

AC 2007-1687: THE TC2K VISIT IS DONE - NOW WHAT?

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The TC2K Visit is Done – Now What?

Abstract

The effort to prepare for and execute an engineering technology program evaluation review has always been extensive. In order to comply with the requirements of TC2K, and to benefit from the assessment and evaluation process, faculty expect this effort to continue between evaluation visits. Because the engineering technology accreditation process shift from verification of input conditions to assessment of results represents such a significant process change, national-level resources to ease the transition have been developed. To date, documentation of the program actions following an engineering technology accreditation review is minimal. Questions of sustainability, impact of curricular change on internal program assessment and evaluation, faculty motivation and workload, and long-term effects on student success must be considered.

This paper presents the TC2K follow-up approach taken by four engineering technology programs from one department at three campus locations. These programs encompass associate and baccalaureate levels with one new and three ongoing accreditations. Initial solutions to the sustainable assessment and evaluation challenges and the corresponding workload are discussed. Initial successes in managing ongoing assessment efforts and strategies for maintaining department-wide consistency while supporting unique program approaches are presented. Issues generated by curricular change are also considered.

Department Accreditation Background¹

A multi-campus, multi-program engineering technology department went through a total of three accreditation reviews in 2004 and 2005. The programs include “2+2” manufacturing and mechanical engineering technology programs at a large residential campus made up of primarily traditional full-time students (West Lafayette) and two associate degree mechanical engineering technology programs at commuter campuses with a mix of traditional full-time and non-traditional part-time students (Columbus and New Albany). The MET associate degree program is essentially identical at all three campuses, with all courses transferring seamlessly into the baccalaureate MET program. In preparation for their first TC2K-based reviews, the department extended its educational processes to incorporate formal assessment and evaluation of program outcomes and educational objectives. The existing foundation for the department’s education processes included a departmental strategic plan that defines the department’s core values, beliefs, mission, and vision. Core learning objectives, defined as the minimum knowledge to be gleaned from a course, were developed and approved for all major courses. Well-defined faculty-driven curriculum design and review processes have been in place for many years. Faculty members conduct assessment and attempt to improve their courses and the degree program, by modifying teaching techniques, exercises and assignments to maximize learning. This has been an ongoing workload

expectation at the course level for more than a decade, and is embedded in the departmental culture.

To coordinate the assessment and evaluation process to the program level, the department formed an Assessment Committee to oversee the assessment activities and coordinate actions to spur continuous improvement of the program and program assessment. Each program (by campus and by discipline) has its own ABET coordinator, who worked with their faculty to prepare detailed spreadsheet maps that show how the specific outcome criteria from ABET Criterion 2, items a-k, are covered by the stated educational program outcomes and the links back to specific courses and activities. It is the coordinators' responsibility to ensure program assessment and evaluation is ongoing, while all faculty members strive to deliver the best engineering technology programs possible.

Figure 1 presents a graphical representation of the linkages within the MET Department's Educational Processes, while figure 2 shows a representative mapping of program outcomes to Criterion 2, items a-k, for one 2+2 mechanical engineering technology program.

