Program Assessment Process/Strategy:

The success of an outcomes-based assessment process depends on the implementation of a comprehensive continuous improvement process. This process should not only allow for the assessment of the Program's Educational Objectives and Outcomes but also for a feedback loop that leads to the proper corrective actions. Proper corrective actions are not limited to curriculum changes but may include faculty development and infrastructure changes as well. In this process, documentation and feedback are very critical to ensure achievement of the Program Educational Objectives and Outcomes assessment. A schematic diagram of the M.E. Assessment Plan is shown in Figure 2. There are three levels (tiers) of assessment:

- *Tier 0 – Program Educational Objectives Evaluation:* This is a review of the M.E. Program Educational Objectives (PEO's) and the overall assessment process. This process includes evaluation of the Program Educational Objectives and assessment process and tools. Evaluation of program educational objectives is conducted on a 2-3 year cycle.

- *Tier 1 – M.E. Program Assessment:* The M.E. program is evaluated annually by a faculty team to determine if the program's desired outcomes are being achieved. Assessment of outcomes is done yearly. Also, this is done to examine how and to what degree each course contributes to the achievement of program outcomes.

- *Tier 2 –M.E. Course Assessment:* The courses within the M.E. program are evaluated on an on-going basis by the faculty teaching the courses (every term). Faculty members have revisited content and structure of individual courses and as a result a set of Course Learning Objectives were developed for each course. This includes all core Mechanical Engineering courses, all specialty courses, and all Senior Design Project courses. The goal is to continually improve the quality of each course.

The three tiers are inter-connected where continuous course-level assessment and curriculum examination feed into Program Outcomes (PO's) assessment, which in turn are linked to the Program Educational Objectives (PEO's). The link between courses, outcomes, and objectives is explicitly shown under Criterion 3.

