentioned problem when the KEMET employees were given choices to identify roadblocks encountered during the implementation of Six Sigma.

Tom Pyzdek states that there should be a clear link between the projects and stakeholder and customer satisfaction requirements.  In his book The Six Sigma Handbook there is a section related to linking projects to strategies.  KEMET can use the steps proposed by Pyzdek in order to ensure that there is a clear statement of what the strategies of the business are and what the link is between those and the Six Sigma initiative and projects.  The use of QFD matrices can help in defining the strategies, links and projects.

1. Define strategies that are meant to satisfy the customer and stakeholders (see Figure 6.2)
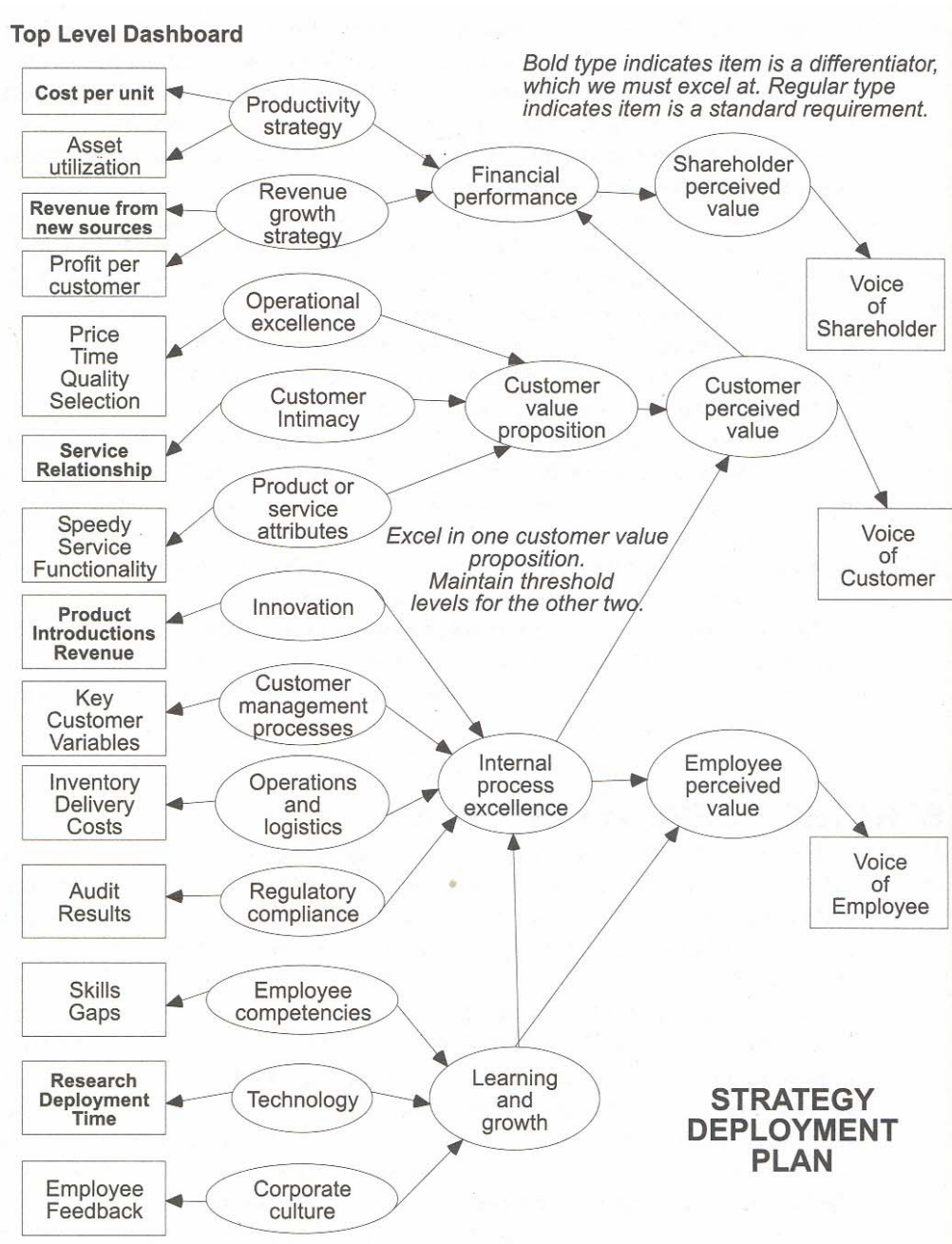


**Figure 6.2 Example of Strategy deployment plan** [8]

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[8] Pyzdek, Thomas. *The Six Sigma Handbook, Revised and Expanded. Chapter* 2 "Sigma Goals and Metrics", page 72.

2.  Create a QFD matrix where the strategies are tied to metrics (please refer to
    Figure 6.3)



**Figure 6.3 Strategy Deployment Matrix[9]**

[9] Pyzdek, Thomas.  *The Six Sigma Handbook, Revised and Expanded. Chapter*  3 "Creating Customer-Driven Organizations", page 134.

3. Once the strategies are tied to business metrics, create a QFD matrix where the metrics are tied to departments (operations) (an example is shown in Figure 6.4)



| Dashboard Metric | | Engineering | | | Manufacturing | | Marketing | | | Criteria Performance Target | Criteria Score | Relative Criteria Score |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Deployment to Operations | Faster prototype development | Reduce Old Design Support | Improve Concept-to-Design cycle time | Faster ramp-up to full production | Increase flexibility to handle product mix | Improve ability to respond to changing customer needs | Improve direct marketing response rate | Identify target markets for new products | | | |
| | New product introductions | ◉ | ○ | ◉ | ◉ | △ | ○ | | ◉ | +50% | 36 | |
| | Revenue from new sources | ◉ | | ◉ | ○ | ○ | ◉ | △ | ◉ | 20% of total revenues | 34 | |
| | Customer relationship | | | | | | ◉ | | | VOC average > 6.5 | 28 | |
| | R&D deployment time | ○ | ◉ | ◉ | | | ○ | | | -30% | 24 | |
| | Numeric Relative Score | 0.18 | 0.08 | 0.22 | 0.11 | 0.04 | 0.19 | 0.01 | 0.16 | | | |
| | Target | 10 weeks | 15% of time | 12 weeks | 6 weeks | -50% on setup time | +0.5 on VOC | +50% | 20% of sales | | | |
| | Score | 702 | 324 | 846 | 426 | 138 | 738 | 34 | 630 | | | |
| | Relative Score | | | | | | | | | | | |

**Figure 6.4 Operations Deployment Matrix[10]**

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[10] Pyzdek, Thomas. *The Six Sigma Handbook, Revised and Expanded.* Chapter 3 "Creating Customer-Driven Organizations", page 137.

4. Make a final QFD matrix where the operations can be translated into specific actions needed (see Figure 6.5)



| | | | Black Belt — Pin manufacturing capability (Mike L) | Customer requirements -> Engr requirements (Mike L) | Reduced BP errors (Lori S) | Reduced prototype -> production model design time (Lori S) | Reduce supplier bid cycle time (Lori S) | Reduce customer bid cycle time (Nguyet H) | Reduce customer "non-responsive" complaints (Nguyet H) | Reduce part-count in new product (Nguyet H) | Target | Numeric Relative Score | Goal Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Departments | Engineering | Faster prototype development | ○ | | | ◉ | △ | | | ○ | 10 weeks | 0.18 | 16 |
| | | Improve Concept-to-Design cycle time | ◉ | | ○ | ◉ | | | | ◉ | 12 weeks | 0.22 | 30 |
| | Manufacturing | Faster ramp-up to full production | △ | | ○ | ○ | ◉ | | | ◉ | 6 weeks | 0.11 | 25 |
| | Marketing | Improve ability to respond to changing customer needs | ○ | | | | △ | ◉ | ◉ | | +0.5 on VOC | 0.19 | 22 |
| | | Identify target markets for new products | | | | | | | | | 20% of sales to new markets | 0.16 | 0 |
| | | Project Impact Score | 0.00 | 3.22 | 0.99 | 3.96 | 1.37 | 1.73 | 1.73 | 3.53 | | | |

**Figure 6.5 Projects Deployment Matrix[11]**

The linkage between the projects and the strategies is also very well presented by Pyzdek. The following Figure is a variation of a flow he created to illustrate the expected relationship.



