# AC 2007-609: INTEGRATING OF A PROJECT MANAGEMENT DATABASE FOR SIX SIGMA QUALITY COURSE

**Erick Jones, University of Nebraska-Lincoln**

*Integrating of a Project Management Database for Six Sigma Quality Course*

**Erick C. Jones**


## Abstract

Many organizations utilize Six Sigma project management techniques to reduce cost in their operations. Engineering managers are expected to know how to manage this specialized project management force including black belt, green belt, and yellow belt project engineers in order to deliver the expected savings and efficiencies that have been produced by other Six Sigma organizations. In order to educate future engineering managers it is important to provide an environment that facilitates learning of how to manage Six Sigma initiatives. This transcript describes the testing and evaluation of the impact a project database had on teaching Total Quality Management using Six Sigma techniques. The results provide evaluation from engineering managers from industry, students in the course, and the Certified Six Sigma Black Belt committee members at the University of Nebraska-Lincoln. Results indicate that using the database provided insights on how an engineering manager would manage these specialists in this environment.


## 1. Introduction

Six Sigma is a methodology for managing business, department, organization, or product (Pande, 2002). Organizations generally use the tools that come with Six Sigma to improve company performance by better serving their customers. We define a Six Sigma organization as any organization that has implemented a Six Sigma program. The purpose for the word "organization" is because businesses, government agencies, and charities have implemented Six Sigma. General Electric, St. Gemma's Hospice, and the Federal Aviation Agency (FAA) are examples of each (Times Online, 2005).

These Six Sigma tools offer fact and data search tools that are used to make highly informed decisions about a project. The tools contribute to project selection, project planning, statistical diagnostics, controls, and a few others help a Six Sigma practitioner complete a project. However, these tools are not all completely new. What sets Six Sigma apart from other management methodologies is the step by step process in which projects are completed. There are several different versions of Six Sigma, however the two most commonly implemented are DMAIC and DMADV (Simon, 2000). Our research was focused on these two. DMAIC and DMADV are acronyms for two 5 step methodologies involved with the specific Six Sigma process used. DMAIC is used to describe the "define, measure, analyze, improve, control" process where DMADV represents "define, measure, analyze, design, verify" process. Each of the letters corresponds to a name of a step in the process. The following defines each of the steps in the methodologies (Simon, 2000).

**DMAIC**

1. Define the project goals and customer (internal and external) deliverables
2. Measure the process to determine current performance
3. Analyze and determine the root cause(s) of the defects
4. Improve the process by eliminating defects
5. Control future process performance

**DMADV**

1. Define the project goals and customer (internal and external) deliverables
2. Measure and determine customer needs and specifications
3. Analyze the process options to meet the customer needs

4. Design (detailed) the process to meet the customer needs
5. Verify the design performance and ability to meet customer needs

These two systems are applied differently. DMAIC is used to improve a current system or product whereas DMADV is used to create a new system or product or process (Simon, 2000).

**2. Previous Research:**

Bill Smith, a senior engineer and scientist at Motorola is credited with originating Six Sigma Quality and Dr. Mikel Harry is credited with originating the theme of "Black Belt's" in Six Sigma programs. (Breyfogle, 2003). Harry was on sabbatical working at a Unisys plant in Salt Lake City when he implemented one of the first versions of Six Sigma to help with issues that arose at the circuit board manufacturing plant. Clifford Ames who was a Unisys facility manager asked Harry to document his methodology of problem solving, and this began what we now know today as Six Sigma (Chadwick, 2000).

In the beginning of the name game, Harry referred to those he trained as "characterization experts." Ames and Harry then brainstormed and came up with the name "Black Belt" because they were "kicking the heck out of variation" (Maguire, 1999). The name stuck and is still the primary name given to these project leaders and coaches.

Despite the positive intent of the name "Black Belt," some companies do not find the term wholesome. For these companies, they associate martial arts with fighting, boisterous strength, self glorification, breaking boards, and other less than desirable stereotypes (Chadwick, 2000). These companies will often use the same methodologies but have different names for the given positions. For instance, Mount Carmel Health Systems refer to their characterization experts as "Guides." Countywide Financial Corporation uses the hierarchy of Gold, Silver, and Bronze. Some companies even go as far as changing the system name from Six Sigma to "Unmatchable Excellence," as the Vanguard Group has done. Even though companies have changed the names of the levels of training or even the name of the management system, the roots of the system remain intact for the most part (Chadwick, 2000).

