# USING SIX SIGMA FOR CONTINUOUS IMPROVEMENT IN ENGINEERING TECHNOLOGY

Sarai Hedges, University of Cincinnati; Virginia Westheider, University of Cincinnati

## Abstract

A grassroots team at the College of Applied Science, University of Cincinnati, formed to use Six-Sigma methodology, an industry-familiar process, to develop an improved assessment plan that is responsive to the Technology Accreditation Commission division of the Accreditation Board for Engineering and Technology (ABET/TAC) accreditation requirements. Using Six Sigma in the evaluation process fits nicely with the engineering technology programs and was readily accepted by faculty.

The scope of the project focused on improving the assessment of ABET/TAC Criteria 3h (lifelong learning) and continuous improvement in accordance with the documented process. In Six Sigma process improvement, a process that works at a "Six Sigma Level" only has approximately 3.4 defects per million opportunities. This paper describes the project selection, definition of the process, calculation of the sigma level, implementation of the DMAIC method, and the level of success of the team in improving the process of assessing graduates' abilities to recognize the need for and to engage in lifelong learning.

## Introduction

Six Sigma, started in 1986 by Motorola, has been defined in numerous ways. It has been called a philosophy, a methodology, and a set of tools [1]. One of the more concise definitions is "a disciplined, data-driven approach and methodology for eliminating defects … in any process -- from manufacturing to transactional and from product to service"[2]. Six Sigma is now endemic to industry—automotive, chemical, financial, manufacturing and retail, to name a few—from American Express to GE, Advanced Micro Devices to Xerox, and is credited with saving millions of dollars while improving product or service quality and customer satisfaction.

In June of 2008, the authors met with Dean Allen Arthur to discuss using the Six Sigma methodology for process improvement within the college. ABET/TAC accreditation was selected as an appropriate area for such an endeavor. The authors met regularly throughout the year on the project with Dean Arthur providing management support. This paper is a summary of the team's progress to-date and is organized according to the phases of the six-sigma process improvement model (DMAIC):


**Figure 1. DMAIC Phases**

## Define Phase

The first phase of Six Sigma projects is the "Define" phase in which the team "defines the Customer, their Critical to Quality (CTQ) issues, and the Core Business Process involved" [3]. Many common Six Sigma and Project Management tools are appropriate to use in this phase, but the authors chose a Pareto Chart, Thought Process Map, SIPOC diagram, CTQC tree, and a Project Charter.

Figure 2 is the Pareto Chart that shows that for Criterion 3 (C3), related to assessment and continuous improvement, the vast majority of programs received "Weakness" ratings in the ABET/TAC evaluators' comments immediately after their 2006 visit. Criterion 1 (C1), program educational objectives, Criterion 2 (C2), program outcomes, and Criterion 7 (C7), institutional and external support, also received weakness ratings but none was consistently rated so poorly as Criterion 3 across programs.