**Project** → Department Plan → Business Unit Plan → Strategy → **Voice of the customer**
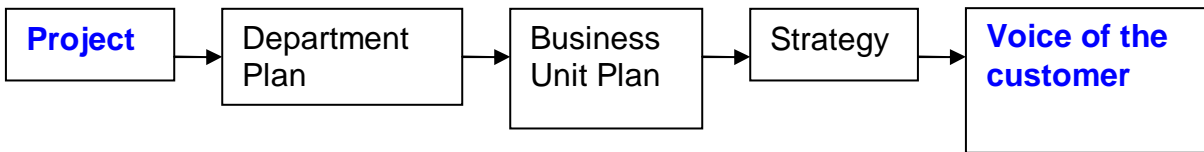
**Figure 6.6 Linkage between Six Sigma projects and Voice of the customer[12]**

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[11] Pyzdek, Thomas. *The Six Sigma Handbook, Revised and Expanded.* Chapter 3 "Creating Customer-Driven Organizations", page 139.

[12] Pyzdek, Thomas. *The Six Sigma Handbook, Revised and Expanded.* Chapter 3 "Creating Customer-Driven Organizations", page 139.

A more simple way to approach this would be using the QFD methodology, but instead of using the house of quality, KEMET can use the Macabe approach as in Figure 6.7



**Figure 6.7 QFD Methodology:  Macabe approach**

# 7. HUMAN RESOURCES FACTOR

Human Resources encompasses topics that have to do with training, compensation and organizational infrastructure. As a reminder, the roadblocks chosen for this study that are classified under this factor are:

- Lack of the correct Human Resources Infrastructure
- Incorrect selection of the BB and GB candidates
- Incorrect focus of Champions, BB and GB

## 7.1 Lack of the correct Human Resources Infrastructure

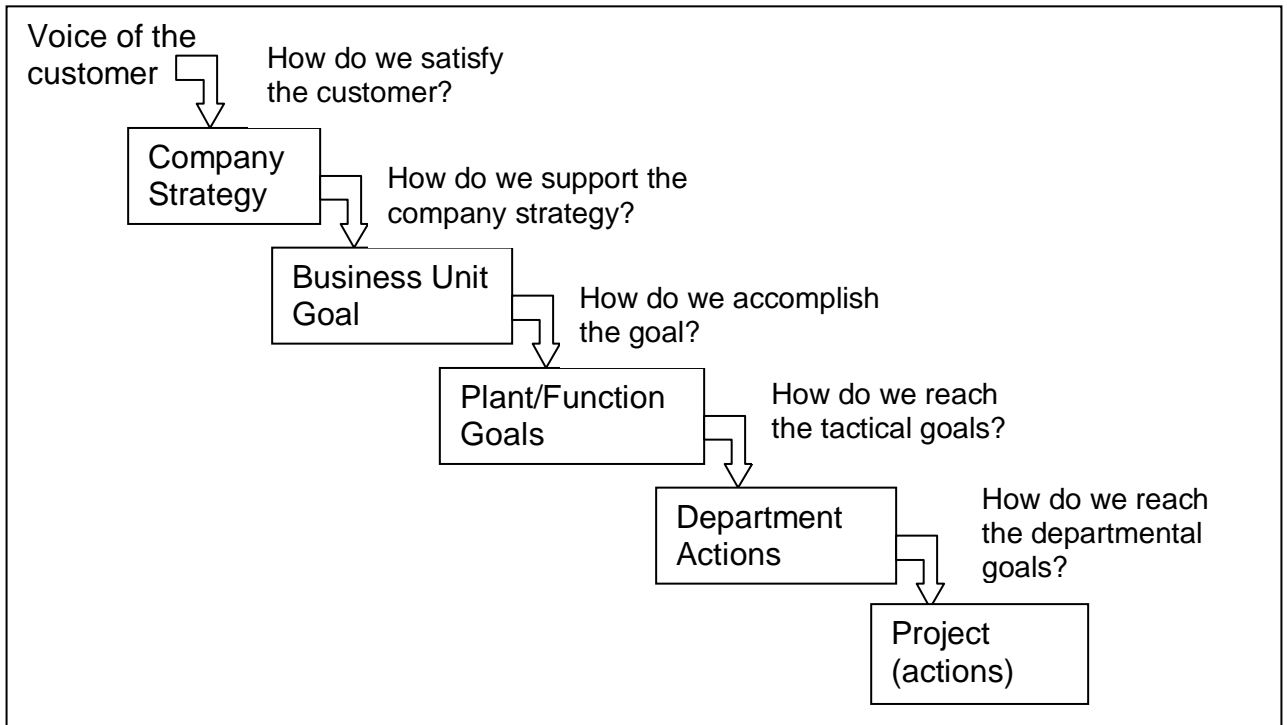Almost 40% of the people who responded to the questionnaire thought that this was a problem encountered when trying to implement Six Sigma in KEMET. This is a very broad category, it involves working on many different things related to Human Resources.

There is a critical factor that is needed in order for Six Sigma to succeed in every organization, there needs to be the right Human Resources infrastructure. A very basic part of this is to ensure that: the organization makes room for a Six Sigma Department or group, there is a clear career path for black belts, there is an incentive tied to becoming a black belt and achieving goals when completing projects (pay/compensation tied to meeting objectives); and, there is some plan for trained resources retention.

In Tom Pyzdek's opinion, as stated in The Six Sigma Handbook, more than 80% of the Six Sigma Implementations fail because the right infrastructure to support it is not there. This infrastructure needs to be able to support the change in organization culture, as stated before.

A different author, Greg Brue, states that there are a few basic infrastructure requirements that need to be fulfilled in the first two years while trying to implement Six Sigma. Some of those requirements are listed below:

1. Set up a database for lessons learned: this is so people do not have to go through the same experimentation or analysis to learn that something does not work. It helps in maintaining a common space where everyone can look to see what other people have tried and learn from it.

2. Establish an ongoing communication plan: this helps let people know the importance of Six Sigma, the expectations to be covered with the implementation of it, what the progress is, and to maintain the philosophy alive.

3. Grow the black belt and green belt communities: this ensures that the knowledge base grows and is enough to attack problems or improve the process as the company and demand for products and services grow.

4. Create compensation plans and progression plans for a full two years: this is one of the most important ones because without a clear career path, very successful and critical resources that are being or have been trained in Six Sigma may feel left out. They may not know that their expertise is appreciated or how their work helps the company if the compensation is not tied to achievements and pay is not according to their process and tools knowledge.

5. Host certification events that reward and recognize black belt achievements: in this author's opinion this helps in promoting Six Sigma, market it as a very important philosophy to follow and motivate individuals to keep learning and participating. It should also be extended to whole project teams.

6. Develop compensation/incentive plans that include not just black belts and team members, but also upper management to ensure continued support.