The position most known in any Six Sigma program is the Black Belt. This is the position that oversees many projects, teaches Green Belts, coaches other Black Belts and serves as the technical expert in Six Sigma tools and statistical methods. Other responsibilities include leading business process improvement projects that have broader impacts on an organization. In addition, they often serve as internal consultants for functional areas.

Other key players in the Six Sigma hierarchy are the Yellow Belts and Green Belts. Each role has a unique job inside of a Six Sigma institution. Yellow Belts are typically employees that are management support staff. This role typically report to those that are responsible for a specific line or system. The Green Belts typically manage an area and are the instigators of Six Sigma projects in that area. In addition, Green Belts will manage projects by utilizing Yellow Belts that are assigned to the Six Sigma team. They can also act as the Six Sigma liaison in an area. By showing their support of the Six Sigma initiatives and showing their team the importance of the project, they play a vital role in the success of a project.

Above the Black Belts are the Master Black Belts and the Executive Sponsor. The Master Black Belt is recruited from the Black Belts. They are trained to become enterprise Six Sigma experts. In addition they become a permanent full time change agent and are the most highly skilled people within the Six Sigma hierarchy. Often they will be trained in multiple functional aspects of the organization and be able to identify high-leverage opportunities for applying Six Sigma across the enterprise. Above the Master Black Belts are the executive sponsors. They are trained in enterprise strategy and develop the enterprise Six Sigma deployment. Master Black Belts also manages the Six Sigma infrastructure and resources. This centralization of the strategy and resources helps eliminate the traditional roadblocks that can hamper a management system.

According to Breyfogle (2003) Black Belts have extensive training in statistics and the Six Sigma methodologies. Black Belts then have the responsibility of coaching others in the company about Six Sigma methodologies. This includes participating in Six Sigma training, participating in Six Sigma projects, and acting as a change agent for the project teams.

Pyzdek's Six Sigma Handbook (2003) discusses the Deming's learning cycle of plan, do, check, act (PDCA). This cycle can be seen in both DMAIC and DMADV. The first step is to define the issues that are predicted to benefit the company. The next step is to do the necessary experimentation and data collection necessary to determine if the predicted benefit will take place. The check step is where the analyses of the data confirms or rejects the predicted benefits. The next step is where either the knowledge is used to design the needed product (or process) and then verify that it successful implements the changes and develops a control plan for the changes.

## 3. Objective

In order to educate future engineering managers it is important to provide an environment that facilitates learning of how to manage Six Sigma initiatives. The general purpose of the Total Quality Management Using Six Sigma Techniques (IMSE 996) course is to provide participants the necessary skills to execute Six Sigma techniques and strategies at the black belt level. With the implementation of a Six Sigma course helper, information collection and evaluation database, we could evaluate the contribution of each Six Sigma member by conducting a series of simulated tests and questionnaires. This database also provides detailed projects information for sharing on internet based platform. The systematic view of effective education on Six Sigma course will be illustrated in the paper.

## 4. System Description

The project management database is a system that can be integrated to the Six Sigma course in order to contribute to the strategic goals of providing modern, relevant training on timely topics that will better prepare students for the workforce and provide added value to their degree. With this system the course can support online delivery teaches the concepts of a timely industry subject of Total Quality Management using Six Sigma concepts through distance education. This course is currently being adapted to online delivery and is an integral part of the Masters of Engineering (MEng) program. Further, the course is the cornerstone of a certificate program currently being given by the University that recognizes "Certified Six Sigma Black Belt Training." This program is not being offered by other departments, but other engineering and business school departments' professors have mentioned that this course has the potential to be cross referenced into other departments' as elective courses in both engineering and business curriculums.

With all the functions mentioned above, the system builds on an assessment consultants as well as traditional student classroom evaluations in order to attain accurate feedback on learning outcomes. Also, industry feedback and evaluation will be assessed due to the fact the class requires an industry project. This course requires the use of a course content database that was created to mirror industry use. This database allows for up to date progress reporting and also provides a way to hold students accountable for projects. Other effective design options include: (1) current online technology which incorporates voice, and power point slides while a student is online, (2) conference calls integrated with a chat line as needed for interactive meetings for more direct communications, and (3) a class project management website which allows students to update progress on the industry class project. Most of the objectives of the course combine the usage of an online database for future development and evaluation. Also, the system build-in function will follow the logic of Six Sigma principle for a better system design.