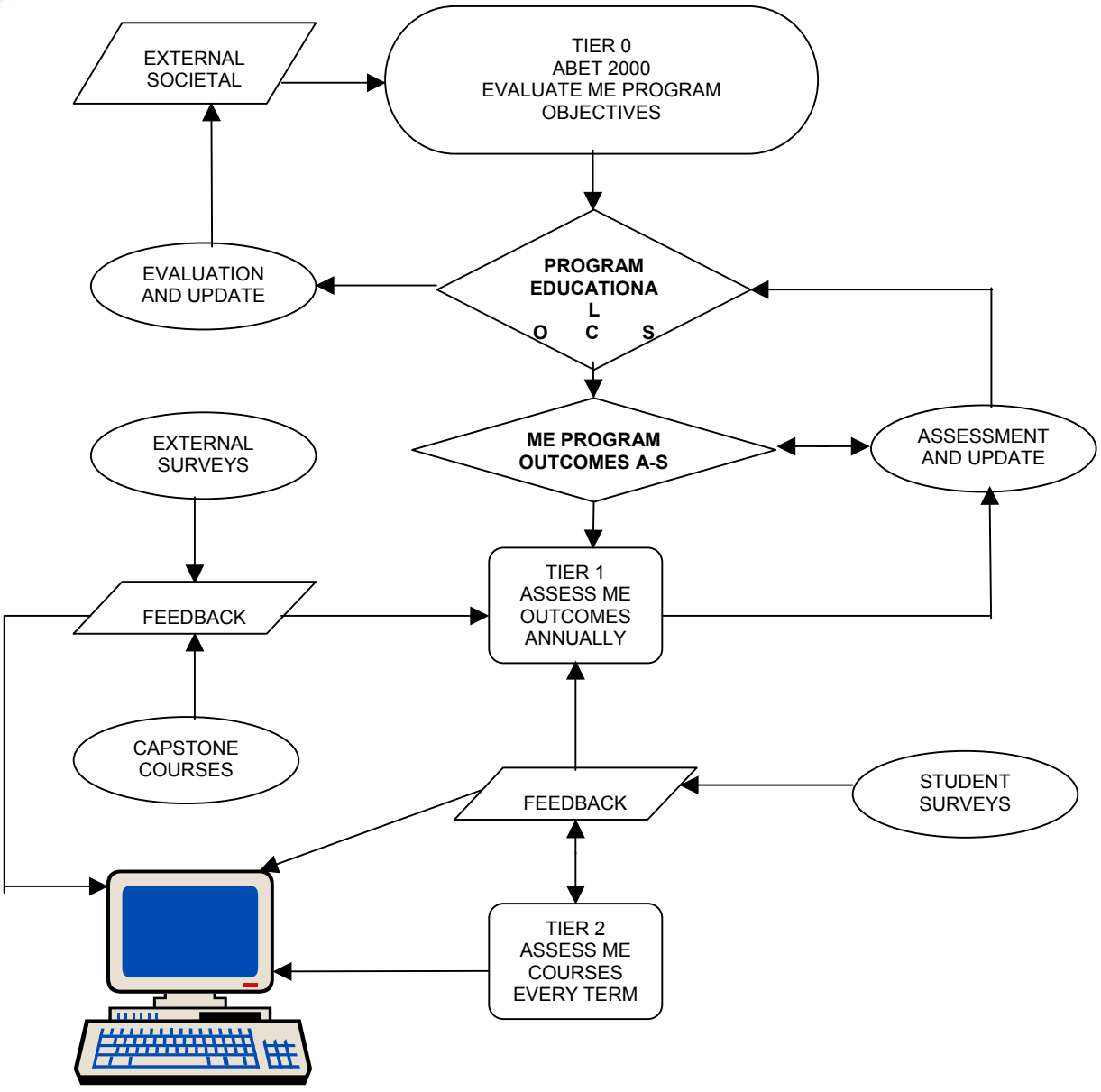

Figure 2. Overall Mechanical Engineering Assessment Process

Program Educational Objectives Evaluation:

This assessment activity is conducted every 2-3 years to review the program educational objectives and to review the overall assessment process. A faculty assessment team is appointed by the M.E. Department Head and provided with the results of the recent annual assessment documents (surveys and other instruments to be discussed later). The team meets with constituent groups (faculty, students, alumni, and industry) to discuss the meaning of the results. The team makes recommendations to the faculty for changes in the curriculum and/or program educational objectives. Figure 3 shows the system and processes of ongoing evaluation reflecting the theme of continuous improvement. A matrix linking the Program Outcomes (PO's) to the Program Educational Objectives (PEO's) is featured in Table A. The numbers indicate the level of connectiveness between an outcome and an objective, (High = 4 and Low = 1).