The proposal to improve the situation in this area related to KEMET is for the leadership team and the Human Resources department to develop a master plan which answers these very important questions:

1. What is the best Six Sigma Organization for us?

**Strategy:** Creating a Six Sigma Organization independent from individual local departments could work for KEMET. A centralized group is created that reports to Corporate can be useful. The Six Sigma Organization can look like the chart in Figure 7.1 below.
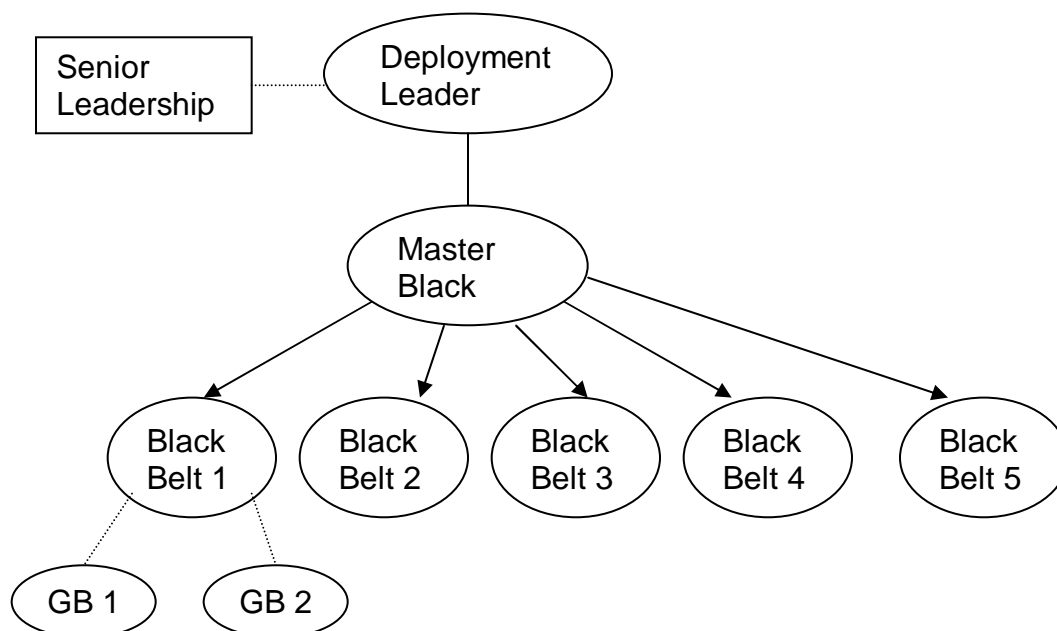


**Figure 7.2 Example of Six Sigma Organization**

Note: The Black Belt-Green Belt relationship is based on sponsorship and tutoring for projects. Green Belts usually keep their old responsibilities and report to their departmental supervisor or manager.

2. Do we have the right amount and quality of resources to afford having a certain number of engineers dedicate 100% to be black belts (project leaders)?

**Strategy:** Ensure that there is a list of candidates to support the functions of the selected BB. This can be covered as part of the succession planning. When a position does not have a competent successor, the BB candidate should be

trained, but the Human Resources department needs to find a good substitute for that candidate's position.

3. What type of career path can a BB follow? What is the "life span" of a black belt position?

**Strategy:** Create a formal plan with time frames for the BBs. Some of them can become managers after a certain time of acting as project leaders, others can follow a technical path, and others can follow a Six Sigma organization path.

4. How do we ensure that we have more candidates to select BB and GB from?

**Strategy:** Have a good internal pool of candidates and keep looking for resources externally. The recruitment process needs to be very strong and have very good sources of personnel (for example, partnering with local universities) and participating in job fairs in different states of the country (even internationally).

5. How can pay/compensation be tied to Six Sigma implementation for upper management?

**Strategy:** As stated in the Leadership Factor chapter, one of the objectives for upper and middle management to accomplish can be tied to Six Sigma implementation and performance. Their end of year (fiscal year) depends on if the objectives are met or exceeded.

6. How can pay be tied to BBs performance? What is the incentive for employees to become BB and perform excellently at it?

**Strategy:** Black belts can have a base salary which is within the company's engineering range according to their responsibilities. Additionally, there can be a special bonus tied to results/project completion. For example, there can be a percentage of the savings assigned as a bonus or compensation for a BB once a year.

7.  What means can we use to communicate the plan and progress made in Six Sigma?

**Strategy:**  For KEMET, it would be very easy to use the KEMET intranet announcement database and open a new space called Six Sigma World.  Also, there can be a brief review every quarter during the CEO's Townhall meeting.  It is critical that success stories are properly publicized.

8.  How do we differentiate a BB from the rest of the employees?  How do we make BB a special position without making it a "club of excellence" program?

**Strategy:**  This special status for BB is important so there is motivation to become a BB and stay in the company and it can be accomplished via a different compensation and career path. As explained when answering questions 3 and 6.

9.  Is there a retention program to ensure that BBs do not leave the company after being trained?

**Strategy:**  KEMET does not have a formal retention plan for BB or critical positions.  In order to ensure not loosing critical personnel the following can be done:  identify critical positions/high qualified personnel, communicate criticality to the individual together with their career path and plan, ensure that salaries are higher than the market, that KEMET is a good company to work for and  that there are opportunities to continue learning (internal and external training).  A good indicator that a good job is being done in terms of retention is that 75% of the trained black belts stay in the company and are focused on Six Sigma projects.

### *7.2 Incorrect selection of the BB and GB candidates*

Black belts and Green belts are selected and trained to carry out the improvement projects in a Six Sigma organization.  Black belts work full-time on selected projects.  They are trained to dig into the chronic and high-impact issues using Six Sigma.  Black belts are supposed to be the agents who translate Six Sigma theory into specific actions.  Green belts are trained to be knowledgeable

in Six Sigma and assist black belts in their functional areas in the implementation of projects and actions.  They can help in collecting and analyzing data, proposing potential solutions and implementing actions to get a project done.

Black belts should have very specific skills to perform well as technical experts, team leaders, and project heads.  They generally exhibit the following characteristics:  (Six Sigma for Managers, pg. 88)

- Work well on their own and in groups

- Remain calm under extreme pressure

- Anticipate problems and act on them (risk management)

- Respect their fellow workers and are respected by them

- Inspire others (leadership trait)

- Are able to delegate tasks to other team members and coordinate their efforts (confidence and trust)

- Understand and recognize the abilities and limitations of their fellow workers

- Show a genuine concern for others, for what they need and want (leadership trait)

- Accept criticism well (constructive feedback accepted)

- Are concerned about the current processes and results and engage in improving the system

- Have the intelligence and interest to learn how to apply the Six Sigma tools

To more objectively evaluate the traits described above, Greg Brue proposes a simple format to rate a Black Belt Candidate.  The following shows the format he suggests and that is recommended for KEMET's selection of Black belts candidates[13].

*Rate the employee on each of these 11 key areas, on a scale of 1 to 5*

*(5=excellent, 4=above average, 3=average, 2=below average, 1=unacceptable).*

*Process and product knowledge __*

*Basic statistic knowledge __*

*Knowledge about the organization __*

*Communication skills __*

*Self-starter, motivated __*

*Open-minded __*

*Eager to learn about new ideas __*

*Desire to drive change __*

*Team player __*

*Respected __*

*Results track record __*

*Total: __*

*A candidate who scores at least 38 has excellent black belt potential.*

*(The total is the sum of all the points from each of the key areas.)*

KEMET can reevaluate the Black belts that have already been trained and decide to leave those people at their current positions and select other people to be trained as Black belts.  It is recommended that a group of leaders come up with a candidate list and evaluate each one of them using the criteria listed above.

Selecting the right people to be trained as Green belts is also important.  These people need to have the following skills:  team players, knowledgeable of their

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[13]Brue, Greg.  *Six Sigma for Managers.* Chapter  5 "Roles and responsibilities", page 88.

own process, very determined to make things happen, quickly acknowledge possible roadblocks when participating in a project, and focused on results. Typically good engineers that run critical processes can be quickly identified as Green belts. KEMET needs to identify those people that will be supporting the Black belt activity.

### 7.3 Incorrect focus of Champions, BB and GB

As mentioned in the previous section, there has to be enough time for the BB and GBs to dedicate to their projects. Champions need to have specific objectives to achieve and make sure that they make the time to follow-up on projects they are sponsoring and verifying everything is according to plan.