## 5. Model Description

The assessment tool is envisioned as assessment software that examines analytical and problem solving skills by utilizing descriptive statistics and regression statistics analysis. Recommendations will analyze best practices when using these techniques with case studies and practical experience. We describe the proposed functions for the assessment tool.

Function1: Test and Evaluate. In this section the respondent logs into the system will be able to choose the function mode he or she will enter. At the beginning of the each test run, the user is required to enter the user name and password, in order to keep track of the previous tests and scores. This helps track the improvements in performance in comparison to the previous runs. Then the test will call in the introduction executable file, which shows the credits. Next the system takes the user to the selection menu, where the user can make choice between the tests and training. Once the training menu is selected it takes the users to the chapter's selection menu. The users can navigate to any of the chapters of their choice or can run in sequence.

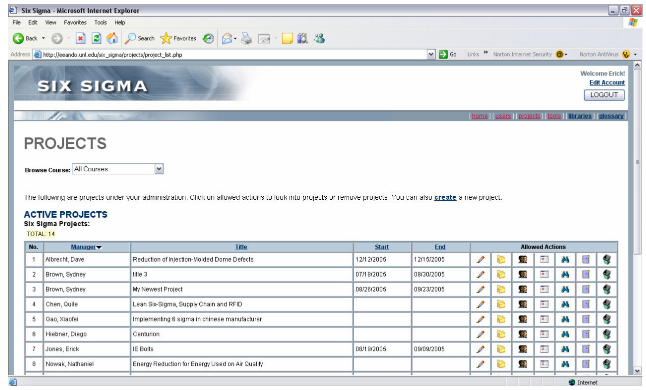


Figure1. System screenshot 1

Figure1 shows us a detailed view of our information sharing function which allows all users to upload and download files for personal usage.

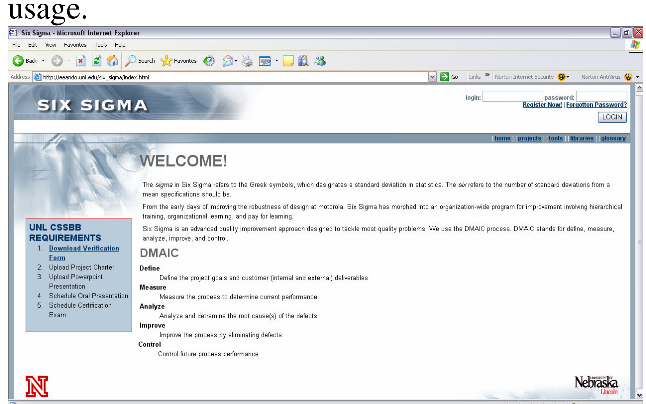


Figure2. System screenshot 2

In figure2, a screenshot of our online tutorial lectures gives students an update Six Sigma lecture and recorded material for all users.

Function2: Internet-based Information Sharing Platform. In this section the student can log in any of the function chapters to upload his or her own project data file which will be available on internet for public viewing. The data files include Microsoft's package and some other special usage software format. The interface is a user-friendly design with the feature of download, upload and online tutorial sharing. The Six Sigma course is aimed to educate students to learn and create projects in an open sources environment. The system provides students a convenient, open environment tool for more effective Six Sigma lecturing.

## 6. Verification and Validation

Verification is the process of ensuring that a model operates as intended. Students will have to successfully demonstrate knowledge of Six Sigma to pass the course. Validation is the process of ensuring that a model represents reality. The system will be examined for both subjective face validity and objective quantitative training validity. Face validity is an assessment by domain experts that the model input and outputs appear reasonable. Face validity will be achieved with the help of expert Six Sigma group from industry and academia.