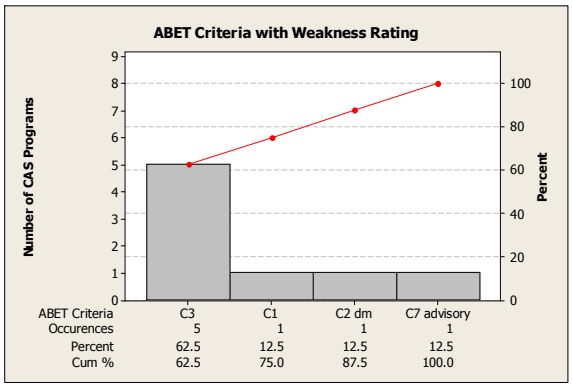


**Figure 2. Pareto Chart**

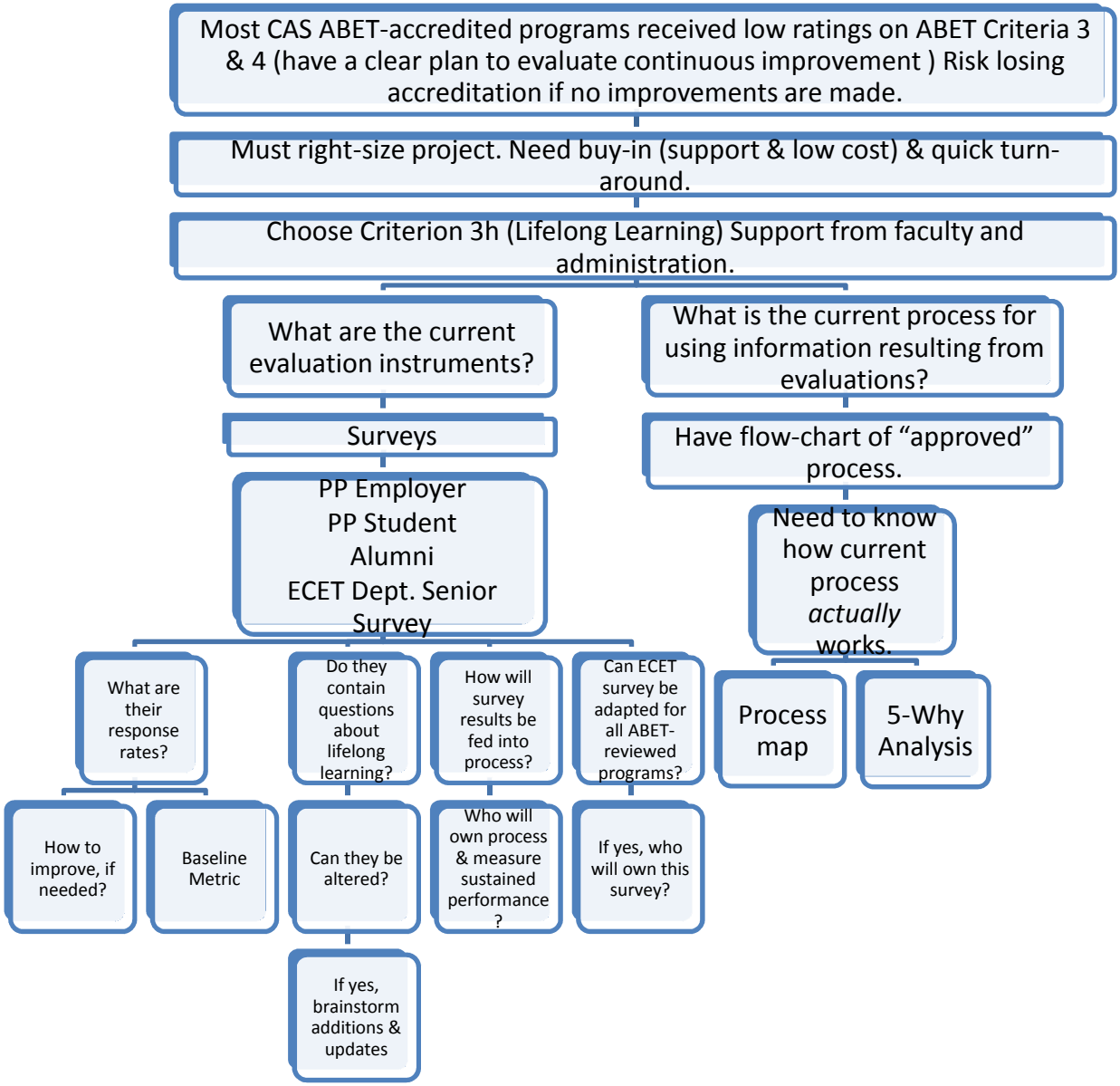


**Figure 3. Thought Process Map**

The Thought Process Map (Figure 3) illustrates the benefits of focusing on Criterion 3h and further illustrates several surveys administered by different bodies within the university that were vehicles that somewhat assessed lifelong learning and need further exploration for possible improvement. Table 1, the Supplier Input Process Output (SIPOC) diagram, more fully describes the process as it pertains to the survey instruments at the beginning of the project. Further investigation of the 4 surveys in the SIPOC diagram found that in 2006 the Alumni Survey was administered by the CAS Career Placement Office and had an abysmal 5.7% response rate. The 2007-08 Employer Survey, administered by the University of Cincinnati Professional Practices Office, had a 69.7% response rate for all CAS students. The Student Professional Practice (PP) Survey, administered by the same office, does not have questions pertaining to lifelong learning and is very difficult to alter. The College Student Services Office administered a Senior Survey until the spring quarter of 2008 when it was discontinued due to a change in university policy and refusal by a university office to continue its administration. The CAS ECET program developed a Senior Survey for its students, which garnered a 75% response rate upon its first implementation in November of 2008, and was willing to share the survey instrument for other programs to use.

**Table 1. SIPOC Diagram**

| Original Process: | | | |
|---|---|---|---|
| **Supplier** | **Input** | **Process** | **Output** |
| Career Placement Office | Alumni Survey | Assessing Graduates' Abilities to Recognize the Need for and to Engage in Lifelong Learning | Graduates' responses |
| CAS Office of Professional Practice | Employer PP Survey<br>Student PP Survey | | Employers' responses<br>Students' responses |
| Student Services (until 08S) | Senior Student Survey | | Seniors' responses |
| ECET department (08S – 09S) | Senior Student Survey | | Seniors' responses |

Using the Critical To Quality Characteristic (CTQC) Tree Diagram (Figure 4), the team identified specific measureable aspects of the process (metrics) that could be used to measure process improvement:

- alumni survey response rate,
- the number of questions on each survey measuring lifelong learning,
- the creation of *one* senior survey, and
- an approved process flow chart.