Champions, for example, are high-level individuals who understand Six Sigma and are committed to its success. They use Six Sigma in their day-to-day work, communicate the Six Sigma message, and help remove roadblocks that Black belts may encounter when trying to implement solutions. These people have enough influence on the organization to find the right people to remove those roadblocks or make recommendations to the team as to how to avoid those problems. It is recommended that the Champions dedicate at least 20 to 30% of their time to ensure there is progress on Six Sigma projects and effecting lasting changes/improvements. They use this time allocated to Six Sigma in selecting Black belt candidates, identifying project areas, and establishing clear measurable goals for projects. They do not need to be fully dedicated to Six Sigma, but they need to be fully engaged in the process and the Six Sigma organization.

Black belts, in the other hand, need to be fully committed to Six Sigma. These people need to be separated from their job responsibilities so they can fully dedicate to finding areas of opportunity, understanding variation, and making sure that projects are successfully completed. When the implementation of Six Sigma was attempted, Black belts were not separated from their old jobs in

KEMET.  They were expected to lead projects and still do their day-to-day activities.

Also, since they had received special training in Six Sigma techniques, some times they were asked to solve problems which are a symptom of major system disruptions (fire-fighting). This is true for both, Black belts and Green belts. KEMET needs to consider that Green belts are supposed to dedicate at least one or two days a week to projects lead by Black belts to achieve excellent quality performance, reduce cost significantly, reduce cycle time by performing breakthrough changes, etc.

# 8. TECHNICAL FACTOR

The aspects related to technical issues from the list provided as options of roadblocks are:

- There was no clear plan for the deployment
- Poor training for Upper Management, BB and GB
- No clear metrics to monitor performance and implementation
- No clear involvement of financial department in training, deployment, and projects
- Incorrect method for project selection (lack of good projects list)
- Poor follow-up of the projects initiated

Out of these roadblocks, Poor follow-up was voted the most times when employees were given the chance to choose among the whole list of problems offered as options.  Incorrect method for project selection or lack of good project list was the third most mentioned one in the questionnaire.  It was also mentioned as the number 1 or most important roadblock just behind Lack of commitment from Upper management.

## 8.1  There was no clear plan for the deployment

Having no plan to deploy Six Sigma is, apparently, a very common problem. Different authors state that Six Sigma may start in companies with a high energy level and they move right into training without setting a clear objective other than implementation and no plan to get there.  This immediately kills a deployment. KEMET went through the same thing, it does not seem that there was an objective or a plan to follow-up while deploying.  A consulting company was contacted for assistance in training.  The training material was evaluated and adjusted to KEMET needs.  The Black belt candidates were selected and the training waves started in December, 2004.

KEMET could have found a partnership with a consultant which included deployment as part of the implementation help needed. This would include aid in developing the implementation plan and working with the Six Sigma Deployment Leader to follow through the certification and implementation of the full methodology. A typical way for many companies to work on the plan is by benchmarking with other companies that have successfully implemented Six Sigma, either in the same industry or a different industry. This provides information as to what the needs for a successful deployment plan are and, also, what the risk of the implementation is with potential solutions for the roadblocks.

One easy systematic way to approach this roadblock could be by following what Tom Pyzdek calls the deployment process outline; and, KEMET can still go back and re-do some or all of the steps. The recommendation is that all the steps are taken and re-done. The outline bases the success in orderly following a logical flow to the implementation and can be adapted to the introduction of almost any new philosophy or change in an organization. Figure 8.1 shows the outline.

1. Deployment goals
    1.1. Business level
        1.1.1. Increase shareholder value
        1.1.2. Increase revenues
        1.1.3. Improve market share
        1.1.4. Increase profitability and ROI
    1.2. Operations level
        1.2.1. Eliminate "Hidden Factory" (i.e., resources used because things were not done right the first time)
        1.2.2. Improve rolled throughput yield and normalized yield
        1.2.3. Reduce labor costs
        1.2.4. Reduce material costs
    1.3. Process level
        1.3.1. Improve cycle time

      1.3.2. Reduce resource requirements

      1.3.3. Improve output volume

      1.3.4. Improve process yield (ratio of inputs to outputs)

      1.3.5. Reduce defects

      1.3.6. Reduce variability

      1.3.7. Improve process capability

2. Identify key value streams

    2.1. Which processes are critical to business performance?

    2.2. How do processes deliver value to customers?

3. Determine metrics and current performance levels

    3.1. How would we measure key value streams?

    3.2. Are our measurements valid, accurate and reliable?

    3.3. Are the processes stable (i.e., in statistical control)?

      3.3.1. If not, why not?

      3.3.2. What are the typical cycle times, costs, and quality opportunities of these processes?

      3.3.3. What is the short- and long-term process capability?

    3.4. Detailed as-is and should-be process maps for critical processes

    3.5. How does current performance relate to benchmark or best-in-class performance?

4. Breakthrough to new performance levels

    4.1. Which variables make the most difference?

    4.2. What are the best settings for these variables?

    4.3. Can the process be redesigned to become more robust?

    4.4. Can product be redesigned to become more robust and/or easily produced?

5. Standardize on new approach

    5.1. Write procedures describing how to operate the new process

    5.2. Train people in the new approach

    5.3. When necessary, use SPC to control process variation

5.4. Modify inventory, cost accounting, and other business systems to assure that improved process performance is reflected in bids, order quantities, inventory trigger points, etc.

**Figure 8.1 Six Sigma deployment process outline[14]**

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[14] Pyzdek, Thomas. *The Six Sigma Handbook, Revised and Expanded.* Chapter 1 "Building the Six Sigma Infrastructure", pages 32-33.

Another approach is taken by using the Six Sigma Roadmap, as described in The Six Sigma Way. Even if it is described with different words, one can relate these steps to the deployment process outline included above. The Six Sigma Roadmap consists of identifying core processes and key customers, defining customer requirements, measuring current performance, prioritizing, analyzing, and implementing improvements, and expanding and integrating the Six Sigma system. This is clearly depicted in Figure 8.2.
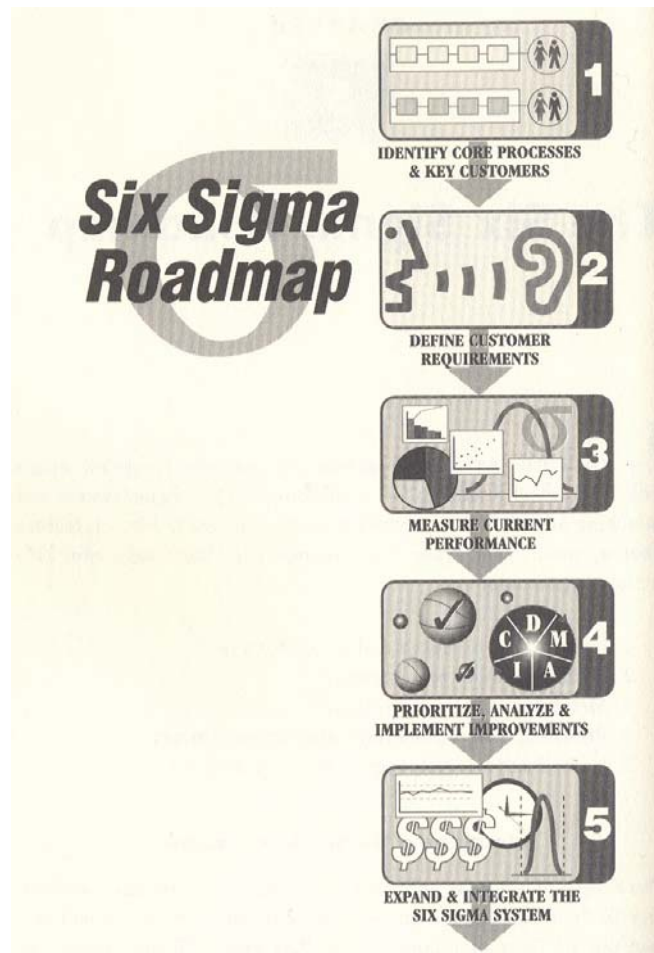


**Figure 8.2 The Six Sigma Roadmap[15]**

The steps will be shortly defined below by using the objectives that each one seeks and the deliverables in each case.

