Is Six-Sigma Certification Appropriate for the Classroom?

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Introduction

As part of a Malcolm Baldrige self assessment of the Middle Tennessee State University (MTSU) Engineering Technology (ET) program, it became clear that there was a lack of consensus among the faculty on the definition of ET itself. A more focused direction was needed for the department. Subsequently, the department chair developed a proposal to "define our product and market." Part of this proposal involved the roles and definitions of engineering technology versus engineering, and the confusion that seems to be present in both industry and academia. A new model was needed in order to define an ET education that attracts students while meeting the needs of those businesses and industries that hire ET graduates. After our students, graduates, and the Manufacturing Engineering Technology (MET) Industry Advisory Committee were surveyed, a new model was developed. Without going into details of this model (a topic for another paper), its key elements provide the following intents for our graduates:

1. Fast track to technical project management.
2. High-value specialty knowledge positions (not design engineering positions).

Each relevant ET course is being evaluated to see what is needed to meet these intentions with an emphasis on "hands-on, can do" attributes. In addition to better hands-on laboratories and more industry collaborations (involving student projects), industry-sought-after certifications are being considered and will be provided "if appropriate" to help achieve these intentions. In particular, the ET Department has decided that a Six-Sigma “Greenbelt” certification would be a good candidate to provide the desired attributes if included as part of the existing Industrial Quality Technology course. This certification is typically part of “Continuing Studies” non-degree programs offered by universities outside the ET degree curriculum, which raises the question, “Is Six-Sigma certification appropriate for the college classroom where students are pursuing a degree in Engineering Technology?”

Six Sigma Certification

The Six Sigma certification is widely-accepted and highly-valued by industry & business. Several levels of certifications are possible; the two most popular are the Blackbelt and the

Greenbelt. The Six Sigma methodology is defined as "a comprehensive and flexible system for achieving, sustaining, and maximizing business success."[1] Six Sigma is uniquely driven by close understanding of customer needs, disciplined use of facts, data, and statistical analysis, and diligent attention to managing, improving, and reinventing business processes.[1] The term "six sigma" is derived from the reference to a process that produces only 3.4 defects out of every million opportunities. Its value and popularity have been on a rapid increase in recent years, and more manufacturing and service operations are now requiring, as a minimum, the Greenbelt level of certification for their technical employees. The Blackbelt certification is a much higher level of certification and is typically done outside the company through organizations such as the American Society of Quality (ASQ) and the Society of Manufacturing Engineers (SME). The Blackbelt requires more in-depth skill in use of statistical tools such as Design of Experiments (DOE) along with successful leadership and completion of an industry project using the six-sigma tools and methodology. The Greenbelt can also be obtained through outside sources, but is typically obtained through training and self-certification within the company (particularly in larger corporations). There is relatively little statistical training as compared to the Blackbelt training except for an overview of statistical process control (SPC). Unfortunately, this self certification by some corporations sometimes may lead to a "coffee & doughnut" seminar where learning and understanding can be questionable. More importantly though, Greenbelt candidates must complete a six-sigma project that is typically directed and controlled by a Blackbelt project manager. It's important to understand that the Blackbelt is dedicated to fulltime effort on six-sigma projects, while Greenbelts do this on a part-time basis as required by their company.

Certifications for both Blackbelt and Greenbelt are also available on-line through many different companies, most notably MoreSteam.com LLC, as well as prestigious universities, such as the University of Michigan. Universities generally do not offer college credit for these classes and certifications; however, CEU's can be earned in this manner. The University of Michigan recently introduced a new graduate program that combines Lean Manufacturing and Six Sigma, titled, "Lean-Six Sigma Certificate." This program consists of 3 graduate engineering courses, and graduate credit is awarded. The certification requires completion of a "Lean and/or Six Sigma project and written report." [2]