The test development process consists of designing the test, evaluating its reliability, and assessing its known group validity. The test will be created in two equivalent halves in order to determine its split half reliability. The split half reliability is calculated by determining the correlation between the two halves and then using the following equation,

$$\text{Re}liability = \frac{2 \times correlation}{1 + correlation} \quad (1)$$

The Reliability is expected to be more than 0.70 which is the generally accepted minimum value. The known group validity will be determined to ensure that the test instrument is able to measure the level of knowledge of individuals taking the test. To determine the known group validity, the test instrument will administered to ten Six Sigma experts from Universities and industries. The expert group will be assumed knowledgeable about Six Sigma and the ten students will be assumed not knowledgeable. The mean and standard deviation of the scores obtained by the expert group is expected to be higher than that of the students. An F - test and independent t - test will be performed to determine if the test could distinguish between the levels of knowledge of these two groups. The F test result will indicate that variance independent sample t-test will be appropriate for comparing the means of the two groups:

$$t = \frac{\left(\bar{x}_1 - \bar{x}_2\right)}{\sqrt{\left(n_1 - 1\right)s_1^2 + \left(n_2 - 1\right)s_2^2}} \sqrt{\frac{n_1 n_2 \left(n_1 + n_2 - 2\right)}{n_1 + n_2}} \quad (2)$$

Where $\bar{x}_1$ and $\bar{x}_2$ are sample means, $s_1^2$ and $s_2^2$ are sample variances, and $n_1$ and $n_2$ are sample sizes. The resulting t statistic will be statistically significant at an alpha level of 0.05. This result will indicate that the test instrument will be able to distinguish a subject's level of bomb threat knowledge.

The training validity will be assessed by administering a pre-test and post-test after taking the training through the system. The mean difference between the post-test and the pre-test will be calculated. The paired t-test will be utilized to assess the increase in knowledge imparted using the system for training,

$$t = \frac{\bar{x} - 0}{s/\sqrt{n}}$$

Where $\bar{x}$ is the mean of the score differences, s is the sample standard deviation of the core differences, and n is the number of paired observations.

The effectiveness of the course will be based on the percentage of students that pass the certification exam with a grade of C or better at the end of the course. A questionnaire will be circulated to the students partaking in the class to gauge the impact of the database throughout the duration of the project.

## 7. Proposed Results

Data collection has not been completed. However, at a high level, everyone seems interested in the project. This ranges from students to industry associates. Industry partners like the prospect of hiring workers that have already been exposed to the principles of Six Sigma. We also feel that the database will have large impact on the effectiveness of the course.

## 8. Conclusion

With the development of a database integrating technology, more and more online sources need to be noticed as an important education tool when conducting lecture. The Six Sigma course at University of Nebraska Lincoln initiated a whole new view of online education with test and information sharing techniques to provide student a creative way to participate Six Sigma course. With in-class lecture and online participation, the outcome of the study will be more effective. The online tool also provides us an environment that facilitates learning of how to manage Six Sigma initiatives. The system evaluates effectiveness of total quality management study which validated in statistical analysis.

## 9. References

[1] Breyfogle, F. W. (2003). Implementing Six Sigma: Smarter Solutions Using Statistical Methods. Hoboken, NJ: John Wiley & Sons, Inc.

[2] Chadwick, C. (2000) *Remembering Bill Smith, Father of Six Sigma.* Web site: <http://www.isixsigma.com/library/content/c030915a.asp>

[3] Maguire, M. (1999, October). Cowboy Quality. Quality Press Magazine, 32, 27 – 34.

[4] Pyzdek, T., The Six Sigma Handbook: The Complete Guide for Greenbelts, Blackbelts, and Managers at All Levels, New York: McGraw-Hill, 2003.

[5] Pande, P., & Holpp, J. (2002). What is Six Sigma. New York: McGraw Hill.

[6] Simon, K. (2000). *DMAIC Versus DMADV*. Retrieved December 10, 2005. Web site:<http://www.isisxsigma.com/library/content/c001211a.asp>

[7] Times Online (2005, May 5). *New ways to hit charity snags for six.* Retrieved 2005, December. Web site: <http://www.timesonline.co.uk/article/0,,8164-1623327,00.html>

**Biographies:**

Dr. Erick .C. Jones is an assistant professor at University of Nebraska Lincoln and his research focuses are RFID, Engineering management and Supply chain Logistics. He has over 10 years of industry experience related to Logistics and Industrial Engineering.