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[15] Pande, Neuman, and Cavanagh. *The Six Sigma Way.* Chapter 5 "The Six Sigma Roadmap", page 68.

Step 1:  Identify core processes and key customers

**Objectives:**  To create a clear understanding of the most critical processes/activities in the company.  To learn who the key customers are and what is valuable for them.

**Deliverables:**  A map of value-delivering activities:  core or value-adding processes, list of all products and/or services provided to customers, process flow across the organization.

Step 2:  Define customer requirements

**Objectives:**  To establish standards of performance according to what the customer needs and wants.  To develop systems that will continuously gather information on the Voice of the Customer.

**Deliverables:**  List of outputs required by the customer, output requirements tied to end products or services, and service requirements to ensure total customer satisfaction.

Step 3:  Measure current performance

**Objectives:**  To evaluate each process's performance against known customer requirements.  To establish a system for measuring key outputs.

**Deliverables:**  Baseline measures (current performance results), capability measures (assessment of the ability of each process), and enhanced measurement systems (this helps to always have the right measurement done in each process.

Step 4:  Prioritize, analyze, and implement improvements

**Objectives:**  To identify core processes improvements and rank them according to what was defined as the customer requirements to make a greater impact.  To implement new solutions and processes which result in sustainable gains.

**Deliverables:**  Priorities for project selection, solutions which target specific root causes, and improved processes after implementing the solutions.

Step 5:  Expand and integrate the Six Sigma System

**Objectives:**  To initiate a system that will drive the company to continuous improvement and excellence in performance.  To standardize the practices which can help the company be best-in-class.

**Deliverables:**  Process controls (measures and monitoring), process owners and management, response plans, and a new culture in the organization.


As seen with both plans, they go from defining what the goal is, determining which processes are critical to make that happen, establish a baseline, perform a benchmark or gap analysis, analyze and implement potential solutions, and standardizing Six Sigma as a new culture and approach to problem solving. KEMET had an attempt to do this and establish process capabilities even before Six Sigma appeared with the use of the "Book of Knowledge."  This can be taken and used to analyze critical processes for a start.


### *8.2 Poor training for Upper Management, BB and GBs*

Considering that this roadblock was only mentioned as a problem by 7 of the KEMET employees in the questionnaire, this should not be considered a major problem.  However, one key issue related to this is the training of GBs.


The training started as Six Sigma was kicked-off.  Upper management received a quick introduction to Six Sigma (it lasted approximately less than one week) and the black belts waves were done in four weeks.  However, the Green belt training was not done in a very organized manner.  Green belts were selected and in-house training was provided in two weeks as needed and the topics to be covered were apparently the most important ones (basic problem solving, process mapping, SIPOC, SPC fundamentals, measurement system analysis, deign of experiments, among others).  Nevertheless, this selection and training was one of the things that was dropped when the priorities changed in the organization.  At least one GB wave was cancelled in the middle of the training and another one that was already scheduled to start never took place.

The action here should be included as KEMET restarts the Six Sigma plan. The deployment leader needs to include the Green belt training and complete the necessary waves for the implementation success.

### 8.3 No clear metrics to monitor performance and implementation

This roadblock was part of the B group in terms of number of times it was mentioned as a problem experienced by KEMET when implementing Six Sigma. This issue can also be related to the fact that there was really no clear objective and plan to accomplish when implementing Six Sigma.

KEMET should have defined very few clear, relevant metrics to look at during the implementation. This would have helped to measure progress of the implementation and understand if there was something going in the wrong way to be able to change the path immediately.

Examples of business metrics that are relevant for KEMET to implement and start tracking are related mainly to two very simple concepts, customer satisfaction and cost reduction. As stated before, there is a high level of competition in the electronics industry and it is obvious for the customers that they have many different suppliers to choose from. Creating a real competitive advantage can be based in being the best in knowing what the customer wants, proactively seeking for what they might need next and giving it to them, as well as, offering the lowest prices. The industry already pushes KEMET to decrease prices due to the high offer of capacitors. Business metrics should apply statistical tools to processes and evaluate their progress. Also, they continually make you ask what outcome is dependent of another (this can be translated to processes, variables, attributes, etc.). Every author who has ever done research about Six Sigma agree that one cannot improve what one does not measure.

A visual representation of metrics is recommended. Dashboards are commonly used and could be a good way for KEMET to track metrics and progress. The first thing that needs to be done is to define the metrics that are relevant and most important to achieve the strategic and tactical goals. Then, there needs to be information collected that can be tied to that specific metric. The last thing is to create and update a dashboard in order to track projects. Metrics need to be defined by leader at every level of the organization. However, some of them that can be useful for KEMET is Number of customer, Cost of Poor Quality, Cpks for critical processes (defined variables as customer requirements), On-time delivery, Manufacturing costs, and Yield. Each one of them can have its own dashboard and each dashboard can derive in sub-dashboards that outline the behavior of some of them in each of the identified critical processes. An example of dashboard including number of customer complaints is shown below.
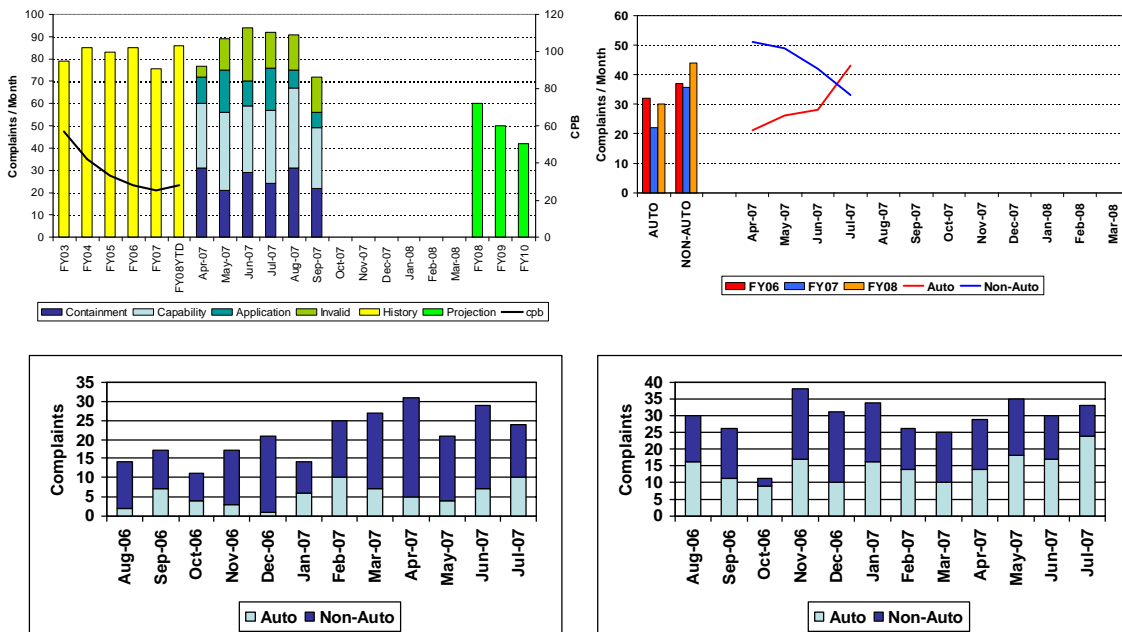
# Customer Complaints Dashboard



**Figure 8.3 Example of Dashboard**

## 8.4 No clear involvement of financial department in training, deployment, and implementation

This roadblock was only mentioned 8 times by the questionnaire participants. This could be because it was not perceived as a failure by the people or because it was not considered as an important part of Six Sigma by them.