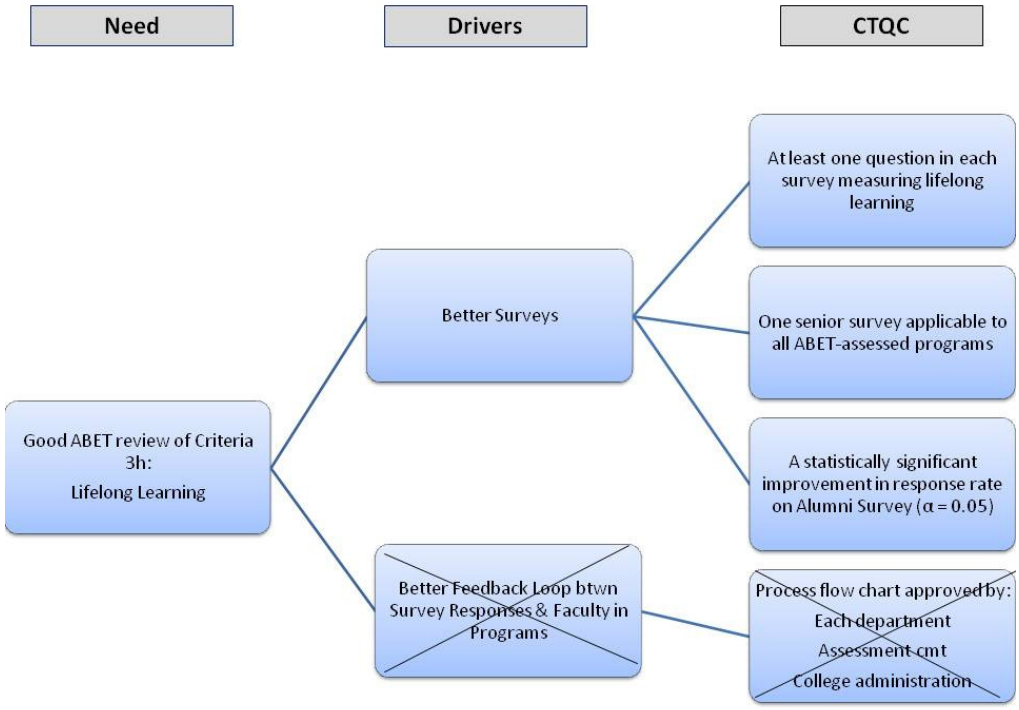


**Figure 4. Critical to Quality Characteristics (CTQC) Tree**

The decision to measure only an improvement in the response rate for the Alumni Survey will be discussed in the "Analyze" section of this report. The other two CTQC's following the "Better Surveys," were chosen with the consultation of the College Assessment Committee, that has members from the suppliers of the survey instruments, those familiar with the ABET/TAC requirements, and those in contact with students past and present. The last CTQC involving the process flow chart was removed from the project after the announcement of a Collegiate Restructuring Initiative in which the College of Applied Science was to be merged with another college. As the structure of the college was destined to change, so would the feedback loop for this process in a manner that cannot be anticipated with any certainty. As a result, the authors were given permission to scale back on this aspect of the project. This led the team to create the following Business Case and Problem

Statement for the project (taken from the Project Charter):

BUSINESS CASE: The majority of degree-granting programs in the College of Applied Science are accredited by ABET/TAC. ABET is "the recognized accreditor for college and university programs in applied science, computing, engineering, and technology, [which] is a federation of 29 professional and technical societies representing these fields" [4]. Failure to meet ABET accreditation requirements may lead to loss of accreditation, having significant and adverse affects on these programs as for "employers, graduate schools, and licensure, certification, and registration boards, graduation from an accredited program signifies adequate preparation for entry into the profession. In fact, many of these groups require graduation from an accredited program as a minimum qualification" [5]. Hence, it is an understatement to say that maintaining ABET/TAC accreditation and achieving positive reviews from ABET/TAC evaluators are important to the college.

