AC 2009-1333: APPLYING THE SIX SIGMA PROCESS WHEN CREATING A MODULAR SIX SIGMA GREEN BELT PROGRAM

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Applying the Six Sigma Process when Creating a Modular Six Sigma Green Belt Program

Abstract

Business demand for Six Sigma educational programs has been on the rise the past several years and it appears that this trend will continue. In response to this demand from both industrial and academic customers, the Department of Technology Systems at East Carolina University (ECU) developed a modular Six Sigma Green Belt (SSGB) course to deliver the Six Sigma body of knowledge to customers. Since the Six Sigma process is also used in the development of final products in manufacturing, it is anticipated that other researchers and academicians will benefit from the lessons learned in creating this training product.

Overview

Once the need for the modular Six Sigma Green Belt (SSGB) course was determined, the DMAIC process most often used for Six Sigma projects was deployed. Tollgates to move from one phase of the process to another were utilized in managing the project. This process helped ensure that a need to backtrack did not occur. The body of this paper describes each phase of the DMAIC process along with an overview of how each phase was used to create the SSGB course product. Special notes for each phase and various tools that can be utilized during each phase have also been included.

A primary design goal for the project was to create a reusable set of curriculum materials that could be used in industrial short course environments or within collegiate academic programs of the Technology Systems department at ECU. The idea was to be able to use the modules as parts of another course, or as stand-alone offerings. An example of this would be using the Theory of Constraints (TOC) and the Lean Manufacturing module as part of an operations management course, or utilizing the statistical quality control modules as stand-alone modules to teach how statistics can be used for quality control. To keep the material manageable and interesting, it was also decided to design the modules so each one would last between 10 to 15 minutes.

The initial phase of the program included the development of a core set of presentation materials by experts in Six Sigma training. PowerPoint© was the primary software tool used to generate a script for these instructional materials. The notes section of each slide was utilized to create a monologue that would be used throughout the development process to support both professional narration and closed-captioning in order to broaden the prospective audience for the course. Student workers and graduate assistants were employed to assist in mastering the course modules using audio voice-over recordings and final product rendering using Camtasia©.

The completed modules and scripts were then reviewed by one or more subject matter experts to insure error-free materials were provided to the next team member in a consistent style and format. The script for each slide was recorded by one of two communications students who were interviewed and selected from a group of five individuals recommended for the task by a senior professor from the Department of Communication. The selected students brought a professional style and quality to the process, while enhancing their portfolio for future employment opportunities.

Once the presentation materials, audio files, and scripts were completed, the entire package of 52 instructional *chunks* were mastered and rendered using Camtasia©. The finished product was reviewed one final time before the module was placed onto a Moodle© course management site where customers could review each module as needed throughout the course. For the first course offering the course was considered to be a blended Distance Education (DE) course. Even though exams were posted online, students had face-to-face interaction with the original content provider to augment the online component of the course.

The body of the paper further elaborates on the DMAIC process (Define, Measure, Analyze, Improve, and Control) and how it was utilized to create the final product. Hopefully, this will assist other academicians and trainers learn the DMAIC process and select appropriate tools from a cross section of online educational learning components. The ultimate goal is to develop a training delivery system that is flexible, responsive, and reliable.

The Six Sigma Process

Six Sigma is a quality management philosophy and methodology that focuses on improving the quality of processes, products, and services. Six Sigma relies on reducing defects through reduction in variation in all forms in products and processes. At the philosophical level, Six Sigma involves everyone in the company in implementing continuous improvement processes. This is completed using a wide variety of ideas and tools that are discussed in the following paragraphs.

The overall structure of the Six Sigma process is shown in Figure 1. As specified in the acronym above, the five phases that constitute the DMAIC process are: Define, Measure, Analyze, Improve and Control. The idea of keeping each phase distinct reinforces the concept that a formal review shall be conducted at the end of each phase. This process allows the team to move on to the next phase only if all the requirements of the previous phase have been satisfactorily completed. This is done to minimize the likelihood that some steps may have to be backtracked since they were not thoroughly completed. The executive project champion, the project manager, and the process improvement team are all involved in the tollgate review.

Figure 1. Six Sigma Phases of the DMAIC Process

The Define Phase

In the define phase of the Six Sigma project, a clear definition of what needs to be achieved is created. At times a project is deployed to improve an existing process, and in such a case a logical analysis to determine the baseline for the process and corresponding issues that need improvement are identified. The customer or the final consumer for the product (or the process under

consideration) are crucial in the define phase as they help provide critical input. To achieve this, customers are interviewed at length to determine their exact requirements as a first step in creating a successful project. Also during the define phase, a project charter is created that defines the boundaries and limitations of the project to help prevent project creep as work progresses. Ideally, a team is created who will stay together until the project is successfully completed. Based on the experience of the project champion, *who owns the project*, and the project manager (*who reports to the project champion*), a cross-functional team of people (*who could contribute to the project during various phases*) is selected. Once the team has been selected, they will be deployed by the project champion. Activities & tools that are generally conducted during the define phase are: gap analysis, brainstorming, Nominal Group Technique (NGT), team building, high-level process mapping and value stream mapping. Creating a high sense of urgency in starting the project and moving on to successive phases is also a prime activity that should be undertaken by the project champion.