The financial department needs to be involved in the implementation to a full extent.  In training, so they can carry out their own improvement projects in their department or other areas.  Also, in validating other Six Sigma projects results.  It is known that Six Sigma is very much associated with reducing costs or savings. It is believed that when quality is improved, variation is reduced, or a process is redesigned cost is related to it.  If quality improves, for example, things like scrap associated with poor quality decrease and there is a positive and direct effect on cost.  Many, if not all, authors recommend that the savings tracking of the Six Sigma projects is validated or consulted with the financial department.

KEMET can include engineers from the financial department in new waves of training.  Also, when defining projects, KEMET needs to add a section related to project savings and could ask that this is signed off or provided directly by the financial department.  This would be better done at the plant level by the cost engineers, but, the Corporate Financial Department can and should participate in this validation too.

## 8.5 Incorrect method for project selection (lack of good projects list)

Selecting correct or winning Six Sigma projects is the basis for Six Sigma success in a company.  In all cases, management, sponsors, BB and GBs look for feedback in terms of savings or improvement on metrics to validate and justify the implementation of Six Sigma.  If the projects are selected properly and carried out correctly quick, positive feedback is accomplished.

There are several characteristics of a good project listed by various authors. Next is the description of characteristics by several authors:

Greg Brue in Six Sigma for Managers states:

The two most important areas to look for are related to effort required and probability of success. Related to effort required to complete the project are number of people to be dedicated or working in the project, money allocated for required changes, and time it will take to show real, tangible improvements. The probability of success can be tied to the potential implementation roadblocks, the probability of actually finalizing the project, and risk assessment.

A project should be SMART. SMART stands for: (S) specific, (M) measurable, (A) achievable, (R) realistic, and (T) time-bound.

Some key project characteristics are the following per Brue:

- Improve key metrics like: increase sales or revenue, reduce actual spending, avoid costs, reduce cycle time, reduce PPMs or number of customer returns
- Recommendations or solutions can be determined and implemented
- Solutions can be put in place in three months
- Project implementation is unlikely to require a major investment
- Helps achieve strategic goals/objectives

In the Six Sigma Way, Pande, Neuman, and Cavanaugh show:

Criterion for Projects Selection is divided in results or business benefits criteria, feasibility criteria, and organizational impact criteria. Each one has several criteria associated with it as shown below.

**Results or benefits criteria**
- Impact on external customers and requirements
- Impact on business strategy, competitive position
- Impact on core competencies

- Financial impact
- Urgency
- Trend
- Sequence or dependency

**Feasibility criteria**

- Resources needed
- Expertise available
- Complexity
- Likelihood of success
- Support or buy-in

**Organizational impact criteria**

- Learning benefits
- Cross-functional benefits

These are just examples of criteria to select projects properly and ensure success of implementation. It is recommended that not all of these criteria are selected to evaluate a project and define if it should be initiated. In order to give KEMET a clear path to evaluating and selecting good projects the following steps are advised.

1. Identify potential projects which could help achieve business strategies
2. Describe the objective and scope of each project
3. Agree on criteria that is important to KEMET for projects to comply with
4. Create a matrix with project evaluation criteria
5. Rate each project according to the criteria (see Figure 8.4 for an example matrix and rating
6. Prioritize the projects according to the rating in the matrix
7. Assign resource and follow-up on the projects progress

| Project/ Criterion | Helps to comply with customer requirements | Tied to one or more strategic goals | Complete project within 6 months | High ROI | Resources needed (personnel) | Probablity of success | TOTAL |
|---|---|---|---|---|---|---|---|
| | 10 | 10 | 8 | 7 | 5 | 5 | Importance |
| Project 1 | 9 | 7 | 7 | 9 | 8 | 5 | 344 |
| Project 2 | 9 | 6 | 7 | 9 | 4 | 8 | 329 |
| Project 3 | 4 | 8 | 8 | 7 | 8 | 5 | 298 |
| | | | | | | | |
| | | | | | | | |

**Figure 8.4 Project evaluation matrix[16]**

The table was built based on the Decision Matrix presented in The Six Sigma Way Team Fieldbook.  It shows the suggested criteria to evaluate processes, but might be changed when management/leadership groups get together to review and define them.

An important point to remember is that there should be enough projects queued in the list to provide the black belt population with for a year.  The list of projects needs to be revisited periodically to ensure that the list is not getting too short so that there are always improvement projects to assign to the black belts as soon as they finish what they are working on.  The recommended period to review the projects list is at least once every quarter, but it will largely depend on the number of projects that the team comes up with and the black belts available to work on projects.

### 8.6 Poor follow-up of the projects initiated
After selecting the projects, this is probably the most important task when implementing or following Six Sigma.  If projects are initiated, but no follow-up is formally conducted and management is not involved in reviewing the progress of it, it is possible that the team or BB may make errors in the implementation that can be avoided.  Also, if no formal report-out is set-up the message that the organization grasps from it may be that it is really not important to do the projects after all.

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[16] Pande, Neuman, and Cavanagh.  *The Six Sigma Way, Team Fieldbook.* Chapter 4 "Selecting Winning Six Sigma Projects", page 41.

In KEMET there are several meetings that take place periodically to review status of different projects, but there is no real standardization in terms of the information or format presented in each meeting.  Also, the projects database is not very strictly used and its methodology is not always completely followed.  By talking to several engineers, it can be understood that they need more help in a standard way to review projects and the project tracking database may not be very used friendly and contain all the steps and sequence required by a Six Sigma project.

There are two ways which can simplify and ensure the project follow-up.  The first one involves some investment, it is based in a Software which is "manufactured" by Minitab$^{TM}$.  KEMET already uses Minitab$^{TM}$ and has a corporate license to use it.  This software is Quality Companion and it is easy to use and compatible with Minitab$^{TM}$.  More detail on this is described later on.  The second way is to create an in-house project charter matrix with very specific information about each project and a checklist of what each one of them should contain to show progress and move on in the right direction.

Quality Companion will be a very good tool for use at KEMET considering that engineers can link their project follow-up files with data that they have already collected and analyzed in Minitab$^{TM}$.  The software offers a very easy way to identify the general information of the project, but also a very organized way to input data related to the process of developing the project.  It can also be customized to add or remove quality tools and steps as needed by the company that uses it.  For example, it has a mode or function to work on the process failure mode effect analysis, however, it can be deleted or skipped depending on the company's or project's need.  It also provides a very fast way to link Minitab$^{TM}$ projects to the Quality Companion file.  This helps the engineer by not having to add the same information more than once in different softwares or databases and to have the tracking and information well organized.  Statistical analysis is

one of the steps, but Quality Companion shows each and every step of the DMAIC process with specific tasks to complete for the project in question in each one of the steps. This ensures that steps are not skipped and that the information is always documented in a standard format.

If KEMET chooses not to invest in the software a project charter can be created in order to follow-up on the projects. A sample Charter Worksheet, Problem Definition Worksheet, and DMAIC Project Plan Worksheet are shown below. All 3 of them need to be used for every project. Refer to Figures 8.5 to 8.7 for the sample worksheets next.

## PROJECT CHARTER WORKSHEET

| Project Title: | | | | |
|---|---|---|---|---|
| Project Leader: <br> Problem Definition: | | Team Members: | | |
| Project Scope: | | Goal/Objective: | | |
| | **PRELIMINARY SCHEDULE** | Target Date: | Actual Date: | |
| | *Start Date* | | | |
| | DEFINE | | | |
| | MEASURE | | | |
| | ANALYZE | | | |
| | IMPLEMENT | | | |
| | CONTROL | | | |
| | *Completion Date* | | | |

**Figure 8.5 Project Charter Worksheet[17]**

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[17] Pande, Neuman, and Cavanagh. *The Six Sigma Way, Team Fieldbook.* Chapter 6 "Define the Opportunity", page 83.