The 2006 findings of the ABET/TAC review of the appropriate College of Applied Science programs varied among the programs. Although no program had any ABET/TAC Criteria ratings in the lowest category, "deficiency", the majority of the programs had ratings in the next lowest category, "weakness", for the same criterion, ABET/TAC Criterion 3: Assessment and Evaluation, which states that "[e]ach program must utilize assessment measures in a process that provides documented results to demonstrate that the program objectives are being met…" This is related to Criterion 4 "Continuous Improvement:… us[ing] a documented process incorporating relevant data to regularly assess its program educational objectives and program outcomes, and to evaluate the extent to which they are being met. The results of these evaluations of program educational objectives and program outcomes must be used to effect continuous improvement of the program through a documented plan" [6]. None of the reviewed programs had either of these criteria listed as a program strength. Lack of a documented program assessment process that is part of a feedback loop for continuous program improvement is a systematic problem throughout the college's programs and ranks high among the programs' faculty and college administration as a problem to solve.

PROBLEM STATEMENT: The ABET/TAC evaluator findings indicated that the majority of degree programs seeking renewal of their accreditation did not have a clearly defined plan for evaluating continuous improvement of program objectives and outcomes (ABET/TAC Criteria 3 & 4). The team seeks to remedy these issues by clearly defining an appropriate feedback loop for improving the process of assessing Criterion 3h: demonstration that graduates have a recognition for the need for, and an ability to engage in lifelong learning. This specific ABET/TAC criterion was chosen because it was identified by the programs' faculty and college administration as difficult to evaluate and because there exist survey instruments in various areas of the college that can be adapted to evaluate this criterion across all of the programs. As this is a grass-roots effort in implementing the Six Sigma methodology at the College of Applied Science, the team also believes that working on this ABET/TAC criterion makes for a right-sized project in terms of faculty and administrative support, probability of success, low implementation costs, and timeliness of completion. The team hopes the successful completion of this project will lead to more support for bigger projects in the future.

There are currently four (4) surveys at CAS that contain questions that assess lifelong learning at least to some extent. They are used in various ways and administered by various bodies. In 2006, the Alumni Survey, which includes some questions related to lifelong learning and is administered by the CAS Career Placement Office, had an abysmal 5.7% response rate. The CAS ECET program developed a Senior Survey for its students, which garnered a 75% response rate upon its first implementation in November of 2008 but the survey needs to be adapted for other programs' use. The University of Cincinnati Professional Practices Office Employer and Student Surveys, which evaluates students on co-op, also have the possibility of being used. The 2007-08 Employer Survey had a 69.7% response rate for all CAS students.

The project team was expected to adapt the most appropriate surveys to evaluate ABET/TAC Criterion 3h. The team was also expected to implement techniques that would increase the response rates for those surveys with low responses and further to improve the feedback loop between the programs being assessed, the entities which administer the surveys and collect the data and the decision points in the process where changes based on the data are recommended and implemented so that program assessment is effectively incorporated in a manner of documented continuous improvement leading to successful ABET/TAC reviews.

# Measurement Phase

After defining the project, the authors measured the current process. Tools used were DPMO and Sigma Level calculations and a histogram. The authors could not perform a Measurement System Analysis. A near-perfect process works at a "Six Sigma Level," which

corresponds to 3.4 defects per million opportunities. Tables 2 and 3 show the team's definitions of Defects, Units, and Opportunities and the calculations for the DPMO and Sigma Level.

Although originally used for continuous ratio data, in concordance with statistical theory, this technique is commonly used for discrete, or attribute data. In this project, the authors focused on the proportion of "bad" (deficiency or weakness) ABET/TAC evaluator ratings for ABET/TAC criterion 3h, binomial data. To calculate the sigma level for such data, the fraction of "bad" ratings was treated as the alpha of the normal distribution and then a conversion table was used to determine the sigma level. The 1.5 Sigma Shift was a convention that assumed that the process would shift over time.

The initial process of assessing lifelong learning showed plenty of room for improvement at a baseline Sigma Level of 1.2.

**Table 2. DPMO Definitions**

| DEFINITIONS | Assessing ABET/TAC Criterion 3 |
|---|---|
| **Defect** | rating of Weakness or Deficiency |
| **Unit** | CAS program reviewed by ABET/TAC |
| **Opportunity** | 1 per program |

**Table 3. DPMO and Sigma Level Calculations**

| CALCULATIONS | Assessing ABET/TAC Criterion 3 |
|---|---|
| **Defects** | 5 |
| **Opportunities** | 8 |
| **DPMO** | (5/8)*1,000,000 = 625,000 |
| **Sigma Level (assumed 1.5 Sigma Shift)** | 1.2 |

The DPMO and Sigma Level in a process are affected by how defects are defined and who or what measures the defects. To have reliable measurements, the measuring devices must have repeatability and reproducibility (R&R). In Six Sigma projects, a Measurement System Analysis (MSA) was conducted to determine the measurement R&R of a process. For this particular process, outside evaluators from other institutions were used to rate the ABET/TAC criteria for the programs. Neither this team nor the university had access to ABET/TAC evaluators to conduct an MSA. Thus, the authors had to proceed under the assumption that, for a given accreditation visit, individual evaluators would repeatedly rate a program about the same and a program would be rated similarly by different evaluators. As a sidebar, the undertaking of an MSA of evaluators by the ABET/TAC accrediting body would be an excellent opportunity for it to elevate its credibility.