In pursuing the requirements of the define phase for the Six Sigma Green Belt Certification program at ECU, the Dean of the College of Technology and Computer Science acted as the project champion and the Director of the Center for Innovation in Technology and Engineering (CITE) Programs served as the project manager. A project team consisting of two faculty members, and the Multimedia Consultant for the college was created.

Through input from students and the advisory boards, a charter related to the kind of certification program to be created was developed. In doing so, several other Green Belt certifications were studied. Eventually, it was decided to create our Green Belt Certification Program utilizing both lean and Six Sigma principles, not Six Sigma principles alone as do many leading certification programs, such as the American Society for Quality (ASQ).

The Measure Phase

In the measure phase of the DMAIC project, the idea is to gather as much data as possible in order to shed light on the present state of affairs as the team establishes a process baseline. Various inputs and outputs are identified and baseline levels before improvement initiatives are implemented are measured. In the measure phase, the process sigma and the process capability for the specified processes are then calculated. Data are compiled and displayed graphically for ease of understanding by everyone involved in the process throughout the improvement initiative.

Primer Section	Desc	Mod #	Modules	Topics	Topic Description	Number of slides	Slides in Module	Deliver
				1	Lean thinking	1		
				2	Value	2		
				3	Value Stream	2		
			Introduction to	4	Value flow	2		
		9	Lean	5	Pull valve	2	22	
					• • •			
				17	Mistake proofing	5		
				18	Wastes	8		
		12	TOC & DFSS	19	Theory of constraints	9	16	
				20	DFSS	16		

Figure 2. Sample Planning Map of the Modules

Activities and tools that may be utilized during the measure phase include: control charts, capability analysis, Pareto analysis, Affinity diagrams, check sheets and other data collecting methods. A partial map of the Module© layout (shown in Figure 2) defines some of the requirements derived during the DMAIC measure phase for the ECU Six Sigma Green Belt Certification project.

The Analyze Phase

In the analyze phase of the DMAIC process, key variables having an impact on the output are identified and the root causes for the loss in productivity and or quality are determined. In the analyze phase, the activities and tools that are likely to be undertaken are: 5-why analysis, cause and effect analysis, Failure Mode Effect Analysis (FMEA), graphical analysis, hypothesis testing, multi-variable analysis, correlation and regression analysis, mathematical modeling, and ANOVA (analysis of variation).

For the Six Sigma Green Belt Certification project an analysis of the other certifications by various universities and trade groups (e.g. the Society of Manufacturing Engineers (SME), American Society for Quality (ASQ), etc.) was conducted and through benchmarking the ideal body of knowledge was determined. As stated earlier, many quality oriented organizations concentrate on Six Sigma principles and less so on lean manufacturing issues, but for the creation of our modules we opted for 45% lean concepts and tools and 55% Six Sigma.

The Improve Phase

During the improve phase of the DMAIC process, the goal is to identify and test solutions that have been brainstormed and to then come up with a pilot "*initial solution*" that can be implemented. During this phase, the stress is also on determining optimum settings for various inputs so as to get the best combination of the outputs. Once an initial solution is up and running, the next step is then to refine the solution through multiple kaizen events utilizing the skills of the process owners and operators. After the process has stabilized, a cost benefit analysis is next conducted to see how much improvement the team has been able to capture. Activities and tools that are conducted during the improve phase are kaizen events or kaizen blitzes, which are also called Rapid Improvement Events (RIE), implementation of the initial and the refined solution, and measurement of the impact of improvements.