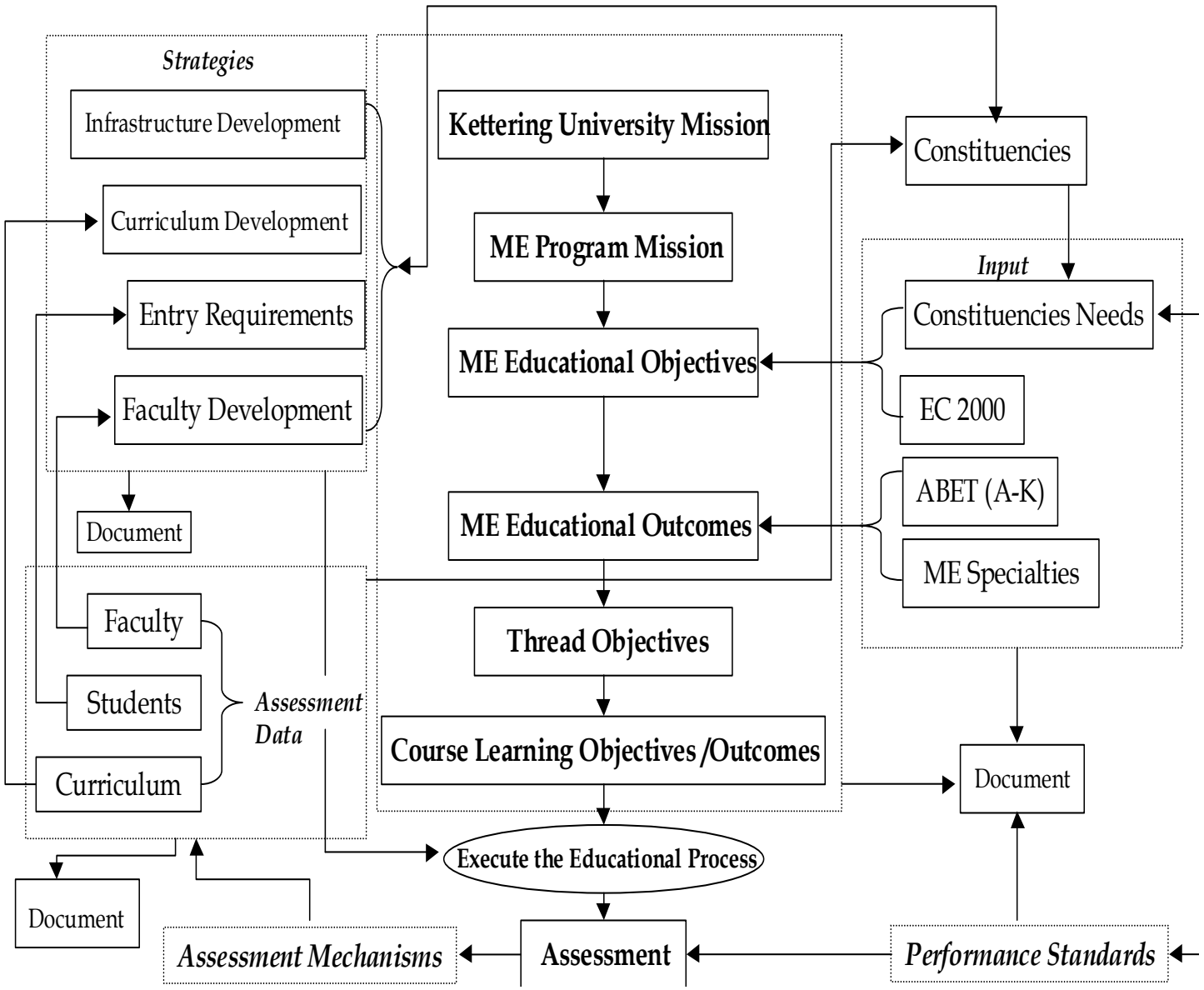

Figure 3. ME Continuous Improvement Process

Table A. Linkage of Program Educational Objectives to Program Outcomes

	PROGRAM OUTCOMES (PO's)																		
Program Educational Objectives (PEO's)	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**	**p**	**q**	**r**	**s**
1. Are knowledgeable in the effective use of modern problem solving and design methodologies.	3	3	3	2	4	1	1	1	1	0	4	3	4	4	3	1	1	0	3
2. Understand the implications of design decisions in the engineering marketplace	1	2	3	2	2	3	3	3	2	2	2	2	1	1	1	1	3	1	1
3. Are effective engineers, i.e. ones who are able to formulate and analyze problems, think creatively, communicate effectively, synthesize information, and work collaboratively	4	4	4	4	4	3	4	3	2	2	4	4	4	4	4	2	2	2	3
4. Have an appreciation and an enthusiasm for life-long learning.	1	1	2	2	1	1	1	2	4	3	2	1	1	1	1	1	1	1	1
5. Perform effectively on teams engaged in continuous improvement activities in engineering and business processes.	1	2	2	2	2	1	1	1	2	1	2	1	1	1	1	1	2	2	1
6. Practice professionally and ethically in the field of Mechanical Engineering.	2	2	2	3	2	4	2	2	2	2	2	2	2	2	1	2	3	3	2
7. Are prepared for positions of leadership in business and industry.	1	1	2	3	3	3	4	3	3	3	2	2	1	1	1	1	3	4	2

Annual Program Outcomes Assessment:

A primary assessment activity for the department is the annual assessment of Mechanical Engineering Program Outcomes. During the summer term, a faculty assessment team (appointed by the M.E. Head) evaluates the data taken during the previous year. This annual assessment of the data ensures a rapid identification and response to problems in the program. A schematic of the annual process is shown in Figure 4. The goal of the annual process is to identify weaknesses in the curriculum, which may result in a failure to meet program outcomes. The faculty team is provided with the assessment data in the University's five-column format (Appendix I-E).