Coding the evaluator ratings as shown in Table 4 allows further analyses. Although the rating "Observation", on the face of it, does not connote a level between "Concern" and "Strength", the team's reading of the "Observation" rating comments made by ABET/TAC evaluators and its listing under "Corrections and Improvements" in the ABET/TAC report gave evidence to such a use for this project.

**Table 4. Evaluator Rating Codes**

| Evaluator Rating | Code |
|---|---|
| Deficiency | 1 |
| Weakness | 2 |
| Concern | 3 |
| Observation | 4 |
| Strength | 5 |

The histogram in Figure 5 illustrates all evaluator ratings over all ABET/TAC-accredited programs received during the 2006 visit. In other words, the graph lumps all ratings together. It shows that, thankfully, there were no "Deficiency" ratings and rating "3", or "Concern", was the most common rating given, with 12 occurrences. Looking back at the data, the team found that seven (7) of the occurrences were related to Criterion 8. Although a "Concern" rating is not as urgent to improve as a "Weakness" rating, it is worth noting and perhaps should be investigated in another project.

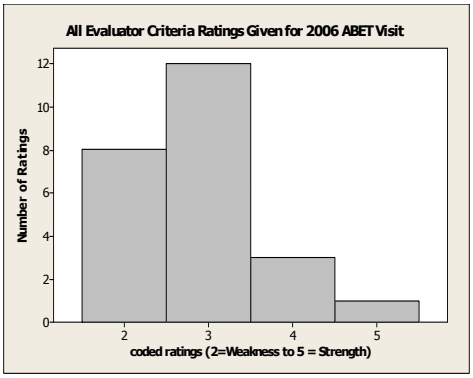


**Figure 5. Histogram of Evaluator Coded Ratings**

# Analysis Phase

This phase includes analyzing the data collected and determining the "root causes of defects and opportunities for improvement" [3]. Tools used were a Cause & Effect Diagram, Brainstorming, a 5-Why Analysis, and

a variation on the traditional Failure Mode and Effects Analysis (FMEA), which is called a "Significant Factor Selection Matrix"

The Cause & Effect Diagram (also called a Fishbone Diagram) in Figure 6 shows a multitude of factors that affect the process. The team used written Criteria 3 and 4 comments from evaluators and brainstormed to come up with factors (also known as "root causes" or "X's").