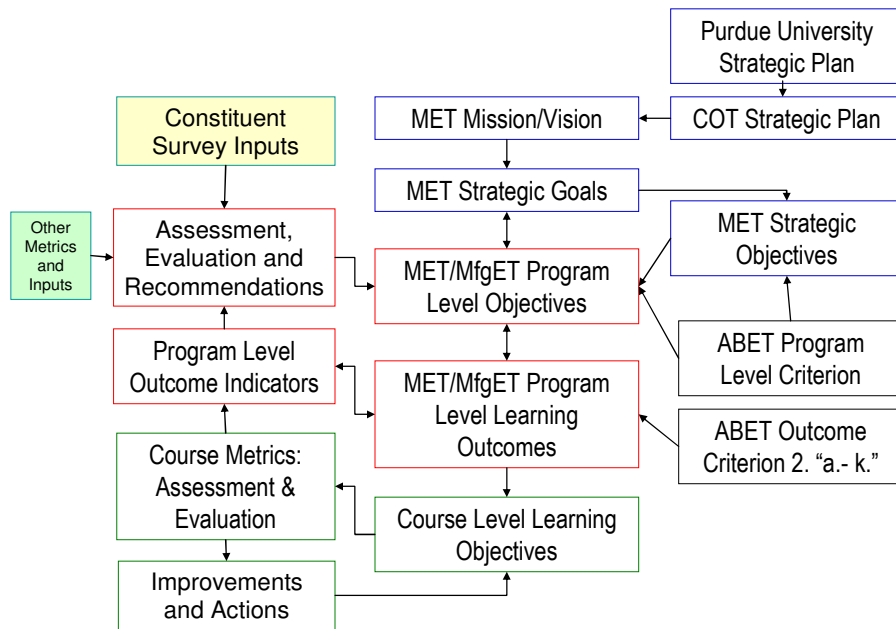


Figure 1. Key links in the MET Department Educational Process

In the one or two years leading up to the various ABET accreditation visits, each program collected and evaluated assessment data for a complete set of Outcome Indicators (OI), up to a total of 96 metrics for one program at one campus in a semester. ABET coordinators tracked the data and corresponding evaluations, presented their findings to the Assessment Committee, and communicated committee recommendations to the affected faculty members. Conducting assessment and evaluation at this level required extensive effort, beyond the level which could be sustained continually. Although the programs benefited from the initial assessment effort, the potential cost in missed

opportunities and faculty burnout prompted the next Assessment Committee goal of developing a streamlined, sustainable assessment and evaluation process that would achieve an optimum balance between benefits to the program and added workload on the faculty.