# PROBLEM DEFINITION WORKSHEET

| |
|---|
| Project Title: |
| What is the area of concern?  What first brought the problem to your attention? |
| What impact has this problem already had?  What evidence do you have that it is really a problem worthy of attention? (Internal or External metrics might be used here.) |
| What will happen if the problem is not addressed/solved? |
| Summarize the information above to be your problem defintion. |

**Figure 8.6 Problem Definition Worksheet[18]**

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[18] Pande, Neuman, and Cavanagh.  *The Six Sigma Way, Team Fieldbook.* Chapter 7 "Power Tools for "Define"", page 104.

# DMAIC WORKSHEET

| Project Title: | | | |
|---|---|---|---|
| **Project Leader:** | | | |
| **Six Sigma Process Step:** | | | |
| **ACTION / MILESTONE** | Responsible | Target Date | Actual Date |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |

**Figure 8.7 DMAIC Worksheet[19]**

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[19] Pande, Neuman, and Cavanagh.  *The Six Sigma Way, Team Fieldbook.* Chapter 7 "Power Tools for "Define"", page 106.

The first 2 worksheets can be reviewed in the first session or when the project starts, but the DMAIC Project plan worksheet is what should be reviewed during every scheduled report-out.

In order to ensure that the Six Sigma Steps are complete and the project and team is ready to move on to the next one KEMET can follow the following minimum requirements for each one of them[20]:

**DEFINE**
- ✓ Confirm that the project is a worthwhile improvement and is supported by the business leaders
- ✓ Verify potential impact of the project on customers, profits and its relationship to business strategy
- ✓ Define problem statement, no symptoms or causes are spelled-out in the statement
- ✓ Have a goal set and measurable target
- ✓ Define project scope
- ✓ Define team
- ✓ Review project charter with sponsor
- ✓ Identify the key customer and process requirements and prepare the SIPOC
- ✓ Create a process map

**MEASURE**
- ✓ Identify clear measures needed for the project
- ✓ Make a decision as to whether or not new collection of data
- ✓ Prepare and test the measurement system (ensure that the metrics are valid and accurate)
- ✓ Prepare baseline for the process

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[20] Brue, Greg. *The Six Sigma Way.* Appendix A.3 to A.7 "Define, Measure, Analyze, Improve, and Control Checklist", page 386 - 390.

**ANALYZE**

- ✓ Identify potential bottlenecks that maybe contributing to the problem
- ✓ Conduct a value and cycle time analysis
- ✓ Analyze data about the process and it performance
- ✓ Develop root cause hypotheses (use Brainstorming, 5-Why's, Ishikawa)
- ✓ Investigate and validate the root causes to verify that the team has found vital few causes of the problem

**IMPROVE**

- ✓ Create a list of potential solutions to the root causes named in the previous step
- ✓ Define a Solution Statement
- ✓ Verify the solution with the sponsor and ensure buy-in from management
- ✓ Develop a plan for testing the solution and validating its effectiveness
- ✓ Implement solution in a "pilot" mode
- ✓ Have a plan to expand the implementation of solution
- ✓ Consider potential problems to derive from the implemented solution and develop contingency solutions

**CONTROL**

- ✓ Select ongoing measures to monitor the performance of the process
- ✓ Determine key process charts and graphs to keep as a Process Scorecard
- ✓ Prepare documentation for the revised process (Control Plans, Process Map, Flow Chart, PFMEA, etc.)
- ✓ Identify a process owner
- ✓ Continuous monitoring of the process

The software or formats themselves are not enough to ensure correct project tracking and progress. The existence of these formats should be reinforced with a formal schedule of reviews. The reviews are recommended in a monthly basis. In these reviews, Black belts should show the status of the projects, present

roadblocks encountered and solutions, and results of implementation when the project is completed.  The reviews need to be established and chaired by the Master Black Belt, but management needs to dedicate time to attend these meetings to ensure that the projects are still aligned with the organizational objectives.  Presentations should not last more than 15 minutes per project and they should contain all the relevant information and conclusions.  It is important to note that data is not shared in this type of meetings.

The review meetings and regular Plant and Business QOS's in KEMET can serve as the platform to communicate project completion and acknowledge gains derived from those projects.

# 9. CONCLUSIONS

This thesis showed the actual, real situation of an attempt to implement Six Sigma. KEMET is the company where the study was focused. The main objective was to identify the causes of failure of the implementation. It is the perception, of the author of this thesis, and several other employees that the deployment was not completely and successfully done. The definition of the roadblocks that prevented KEMET from having a complete successful implementation was performed. After this, an explanation was done on each one of the roadblocks encountered in the implementation path. For each one of the roadblocks, there are suggestions to overcome these roadblocks which are feasible to implement in such environment as KEMET's.

The most important results show that 73% of the surveyed people consider that Six Sigma is still in use as a method for problem solving. And 86% thought that the deployment was not successfully performed. The fact that such a large percentage of the population believes that Six Sigma is still alive makes it an easy task to sell upper management the idea that the failed implementation did not fail 100% and that it is still "reworkable." In order to improve the implementation and inject new life to Six Sigma, several simple actions can take place.

It is important to remember that there needs to be total buy-in from upper management to retake the implementation and work on it some more with emphasis on critical areas identified as the main roadblocks by the people who responded the survey.

The roadblocks were first classified in three different categories: leadership, human resources, and technical factors. Leadership includes roadblocks related to senior and upper management as well as the deployment leader. Human resources refers to the infrastructure, training, organizational changes and compensation changes. Finally, the technical factor involves everything that has

to do with actual Six Sigma action, deployment plans, project selection and tracking.

The roadblocks, as offered in the survey and voted by KEMET employees, can be divided in two different ways. One would be as the most named ones when given all the roadblocks to choose from. The second one is the roadblocks most voted as the most important one.

In the first division, the roadblocks that were mentioned the most times there were 3 different categories which we classified using letters from A to C. The list with those roadblocks arranged in ascending order follows.

| Roadblock | # of occurrences | Group |
|---|---|---|
| Poor follow-up of the projects initiated | 20 | A |
| Lack of commitment from upper management | 19 | A |
| Incorrect method for project selection (lack of good projects list) | 18 | A |
| Lack of alignment of 6-Sigma with Organizational Objectives | 17 | A |
| There was no clear plan for the deployment | 14 | B |
| No clear metrics to monitor performance and implementation | 14 | B |
| Lack of communication of the objective, strategy, and plan | 13 | B |
| Incorrect focus of the Champions, BB and GB | 12 | B |
| Lack of the correct Human Resources Infrastructure | 11 | B |
| No clear involvement of financial department in training, deployment, and projects | 8 | C |
| No clear involvement of financial department in training, deployment, and projects | 8 | C |
| Poor training for Upper Management, BB and GB | 7 | C |
| Incorrect selection of the BB and GB candidates personnel | 5 | C |

**Table 9.1 Roadblocks classified in groups based on number of times mentioned**

The next important conclusion is which ones KEMET employees identify as the most important factors which stopped the implementation from being successful. The main four roadblocks voted as number one in importance are:

| Roadblock | % of times mentioned (out of 28) |
|---|---|
| Lack of commitment from Upper Management | 36% |
| Incorrect method for project selection (lack of good projects list) | 21% |
| Lack of alignment of 6-Sigma with Organizational Objectives | 11% |
| There was no clear plan for the deployment | 7% |

**Table 9.2 Roadblocks by percent times mentioned as the number one problem KEMET encountered in the implementation**

As mentioned above, this thesis has recommendations for every one of the roadblocks proposed as potential problems which caused the failed Six Sigma implementation in KEMET.  In this section, a brief reminder of the proposed solutions is presented.  This is done only for the roadblocks categorized as A type problems and the main four categorized as number one most of the time. An interesting to notice is that at least 3 of the ones voted as most important ones are contained in the ones mentioned the most time out of the total list. Additionally, an attempt is made to assign a leader or team to the implementation of each one of these tasks.  It has already been stated that the appointment of a Deployment Leader is critical, however, not all of these actions need to be driven by him.