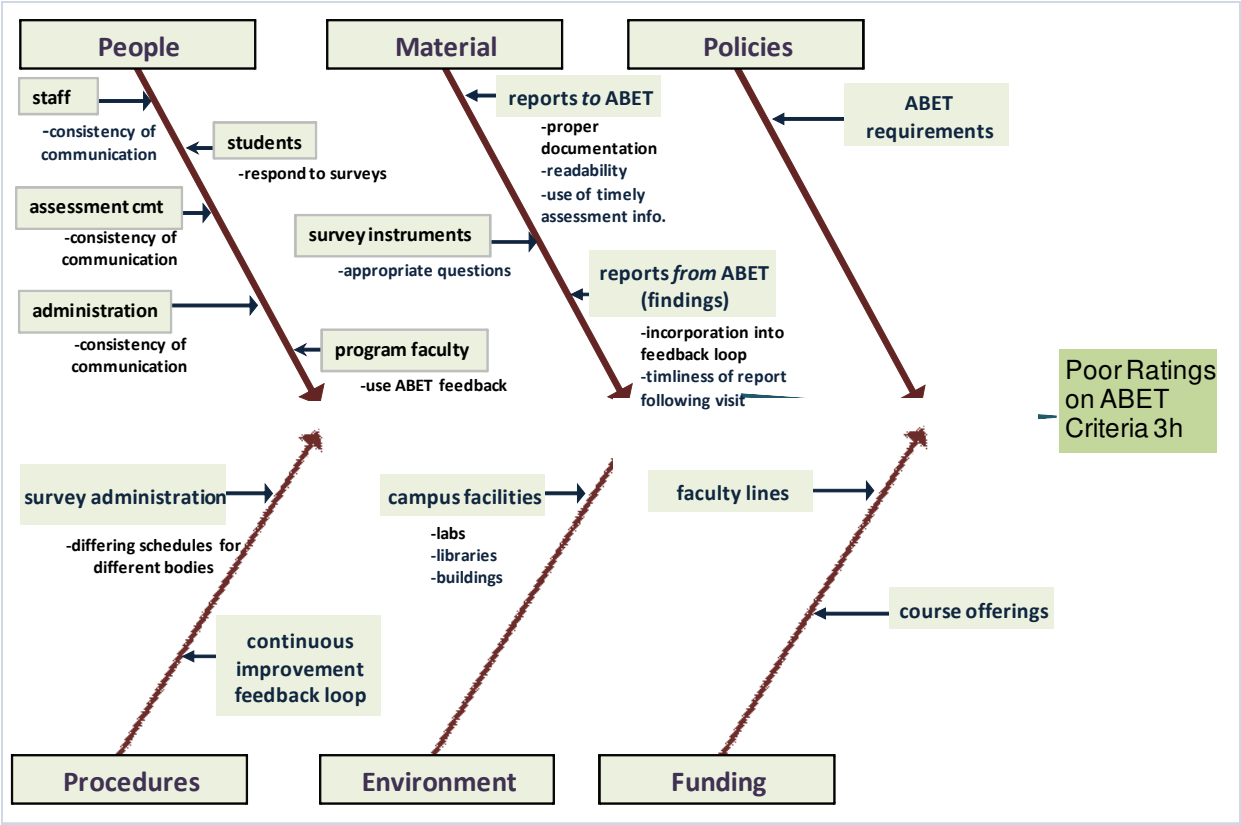


**Figure 6. Fishbone Diagram**

Procedures involved in the feedback loop, students, and the survey instruments were selected as factors to pursue to improve the process using Table 5, the Significant Factor Selection Matrix. As factors related to the feedback loop could not be pursued due to the Collegiate Restructuring Initiative, the team focused its efforts on the survey instruments.

**Table 5. Significant Factor Selection Matrix**

| **Significant Factor Selection Matrix** | | | | | |
|---|---|---|---|---|---|
| **Improving Assessment of Lifelong Learning for ABET Accreditation** | | | | | |
| | **Selection Criteria** | | | | |
| **Possible Causes (X's) for Poor Ratings on ABET Criterion 3h Applicability Rating (1 = low to 5 = high)** | Covers all Programs | Low Cost To Fix | Ease of Implementation | Ability to Influence | **TOTAL SCORE (add ratings):** |
| Consistency of Communication from Staff | 5 | 4 | 5 | 5 | 19 |
| Consistency of Communication from Assessment Cmt | 5 | 5 | 5 | 4 | 19 |
| Consistency of Communication from Administration | 5 | 5 | 5 | 4 | 19 |
| Use of ABET feedback by faculty | 5 | 5 | 4 | 5 | 19 |
| Students Don't Respond to Surveys | 5 | 4 | 5 | 5 | 19 |
| Poor Documentation to ABET | 3 | 3 | 3 | 3 | 12 |
| Report Not Readable | 3 | 5 | 5 | 3 | 16 |
| Report Doesn't Use Timely Assessment Info | 4 | 5 | 3 | 2 | 14 |
| Survey Instruments Contain Appropriate 3h Questions | 5 | 5 | 5 | 5 | 20 |
| ABET Findings Not Incorporated Well Into Feedback Loop | 5 | 5 | 4 | 5 | 19 |
| ABET Findings Not Provided in Timely Manner Following Visit | 5 | 5 | 1 | 1 | 12 |
| ABET Requirements Unclear | 1 | 5 | 1 | 1 | 8 |
| Reporting Schedule Vary Widely for Surveys | 5 | 5 | 1 | 1 | 12 |
| Poor/Nonexistent Continuous Improvement Feedback Loop | 5 | 5 | 4 | 5 | 19 |
| Few/Poor Quality Lab Facilities | 1 | 1 | 1 | 1 | 4 |
| Few/Poor Quality Libraries | 1 | 1 | 1 | 1 | 4 |
| Few/Poor Quality Buildings | 3 | 1 | 1 | 1 | 6 |
| Not Enough Faculty Lines | 2 | 1 | 1 | 1 | 5 |
| Not Enough/Not Appropriate Course Offerings | 1 | 1 | 1 | 1 | 4 |

The team attended the monthly College Assessment Committee meetings from November 2008 – April 2008 and was able to work with them to review and update the Professional Practices Employer Survey and the Alumni Survey to include questions relevant to assessing ABET/TAC Criteria 3h. During this review, the Committee additionally updated the Alumni Survey for readability and brevity.