The faculty team determines if the numerical metric is satisfied for each assessment criteria under each program outcome. If the metric is not satisfied, the team has the following possible actions:

1. Metric change: The faculty assessment team may determine that the assessment metric is inappropriate and recommend changes to the metric.
2. Tool change: The faculty assessment team may determine that the assessment tool is inappropriate and recommend a change to the tool. For instance, they may recommend that a survey question be rewritten or eliminated.
3. Curriculum change: The faculty assessment team may determine that the metric is not being satisfied due to a gap in the program. The team would make a recommendation to the faculty that a change be made to the curriculum.
4. Continue to monitor: The faculty assessment team may determine that no immediate action is warranted and decide to continue to monitor the situation.

The faculty assessment team then prepares a memo to the Department Head summarizing their findings. At a minimum the memo must include a completed five-column assessment form and an updated five-column matrix used in the following year's assessment. Suggested changes in the curriculum are forwarded to the faculty for study and action.

In addition, Course Level Assessment is conducted on an ongoing basis. Each core course has a coordinator who is responsible for building and maintaining course notebooks.

To summarize the documentation process for this assessment plan, each year the assessment team prepares:

- A program assessment memo explaining the results and making recommendations.
- A completed annual five-column matrix showing metrics and actions taken.
- A revamped five-column matrix to be used the following year.

Available to the ABET team will be two sets of notebooks. The first set consists of Course Notebooks while the second set consists of Outcomes Notebooks. The Course Notebooks have been standardized to have the following information: ABET Course Syllabus; Sample Course Material; Instruments/Tools; Data/Feedback; and Primary Outcomes. The Outcomes Notebooks, whose purpose is to provide evidence of outcomes achievement on an outcome-by-outcome basis, have also been standardized to have the following information: Outcome; Tools/Instruments; Data; Students' Work; Five-Column Form; and Loop Closing.