Six Sigma Certification at MTSU

Which Six Sigma certification, Blackbelt or Greenbelt, should be provided at MTSU? And, is it appropriate for college credit? MTSU does not want to offer college credit strictly for those individuals desiring a six-sigma certification. It is not our intention to offer a course that would be engulfed with non-degree-seeking persons that just want to obtain a Blackbelt or Greenbelt certification. Would it be reasonable to enhance an existing course so that a six-sigma certification could be awarded to degree-seeking students upon successfully completion? Certainly, if such an industry-accepted certification were awarded, it should meet the intent of providing specialty knowledge to our graduates along with “hands-on” industry projects.
The current ET course, "Industrial Quality Technology," was reviewed to see if it made sense to modify the course content to include a certification. This course used the text, *The Management & Control of Quality.* [3] The same textbook is used also by the College of Business in case

studies of various corporate quality systems. The ET course covered such topics as: Quality systems and philosophies, management systems, TQM, leadership and strategic planning, human resource development, process management and DFM, performance measurement & benchmarking, strategic information management, QC systems design, ISO 9000, and Weibull analysis. No outside project was required. In fact, the course was more management than technology, and obviously did not meet the "hands-on" emphasis that was desired in our model. It would have to be totally re-designed to do so.

Could the course be re-designed to offer a six-sigma Blackbelt certification? That question is easy to answer. It is not feasible to offer this level of certification due to the requirement that full-time effort be applied to an industry project, which must be completed by the end of the semester. Simultaneously, the student must learn the six-sigma methodology and application of extensive statistical tools while attending other college classes and completing coursework. On the other hand, a simpler Greenbelt part-time project could be completed within the semester. However, the Greenbelt course content would not be very challenging for an upper-division ET course, and consequently not deserving of credit toward the ET degree. Based on these facts, the course was re-designed to teach the Blackbelt-level skills along with a much higher degree of knowledge and understanding; and, an industry project was added at the Greenbelt-level of participation. Not only would the students receive Greenbelt certification by MTSU, but they would also be equipped to handle a full-time project after graduation and obtain their Blackbelt certification if they desire.

Industrial Quality Technology course re-design

The re-designed course topics are based on the outline used by the SME Six Sigma Blackbelt on-line course, which uses the MoreSteam.com service. On-line services, like MoreSteam, provide an excellent program that includes DOE software[4] along with a toolbox of Excel templates that support SPC, hypothesis testing, multiple regression, and miscellaneous other tools used throughout the six-sigma methodology (project charter form, project priority calculator, sigma-level calculator, fishbone diagramming, and FMEA form, just to name a few).

The Blackbelt course topics, along with the student Greenbelt project schedule, are summarized in the following table. This course was taught for the first time in the fall 2003 semester. The weekly class met for 2 hours and 40 minutes, and consisted of 2 sessions per class.

Table 1. Industrial Quality Technology Course Topics & Schedule

Topics	Project Schedule
Introduction -- DMAIC; Sigma Level	Team assignments
Thought Process Mapping, Define Phase	Plant visits
Process Mapping (value stream)	Plant visits
Project Selection, Project Charter/Tracking	
Voice of Customer	Teams define projects
CTQC Tree Diagram, QFD Tools	
Measure Phase, Gauge R&R	Project definitions due
Collecting Data/Sample Plan, Performance Metrics	Teams begin data collection process
Charting Process Behavior, SPC Review	
XMR Charts, Process Capability	
Analyze Phase, Root Cause	Teams determine root cause
Correlation & Regression, Sample Size	
Hypothesis Testing	Teams collect any additional data
Intro to Design of Experiments (DOE)	Practice DOE problems in Text
One-Factor DOE Software, Blocking	Teams analyze data
Beyond One-Factor DOE	DOE practice problems
Designing 2-Level Full Factorials	
2-Level Fractional Factorials	Teams do DOE in plants if agreeable
General Factorials	Teams complete data analysis
Improve Phase, Review FMEA & Prioritizing	Teams analyses due
Corrective Action Matrix, Piloting a Solution	Teams recommend corrective action
System Dynamics Examples & Applications	
Visual Control & 5-S, TPM	
Leading Teams & Leading Change	Final Report Preparation
Report presentations	Presentations to companies
Report presentations	Final Reports due

No textbook was followed, but several references were used in addition to several public six-sigma websites. Required references were: *The Six Sigma Way Team Field Book* by Pande, et. al.,[5] the *Six Sigma Pocket Guide* by Rath & Strong,[6] and *DOE Simplified* by Whitcomb.[7] For instruction and exam questions, the *Certified Six Sigma Blackbelt (CSSBB) Primer* by Wortman[8] was used. (Since MTSU was certifying students as Greenbelts, it was important to use an independent source for exam questions to better validate the certification).