At the beginning of this project, the ECET department was conducting its own Senior Survey. A 5-Why Analysis (Table 6) shows the thought process in analyzing this problem. The outcome was that the College Assessment Committee altered the ECET Senior Survey and adopted it for all ABET/TAC-assessed programs in the college.

**Table 6. 5-Why Analysis**

| **5-Why Analysis For Senior Survey** | |
|---|---|
| Why does ECET do their own Senior Survey? | **1** |
| There is no other Senior Survey available. | |
| Why? | **2** |
| College office stopped administering Senior Survey. | |
| Why? | **3** |
| University Admissions took over senior graduation documents and refused to continue administering the College Senior Survey. | |
| Why? | **4** |
| They say it is out of their purview. | |
| Why? | **5** |
| They want another office to take over that task. Can we get another college office to do it? | |
| Yes--the College Director of Assessment will take it over and facilitate through Assess. Cmt. to adapt ECET Senior Survey to all ABET/TAC programs. | **How** |

Preliminary investigation of the process showed that the Alumni Survey had only a 5.7% response rate. Both a paper copy and online option were available for alumni to take the survey. During the February College Assessment Committee meeting, attendees brainstormed ideas to improve the response rate. Incentive ideas such as book bags and key chains were mentioned. The team further studied ways to improve the response rate of the Alumni Survey by performing a literature review of survey response and by benchmarking with Alumni Surveys at other institutions of higher learning.[7-15] Originally, the Alumni Survey was administered by the College Career Development Office by paper and then in 2006 by paper or with an option to complete the survey of the college's web site. The team decided that it would call a new Alumni Survey administration method a success if the response rate had a statistically significant increase from the previous year at a 0.05 level of significance.

# Improvement Phase

In this phase, the team implemented solutions aimed at correcting the problems that were defined, measured, and analyzed in the previous phases. Tools used were a Correction Action Matrix and a statistical hypothesis test to verify and measure improvement.

The team implemented an action plan to improve the surveys that included creating one Senior Survey for all ABET/TAC-accredited programs within CAS, adding/updating lifelong learning questions in the Alumni Survey and Employer PP Survey and the Senior Survey, changing the administering body for the Alumni Survey to the Director of Assessment, and updating the administration methodology for the Alumni Survey. The action plan relates to those factors rated most highly in the Significant Factor Selection Matrix (Table 5), with the exception of improving the feedback loop. Further details of the action plan for improvement are in the Correction Action Matrix (Table 7).

**Table 7. Corrective Action Matrix**

| **Corrective Action Matrix** | | | | | |
|---|---|---|---|---|---|
| **Action** | **Champion** | **Implementation Target Date** | **Effective? (yes, no)** | **Measure of Effectiveness** | **Current Status** |
| **Create one Senior Survey** | assess cmt | Jun-09 | yes | document | complete |
| **Change Administering Body for Senior Survey to Prof. Practice Office** | Westheider | Jun-09 | yes | document | complete |
| **Add/Update Lifelong Learning Questions in Alumni Survey** | assess cmt | Feb-09 | yes | document | complete |
| **Add/Update Lifelong Learning Questions in Employer PP Survey** | assess cmt | Feb-09 | yes | document | complete |
| **Add/Update Lifelong Learning Questions in Senior Survey** | assess cmt | Feb-09 | yes | document | complete |
| **Change Administering Body for Alumni Survey to Assessment Office** | Westheider | May-09 | yes | statistical test | complete |
| **Update Administration Methods: paper/web and two reminders** | Westheider | May-09 | yes | email verification | complete |

Using the changes just described, the improved surveys were piloted in the spring quarter of 2008. With the new College Assessment Committee-created College Senior Survey and its new method of administration by the university's Professional Practice Office, the response rate was 56.2%. Comparisons with previous

College Senior Surveys cannot be made as those response rates are unavailable, but the rate is within those seen in other types of surveys studied during the Analysis Phase of the project. A new method to improve response rates in the Alumni Survey was implemented, which was created in response to the literature review done in the Analyze Phase. The team did not think that it could acquire funds for incentives and primarily used an experiment and cost-benefit analysis [7] to improve response rate with little cost. The Alumni Survey administration was moved from the College Career Development Office to the Director of Assessment's Office. In addition to an original mailing of the survey in June, students were also able to complete the survey using Survey Monkey on the college's web site in the Alumni area. In changing the administration method of the survey, follow-up postcard reminders were sent. As the team learned [7], the most important impact reminders have on response rate is not in their presentation but in their repetitiveness. The reminders were simple and inexpensive postcards. They were sent two weeks and five weeks after the original mailings. This new survey and method of administration proved highly successful with the rate of alumni responding, nearly doubling from 5.7% in 2006 to 11.4%. This represents a highly statistically significant increase ($p$-value = 0.000). The team met its goal here. The Employer Professional Practice survey results showed a response rate of 65.1% for 2008-09. This is lower than the previous year but the decrease is not statistically significant at $\alpha = 0.05$.