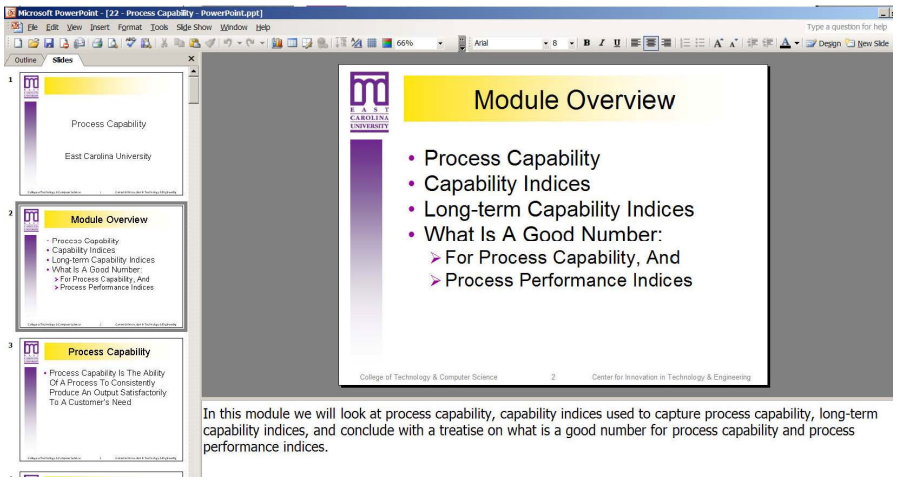

Figure 3. Screen Shot of Powerpoint™ During Module Creation

In the Six Sigma Green Belt Certification project, the modules were developed and checked for errors utilizing the skills of the faculty specializing in lean and Six Sigma principles. The development of the modules was primarily conducted using PowerPoint© as shown in Figure 3 below. Moodle© was the software used to organize and deliver the modules to students. A sample is shown in Figure 4.

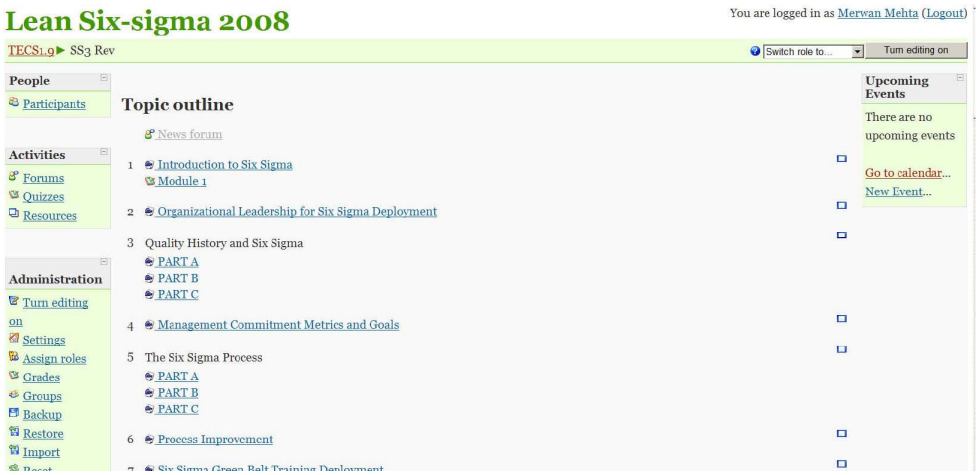

Figure 4. Screen Shot of Moodle™ Used for Organizing the Modules

The Control Phase

In the control phase of the DMAIC process, the project plans have been implemented and the project has been closed out and handed over to the day-to-day operators. Also, during this phase the necessary systems and structures to maintain the process at the optimum levels should be created. Plans to sustain the new process through constant monitoring and control should be developed and implemented.

During the control phase, plans on how the process team will now take the metrics of the process as

implemented as a new baseline. They shall then create and implement a system for continuous improvement. During this phase, the assignment of responsibility & accountability for the process should be done, and a time table to monitor process regularly should be created.

Through brainstorming of the process team, the stages at which the process can be derailed should also be identified in this phase and what action will be undertaken if an abnormal situation arose to throw the process off track should be developed. Utilizing the concept of poke-yoke or mistake proofing, how the process can be made robust is determined during the control phase and simple means to make the process self-correcting are implemented. Finally, project success in achieving the defined goals of the project should be celebrated and the project team members should be showered with rewards and recognition to boost morale.

The activities and tools that are undertaken in the control phase include creation of visual aids for visual management, development of standard operating procedures, identifying and establishing control mechanisms for effective monitoring of the process, and control plans using statistical means to monitor that the process has only random variation and does not have any special causes to throw the process out of track.

In implementing the Six Sigma Green Belt Certification project, once the modules were developed they were tried out extensively before hosting for the students. Also, a process to conduct a regular annual review was put into place with responsibilities assigned to specific individuals who initially supported the development of the original product.

Conclusions

Overall, the Six Sigma DMAIC process was successful in developing the Six Sigma Green Belt Certification. Six Sigma – *through the DMAIC process* – provides a definite method by which all projects could easily be conducted. Using the DMAIC process helps eliminate the need to revisit phases of the project after the project has moved on to the next phase. This is accomplished by moving the team thorough the evaluation scenarios by utilizing the toll gate process. By utilizing the same methodology as we were using in our classes, this project avoided the trap of having to revisit earlier steps, thus allowing the team to stay away from expensive backtracking and redevelopment cycles.

After seeing the interest that the Six Sigma process has generated, the Six Sigma Green Belt Certification program has shown to be widely successful. An added benefit is that we have been able to *mix-and-match modules* to create specific customized courses to meet additional training requirements by industry constituents throughout the region. Furthermore, by incorporating on-line tests using the Moodle© test bank function, students have been able to use the same software configuration, thereby minimizing adverse learning curve effects.

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