Since some of the course tools are very basic and have already been learned by students in previous courses (e.g. SPC, Value Stream Mapping, basic statistics), very little explanation was needed; however, students needed training to know when and how to apply them in the six-sigma "Define, Measure, Analyze, Improve, Control (DMAIC)" methodology.

Students did need training in the understanding and use of DOE, which 3 weeks (6 sessions) were allocated to cover. This complex topic could not have been absorbed by the students in

such a short time without the use of two significant learning tools – the DOE software along with on-line simulations. The *DOE Simplified* reference book included a CD ROM which contained the "educational version" of Design-Ease 6.0 DOE software with a 6-month license. Students were able to individually practice DOE to solve on-line simulations – from formulating recipes for pizza and beer to attacking a castle with a trebuchet (catapult). (These simulations were purchased for the semester from MoreSteam for about $20 per student). Comments were very favorable from the 18 undergraduate and 5 graduate students, who felt they were now ready and capable of applying DOE to real-world situations.

Seven student project teams were organized and setup with local companies to perform Greenbelt level projects in applications ranging from food manufacturers (Rich's Products & General Mills/Pillsbury), to automotive suppliers (MAHLE Tennex & Calsonic), to aerospace and electrical suppliers (Goodrich & Square-D). The graduate students were project coordinators and I acted as the overall project leader and advisor. Presentations were made in class for student team practice, for sharing of information among the teams, and for my critique prior to presentations to the sponsoring companies. While we do not yet know how successful we will be in this overall endeavor, our industry sponsors and collaborators were very pleased with the student project results, and requested that we return to continue projects or start new ones.

Summary & Conclusions

Twenty-one Six Sigma Greenbelt certificates were awarded to those successfully completing their coursework & exams, while contributing significantly to their industry projects. This course concept has proven very successful based on student comments and the interest shown by other students currently desiring to take this course. Due to the increased demand, MTSU will offer this undergraduate course during the May 3-week summer semester Intercession period. Two to three sessions per day will be covered. The student will receive a course grade based upon his/her exam scores, and will then have the option to complete an industry project during the summer to earn the Greenbelt certification.

At the request of the MET Industry Advisory Committee members, we are scheduling a non-credit class to be hosted on campus this fall for those that desire Greenbelt certification without having to enroll as degree-seeking students. (Blackbelt certification is under study).

In conclusion, the MTSU ET Department believes our certification offering for undergraduate degree-seeking students to be appropriate and will continue on this path for other courses as well. For example, for this spring semester, the ET Department will offer a certification in Lean Manufacturing as part of the current course, "Productivity Strategies." We are optimistic that these initiatives will provide highly-valued graduates to employers and will give our graduates a fast track to high-value specialty knowledge positions. Even though informal feedback from both students and industry sponsors have been very favorable, only time will tell how successful we are in this approach.

References:

1. MoreSteam.com LLC at www.MoreSteam.com
2. University of Michigan at http://cpd.engin.umich.edu
3. The Management and Control of Quality, 5th edition, Evans & Lindsay, Southwestern Thomson Learning, 2002.
4. Design-Ease 6.0, Stat Ease Corporation.
5. The Six Sigma Way Team Fieldbook, Pande, Neuman & Cavanagh, McGraw-Hill, 2002.
6. Six Sigma Pocket Guide, 10th edition, Rath & Strong, McGraw-Hill, 2002.
7. DOE Simplified, Anderson & Whitcomb, Productivity, Inc., 2000.
8. Certified Six Sigma Blackbelt (CSSBB) Primer, 1st edition, Wortman, Quality Council of Indiana, 2001.

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