# Control Phase

The Control Phase of a Six Sigma project makes sure that process improvements are maintained into the future. The team has the following plans for future improvement: follow-up with improving the feedback loop when the new college structure is determined; investigate the possibility of incentives for survey completion to further improve survey response rates; further investigate, if there is managerial (decanal) support; and work to improve the assessment of Criterion 8, which received many "Concern" ratings at the last ABET/TAC visit; and, finally, determine a new DPMO and Sigma Level annually and after the next ABET/TAC visit in 2013. The team further plans to communicate the success of this project to build momentum for continuous improvement projects in areas such as classroom assessment and retention.

# Conclusion

As this project has shown, the Six-Sigma methodology is an appropriate and effective tool for making improvements in educational assessment. Although a definitive conclusion as to the overall level of success of this project cannot be determined until the next ABET/TAC review, milestones along the way have had measurable success. The response rate of the Alumni Survey significantly improved (statistically and otherwise) and changes to survey instruments were achieved through consensus. The effects of the changes in administration of survey instruments other than the Alumni Survey remain to be seen. They will continue to be monitored. The need for an improved feedback loop will be addressed after the collegiate restructuring. Finally, the ABET/TAC evaluators' review of the college's assessment of students' lifelong learning after the next visit will determine if this process, currently running at a low 1.2 sigma level, improved overall.

# References


[1] http://www.asq.org/learn-about-quality/six-sigma/overview/overview.html

[2] http://www.isixsigma.com/sixsigma/six_sigma.asp (viewed Dec. 10, 2007)

[3] http://www.isixsigma.com/dictionary/DMAIC-57.htm (viewed Sept. 28, 2009)

[4] http://www.abet.org (viewed Feb. 26, 2009)

[5] http://www.abet.org/why_choose.shtml (viewed Feb. 26, 2009)

[6] 2008-2009 Criteria for Accrediting Engineering Technology Programs

[7] IMPROVING ALUMNI SURVEY RESPONSE RATES: An Experiment and Cost-Benefit Analysis http://www.springerlink.com/content/u51528n44l822343/fulltext.pdf

[8] Strategies for Generalizing Findings in Survey Research, http://www.joe.org/joe/2008april/tt1.php

[9] How to Use the Data: Quality Measures - Response Rates http://www.census.gov/acs/www/UseData/sse/res/res_def.htm

[10] Measuring Customer Satisfaction 2nd Edition, Bob E. Hayes © 1998 published by ASQ Quality Press

[11] "Impact of Monetary Incentives and Mailing Procedures An Experiment in a Federally Sponsored Telephone Survey" by Brick, Collins Hagedorn, Montaqula, Brock Roth, Chapman—Methodology Report March 2006 published by the U.S. Department of Education Institute of Education Sciences NCES 2006-066

[12] "Incentives in a Business Survey: A Study in Improving Response Rates" by Kaplan and White from the Joint Statistical Meetings – Section on Survey Research Methods—2002

[13] North Carolina State University 2006 Baccalaureate Alumni Survey: Introduction, Methods, and Alumni Demographic Profile http://www2.acs.ncsu.edu/UPA/survey/reports/alum06/alum06intro.htm
[14] University of Colorado at Boulder Alumni Survey, Summer 2007 http://www.colorado.edu/pba/surveys/alumni/07/index.htm
[15] RIT dept of econ Alumni Survey http://www.rit.edu/cla/economics/alumnisurvey.html

# Biographies

**SARAI HEDGES** is an Associate Professor at the University of Cincinnati. She earned her B.A. (Mathematics and Music, 1991) from SUNY Potsdam College and M.S. (Applied Statistics, 1993) from Bowling Green State University. She is a Certified Six Sigma Green Belt (CSSGB) and teaches courses in statistics and project management.

**VIRGINIA WESTHEIDER** is an Academic Director at the University of Cincinnati. She earned her B. A. (English Literature, 1983) from Rutgers, The State University of New Jersey and M.A. (Counseling Psychology, 1986) from the University of Cincinnati. She is a member of the founding class of the Institute for the Development of Excellence in Assessment and Leadership ( IDEAL) designated as a National Academy of Engineering's Center for the Advancement of Scholarship in Engineering Education (CASEE). She presents annually at the national ABET Symposium. Currently, she is Director of Assessment and Accreditation for the College of Engineering and Applied Science, University of Cincinnati.