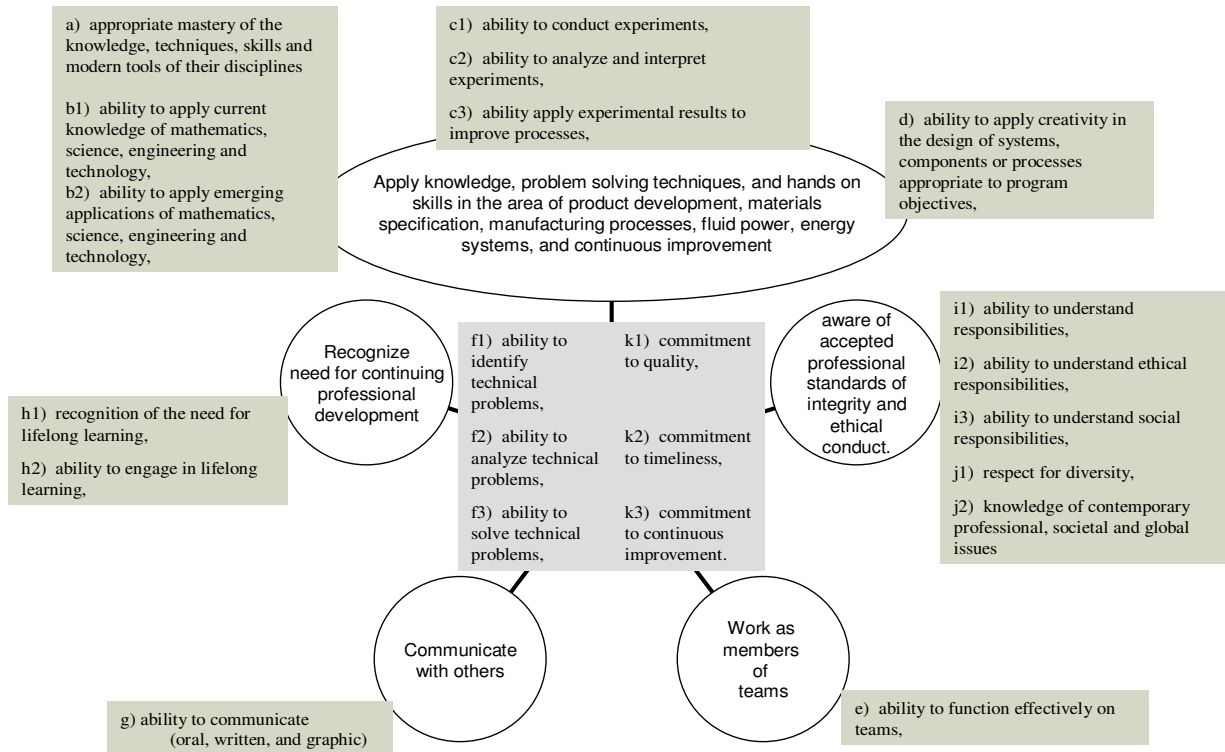


Figure 2: Mapping Criterion 2 a-k to 2+2 MET Program Outcomes

Assessment of Learning

The introduction of the TC2K criteria by the Technology Accreditation Commission of ABET placed significantly more emphasis on learner-centered instruction and on measuring learning². Rather than focusing on the input to the learning process, e.g. faculty, textbooks, syllabi, this approach involves measuring the output of the process, e.g. student learning. Numerous assessment methods are available. At institutions with large enrollments in engineering technology programs, assessment techniques such as surveys, performance on standardized exams and other similar tools are effectively used. Many of these techniques can be found in a CD-ROM developed by Rogers in 2004³. This work sought to “bring common sense into the assessment of educational programs”. For small programs, other approaches must be determined. The reference by Angelo and Cross explains how to get started with classroom assessments and includes examples of many effective assessment practices⁴. Additional resources in classroom-based

techniques include publications by Walvoord and Walvoord and Anderson^{5,6}. Specific examples of classroom assessment include the testing method used by Bluestein to test students' proficiency in prerequisite classes, Ahmadian's rubrics for laboratory assignments and for oral presentations, and team problem-solving presentations described by Shaeiwitz⁷⁻⁹. The challenge is in linking classroom assessments to achievement of program outcomes, particularly in ensuring any grading-based assessment is done appropriately^{10,11}.

Post-ABET Assessment and Evaluation Goals

Once the evaluators were gone, the realization of the time required to write the self-study, plan appropriate assessments, prepare for the visit of the evaluators and, in general, living ABET began to sink in. A letdown was expected. Continuous improvement, however, is supposed to be continuous and the level of effort expended during the eighteen months prior to each program's evaluation visit could not be sustained. The Assessment Committee and the Department leadership needed to inculcate the TC2K educational process into the life of the faculty at a level that is comfortable and meets ongoing process requirements.

Consistent with the philosophy of continuous improvement, the major assessment task following the successful TC2K-based accreditation of the four engineering technology programs has been improving the assessment process itself. The assessment process leading to the next round of ABET accreditation visits needed modification to address three fundamental areas of the overall assessment and evaluation program; the workload involved in assessment, verification of current assessment results through triangulation (at least three metrics, data sets, or assessment methods relating to one program outcome aspect), and improvement of assessment methods and metrics. These areas were identified as most significant for the following reasons:

- **Workload:** this directly impacts the sustainability of the assessment process and the implementation of improvements to the program. The process must adhere to the philosophy of, "less is more" and focus on the value and relevance of all information gleaned throughout the assessment and evaluation process.
- **Triangulation:** this ensures the validity of assessment and evaluation results by measuring learning with multiple assessment methods.
- **Methods and metrics improvement:** by measuring learning with multiple assessment methods.

Department-wide, the assessment process has been streamlined to consist of semi-annual review meetings, where ABET coordinators report their findings, by semester or year, and the Assessment Committee reviews results and offers its recommendations. Each coordinator is responsible for developing an assessment and evaluation process that will serve the program, students and faculty at his/her location, subject to Assessment Committee approval. The processes are somewhat similar, but customized to meet unique program constraints. Most program assessment points were originally selected from existing course assessments to streamline assessment data collection. Frequency and

extent of program-level evaluation represent the primary areas of adjustment to make the assessment process sustainable for the four programs.

Revised Assessment Processes for the MET Associate Degree only Programs

Both campuses offering only AS MET degree programs have about 60 students and two full-time faculty each. The Columbus campus MET faculty focused their efforts on direct assessment of program outcomes by using classroom assignments, lab reports and exam questions. An example of an embedded assessment utilized by the MET faculty is a laboratory report. The MET program consists of many classes with laboratory activities that require lab reports. The rubric used for lab reports is a fifteen part rubric with each part varying from 1 to 4. Examples of Individual categories include spelling/grammar, participation, calculations, appearance, analysis, summary, conclusions, procedures, results, and drawings/diagrams. Assessments can be made of technical content (program outcome (PO 1)), verbal communications including both written content and graphical communications (PO 3), experimental understanding and teamwork. Appendix 1 shows the rubric used for the lab reports. This type of embedded classroom assessment is critical to sustaining the continuous quality improvement program between accreditation visits. In this case, classroom assessment refers to assessment of laboratory reports, integrated project experiences, and individual exam questions. The objective is really to extract as much assessment information from a single classroom activity as possible.