**1.  Lack of commitment from upper management**
**Proposed Solution:**
✓ Assign a Deployment Leader
✓ Tie implementation and Six Sigma objectives to upper management compensation, use the yearly bonus and make it a clear MBO

✓ Enforce communication from upper management to the rest of the organization which shows that they understand, support and embrace Six Sigma

✓ Formally kick-off the program (CEO letter)

**Solution Implementation Leader:**

CEO, Vice-president of Quality and Senior Management Team


## 2. Poor follow-up of the projects initiated

**Proposed Solution:**

✓ Create a periodic meeting for results/progress review (monthly as a minimum)

✓ Use a common/standard format (Quality Companion software can help)

- Project charter containing general information of the project

- Problem definition worksheet

- DMAIC worksheets using checklist for minimum tasks to complete before moving to the next step of the methodology

✓ Involve management in the report-outs

✓ Evaluate results of progress

**Solution Implementation Leader:**

Deployment Leader with the Plant Managers


## 3. Incorrect method for project selection (lack of good projects list)

**Proposed Solution:**

✓ Consider the winning project characteristics

✓ List all projects that are needed to achieve the strategic objectives

✓ Rate the project list using the evaluation matrix (choose the adequate criteria to rate projects against)

✓ Prioritize projects according to the rate obtained from the evaluation matrix and assign a project leader of black belt to it

✓ Keep the list alive and revisit every time it seems the project list is getting short enough that it endangers having enough projects to provide black belts with as soon as they complete projects

**Solution Implementation Leader:**

MBB and Plant staff

**4. Lack of alignment with Organizational objectives**

✓ Use of the House of Quality approach

- Define strategies that are meant to satisfy the customer and stakeholders
- Create a QFD matrix to tie strategies to metrics
- Create a QFD matrix tying metrics to departments or operations responsible for them
- QFD used to tie operations to specific actions or projects needed

✓ Use of QFD, the Macabe approach to define the projects starting with the strategic objectives and getting as specific as the operations objectives that support those strategies

**Solution Implementation Leader:**

Director of Quality and Manufacturing to clearly define the objectives, MBB to ensure projects list support those objectives

**5. There was no clear plan for deployment**

**Proposed Solution:**

✓ Partner with consultant company to develop a plan

✓ Benchmark with other companies that have implemented the methodology

✓ Use Tom Pyzdek's Deployment Process Outline

✓ Use the Six Sigma Roadmap approach

**Solution Implementation Leader:**

Deployment Leader in agreement with Management (Senior and Plant)

Both of these approaches try take the strategy of the implementation as the basis. This makes the strategy and goal critical to be able to define the path to follow. After defining the strategy, the process goes through identification of key

processes, performance metrics, and critical variables. The final point in both approaches is to develop a standard new and stronger quality system.

This thesis was just a first approach to try to improve the Six Sigma implementation in KEMET. More detailed analysis can be done related to the problems and new ones may arise. This study leads to other possible investigation work. Future investigation can be done in the following areas:

1. Develop a detailed plan for each one of the main five roadblocks
2. Study the implementation of actions, follow-up on them and define any other problems that may arise
3. Define other roadblocks that this work has not presented, study the ones that the KEMET participants mentioned while asked question #12 in the questionnaire
4. Develop a model that may suit the deployment of any other program which may experience the same type of problems described in this work for KEMET's Ceramic Business Unit
5. Create a plan to incorporate Six Sigma in KEMET's Corporate Quality System
6. Compare and contrast the differences in the implementation between the Tantalum and Ceramic Business Units (evaluate successfulness in both)

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## 11.  APPENDICES

*APPENDIX A – QUESTIONNAIRE SAMPLE*

**The objective of this questionnaire is to determine the perception of the members of the organization regarding the success of the Six Sigma Implementation.**

**I.      GENERAL INFORMATION**

**1.  What is your current position?**

**2.  Is your position different from the one you held while being trained in 6-Sigma?**

☐      Yes                      ☐      No

**3.  What is your role in 6-Sigma with the company today?**

**4.  How did you get involved in the 6-Sigma Program?**

**5.  How & Where did you get trained?**

**II.     SIX SIGMA – DEPLOYMENT**

**6.  Are you using 6-Sigma methodology now?**

☐      Yes                      ☐      No

**7.  How do you use 6-Sigma?**

**8.  In your opinion is 6-Sigma still in use throughout the Business Unit?**

☐      Yes                      ☐      No

**9.  In your opinion was 6-Sigma successfully deployed?**

☐      Yes                      ☐      No

**10. What would you have done differently?**

**III.    IDENTIFICATION OF ROADBLOCKS**

**11. From the list below, please choose ALL the roadblocks that you think KEMET ran into when deploying/implementing 6-Sigma**

☐ **Lack of commitment from upper management**
☐ **No alignment with customer expectations**
☐ **Lack of communication of the objective, strategy, and plan**
☐ **Lack of alignment of 6-Sigma with Organizational Objectives**
☐ **There was no clear plan for the deployment**
☐ **Lack of the correct Human Resources Infrastructure**
☐ **Poor training for Upper Management, BB and GB**
☐ **No clear metrics to monitor performance and implementation**
☐ **No clear involvement of financial department in training, deployment, and projects**

☐Incorrect selection of the BB and GB candidates
☐Incorrect focus of the Champions, BB and GB
☐Incorrect method for project selection (lack of good projects list)
☐Poor follow-up of the projects initiated

12. Name the 3 main problems that prevented KEMET from having a perfect 6-Sigma deployment.  Please provide them in prioritized order starting with the most important one. You can copy/paste from the options listed in the previous question.

1.
2.
3.

## *APPENDIX B – KICK-OFF LETTER SAMPLE*

From: (President, CEO, or other executive staff member)

To: All Employees

Subject: Six Sigma Success

Today, the world in which we compete is far different from what we've previously experienced. Competition is stronger than ever, customers have more choices and are demanding higher quality and faster delivery, and profit margins are shrinking across our industry. To thrive and effectively compete in this kind of environment and deliver in our commitments to ourselves, shareholders, and customers, we need to explore new ways to improve our performance. There has never been a better time to develop a strategy that will widen the gap between our company and competitors, meet our customers' expectations and ultimately boost our bottom line.

That strategy is Six Sigma. Six Sigma is the best way for us to break through to the next level of cost savings and delight our customers by rapidly accelerating and improving our performance, processes, products, and services. Our goal is to be a high-growth company and our first target is to become a $ _____ company.

The term "six sigma" is actually a measurement that will tell us how rapidly we are eliminating waste and defects in our processes. Yet it is far more than a mere measurement. Building on our existing quality systems, Six Sigma is the way in which we will take our productivity and profitability to the next level.

You will all have a chance to get acquainted with and receive essential training in the Six Sigma methodology. In addition, some people will receive further training and begin to initiate its methods to start achieving our goals. The focus at all levels will be to generate productivity, which is directly tied into our bottom-line performance. Six Sigma will require us to refocus and reformulate both our belief system and our process steps. I urge you to support, endorse, and use its tools to make our company the highest-quality, lowest-cost provider of goods and

services in our industry.  As we reach our goals you will recognized and rewarded for your dedication to the initiative's success.

The executive staff is committed to the program and has already had training on the methodology.  We will continue to train participants at all levels and will begin Six Sigma "black belt" training on (date).  Black belts are the designated project leaders who will assemble teams and begin Six Sigma projects in various areas.  We are not doing it alone; we have selected (Company Name) as our business partner.  Their expertise, training, and guidance will best position our Six Sigma initiative for success.

Again, your commitment, support, and understanding of our Six Sigma goals are critical.  Together, we can achieve the results we're seeking and improve our performance.  Please join me in supporting this exciting effort.

Thank you,

President, CEO, or other executive staff member's name