All assessments at the Columbus campus are tied to course core learning objectives. The most difficult task with such a direct assessment is developing the performance rubric. Many of these rubrics were created for the initial ABET evaluation of the MET program and, once created, are valuable in terms of sustainability of the assessment effort. In fact, the rubrics for oral presentations, lab reports, research reports, and integrated, capstone projects are now used in the grading of those activities, increasing consistency in grading and facilitating assessments. The process has resulted in a number of specific instructional delivery changes and appears to be serving the purpose of increasing learning. The only substantial change in the assessment process thus far has been to cut back on the frequency with which OI data are collected and evaluated, since this represents the primary ongoing effort. Surveys to examine the experiences of local employers and past graduates will continue on a three-year cycle, but the relatively small numbers involved makes this a manageable task. Surveys regarding ethics, lifelong learning and other topics of current students will also continue on an annual basis.

At the New Albany campus, three levels of assessment were defined for feedback on five program outcomes. Level 1 assessment is done within individual classes and use various measures of student work related to Program Outcomes, including written reports, oral presentations, homework and project assignments, and test questions. The instructor determines the metric and compliance standard and is responsible for implementing all potential improvements. Level 2 assessments evaluate student growth and overall compliance with program outcomes using Core Learning Objective (CLO) surveys, class evaluation surveys and current student surveys. Level 3 assessment involves post

graduation performance judged by both the graduate and their employer using surveys sent shortly after graduation and again five years later. The Evaluation and Improvement Plan then draws upon multiple assessment points for each program outcome. By using many assessment points for each outcome, triangulation of each outcome and flexibility of data collection is possible. Each assessment point includes a course identification, the specific ABET topic, the assessment mechanism, the metric used, the standard for success and a description of any needed evaluation and improvement tasks. Both faculty members comprise the New Albany Evaluation and Improvement (E&I) Team. The E&I Team collects designated assessment data during the academic year, conducting an annual data review and evaluation each May. From the evaluation, the E&I Team identifies areas in need of improvement, develops improvement processes and action plans, and communicates and coordinates strategic initiatives with the MET Assessment Committee.

For two faculty members, this represents a significant time investment, so workload reduction was the starting point for improvement of the assessment and evaluation process. New Albany's ABET Coordinator began by reducing the number of assessment points undertaken for the 2005-2006 academic year. Most data for the 26 established assessment points met their standards for success the previous year, and no assessment points had shown a decline over the previous two years. Although all class activities (reports, homework, projects, tests, etc) that form the basis for these assessment points will continue, 2006-2007 academic year evaluation and improvement activities focused on the five assessment points showing a need for improvement in student proficiency. In addition, ineffective assessment points were removed.

Selective use of triangulation was applied in 2006-07 to verify that the improvements achieved since 2003 have been sustained. This was implemented for all five program outcomes, especially in the areas of communication, teamwork, and professional standards of integrity and ethical conduct. In order to address methods and metrics improvement, the New Albany ABET Coordinator will review each remaining assessment point for indications of the root cause of any marginal results, and will begin a general examination of the assessment methods used for Program Outcome 1 (technical skills).

Revised Assessment Processes for the 2+2 Programs

Both baccalaureate programs are delivered to primarily full-time, traditional students by approximately twenty-five full-time faculty, with four faculty members delivering the manufacturing engineering technology (MFET) core courses. MFET core classes are offered annually, so most data for most Outcome Indicators (OI) are collected once per year. Based on evaluation of pre-ABET visit data, the second year's efforts dealt with gaining a better understanding of student achievements related to non-technical skills such as teamwork and communications. To date, the MFET ABET coordinator has revised the program's assessment plan annually to address perceived shortcomings.

For the 2+2 MET program, all core courses and many electives are taught each semester. Types of assessments include surveys, rubric-based evaluations, and scores on specific examination questions. Two complete sets of OI data were obtained and evaluated prior to the ABET visit. During the ABET visit year, the only OI data collected were those OI where a performance standard was not met, where the metric and/or performance standard was modified, or if some other problem was identified during the first two rounds of assessment. Departmental surveys addressing TC2K Criterion 2, items h-k, were revised to handle possible confusion about the meaning of specific aspects of the survey. To balance the assessment and evaluation workload, an assessment calendar was developed to ensure the collection of at least two data sets per metric prior to next ABET visit. Because they have revealed concerns about students' understanding of professional expectations such as working in the global economy, the refined h-k surveys will be administered every fall. For both 2+2 programs, surveys of graduates and industry representatives will be administered every three years. The alumni are grouped into 3-year cohorts to avoid survey repetition and especially to avoid annoying the employers of program graduates.

Moving Forward

The assessment and evaluation process is now organized to be truly ongoing for the four programs considered in this paper. The next big challenge is be able to revise the curricula without necessitating scrapping of all existing assessment points. This hurdle has not been attempted so far, but the link from course core learning objectives to program outcomes will hopefully serve as the key to keeping assessment revision closely aligned to curricular revision. The departmental educational processes have proven to be robust, and departmental faculty are optimistic that these processes will facilitate large-scale improvement as well as minor program adjustments.

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Appendix A: Sample Lab Report Rubric

CATEGORY	4	3	2	1	Rubric Score
Components of the report	All required elements are present and additional elements that add to the report (e.g., thoughtful comments, graphics) have been added.	All required elements are present.	One required element is missing, but additional elements that add to the report (e.g., thoughtful comments, graphics) have been added.	Several required elements are missing.	
Question/ Purpose	The purpose of the lab or the question to be answered during the lab is clearly identified and stated.	The purpose of the lab or the question to be answered during the lab is identified, but is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is partially identified, and is stated in a somewhat unclear manner.	The purpose of the lab or the question to be answered during the lab is erroneous or irrelevant.	
Spelling/ Grammar	One or fewer errors in spelling, punctuation and grammar in the report.	Two or three errors in spelling, punctuation and grammar in the report.	Four errors in spelling, punctuation and grammar in the report.	More than 4 errors in spelling, punctuation and grammar in the report.	
Participation	Used time well in lab and focused attention on the experiment.	Used time pretty well. Stayed focused on the experiment most of the time.	Did the lab but did not appear very interested. Focus was lost on several occasions.	Participation was minimal OR student was hostile about participating.	
Procedures	Procedures are listed in clear steps. Each step is numbered and is a complete sentence.	Procedures are listed in a logical order, but steps are not numbered and/or are not in complete sentences.	Procedures are listed but are not in a logical order or are difficult to follow.	Procedures do not accurately list the steps of the experiment.	
Calculations	All calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results labeled appropriately.	No calculations are shown OR results are inaccurate or mislabeled.	
Appearance/ Organization	Lab report is typed and uses headings and subheadings to visually organize the material.	Lab report is neatly handwritten and uses headings and subheadings to visually organize the material.	Lab report is neatly written or typed, but formatting does not help visually organize the material.	Lab report is handwritten and looks sloppy with cross-outs, multiple erasures and/or tears and creases.	
Analysis	The relationship between the variables is discussed and trends/patterns logically analyzed. Predictions are made about what might happen if part of the lab were changed or how the experimental design could be changed.	The relationship between the variables is discussed and trends/patterns logically analyzed.	The relationship between the variables is discussed but no patterns, trends or predictions are made based on the data.	The relationship between the variables is not discussed.	
Summary	Summary describes the skills learned, the information learned and some future applications to real life situations.	Summary describes the information learned and a possible application to a real life situation.	Summary describes the information learned.	No summary is written.	
Conclusion	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiment.	Conclusion includes whether the findings supported the hypothesis and what was learned from the experiment.	Conclusion includes what was learned from the experiment.	No conclusion was included in the report OR shows little effort and reflection.	
Drawings /Diagrams	Clear, accurate diagrams are included and make the experiment easier to understand. Diagrams are labeled neatly and accurately.	Diagrams are included and are labeled neatly and accurately.	Diagrams are included and are labeled.	Needed diagrams are missing OR are missing important labels.	
Materials	All materials and setup used in the experiment are clearly and accurately described.	Almost all materials and the setup used in the experiment are clearly and accurately described.	Most of the materials and the setup used in the experiment are accurately described.	Many materials are described inaccurately OR are not described at all.	
Scientific Concepts	Report illustrates an accurate and thorough understanding of scientific concepts underlying the lab.	Report illustrates an accurate understanding of most scientific concepts underlying the lab.	Report illustrates a limited understanding of scientific concepts underlying the lab.	Report illustrates inaccurate understanding of scientific concepts underlying the lab.	
Data	Professional looking and accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in written form, but no graphs or tables are presented.	Data are not shown OR are inaccurate.	
Variables	All variables are clearly described with all relevant details.	All variables are clearly described with most relevant details.	Most variables are clearly described with most relevant details.	Variables are not described OR the majority lack sufficient detail.	
Total Score					