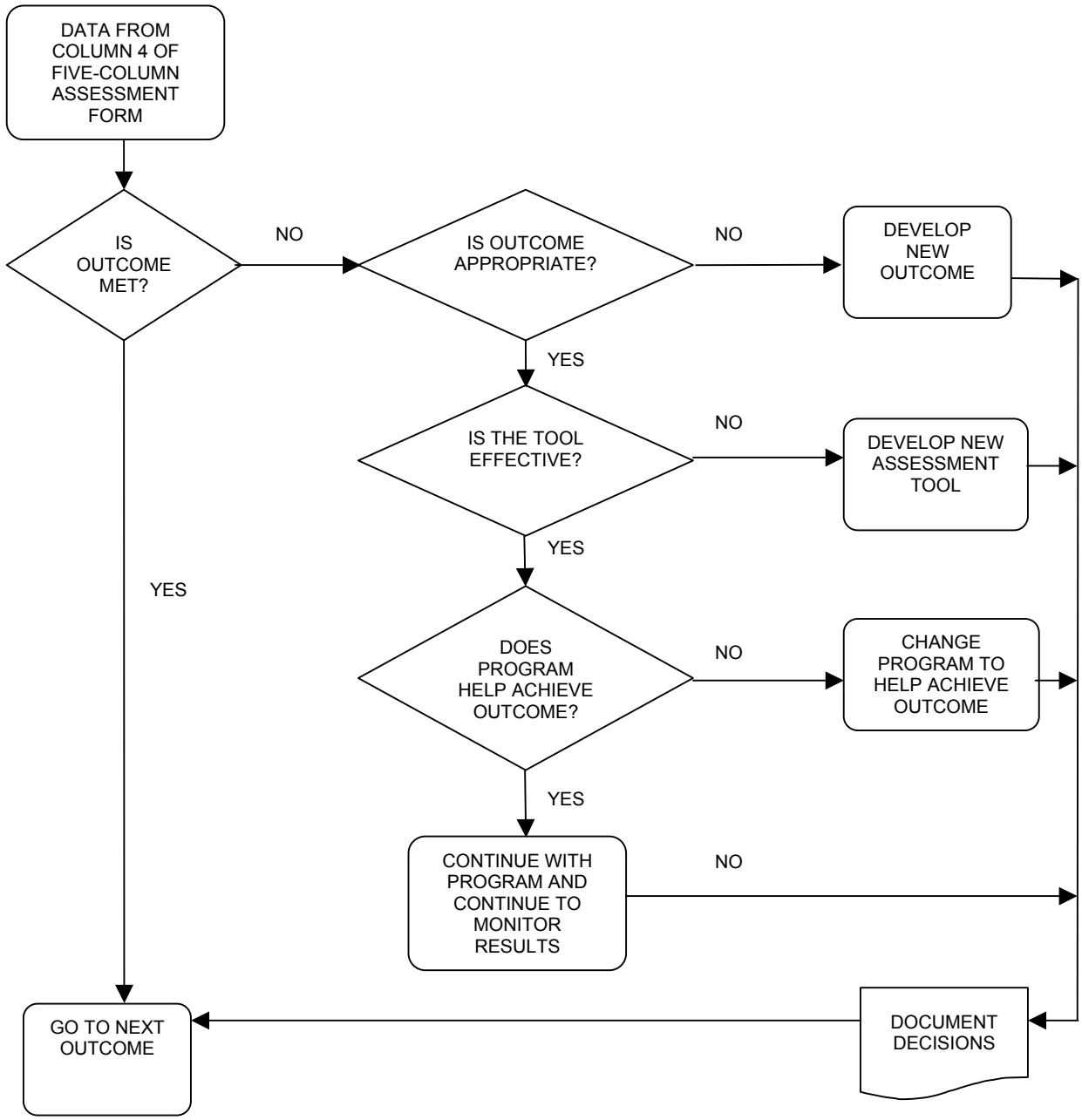

Figure 4. Tier 1: Annual Mechanical Engineering Assessment Process

Program Assessment Tools:

The program assessment tools are those that are used to determine if the stated program outcomes are being met. Kettering University has developed a series of assessment tools. In addition, the M.E. department has developed several additional tools. These assessment tools are explained next and summarized in Table B. Each tool has been evaluated as being Formative (F) or Summative (S), Attitudinal (A) or Objective (O), and whether the tool is nationally normed. Since it is important to triangulate and employ a variety of types of assessment tools, the tools used by Mechanical Engineering were selected to cover each of the above stated categories.

Table C shows the assessment tools and the outcomes they intend to address by providing assessment data for. Table D focuses on the tie between the ME courses and the ME outcomes. In Table D, a "P" is entered for primary contribution of course learning objectives in meeting that particular outcome while "S" stands for secondary contribution. The "P" and "S" entries have been generated by course coordinators upon consultation with faculty members who normally teach that course.

Table E presents the contribution of support courses in the achievement of ME program outcomes.

Tools Administered by the Department:

1. ***Program Exit Survey*** – Once per year, students complete a program exit survey in all Mechanical Engineering capstone courses. This survey is used to evaluate the success of the M.E. program in providing students with opportunities to achieve the program outcomes.

2. ***Outcomes – Based Course Survey*** – Every term, in every M.E. course, a student survey is conducted. This survey is used to determine the quality of the course, the various outcomes that this course tries to satisfy, and the level of achievement of these outcomes. Also, students' perceptions of the class (in terms of Program Outcomes) are compared to the faculty's intent.

3. ***Capstone Portfolio*** – In capstone (Senior Design Project) courses, each M.E student team creates a portfolio of their work. The portfolio includes samples of writing, calculations, analysis, synthesis and evaluation, a CD and a videotape of the presentation. An internal/external team evaluates the portfolios at the end of the year using a one-page form so that the results are considered to be objective. The portfolios will be available for the ABET team during their visit.

4. Fundamentals of Engineering (FE) Exam – Although the FE exam is not required, the M.E. program tracks the performance of Mechanical Engineering students who take the exam. M.E. faculty members educate students about the importance of professional registration and encourage students to take the exam. The ME department holds refresher courses twice a year for all seniors, free of charge for Kettering students. The FE exam is considered to be an important tool, because it is a nationally normed objective exam.

Tools Administered by the University and Used for the Assessment of the ME Program:

The University's Office of Institutional Effectiveness and the Office of Enrollment Management (co-op and thesis) conduct thirteen different surveys. The ME program selected five surveys of direct relevance to assessment:

1. Employment Survey – This survey is developed and administered by the Corporate Relations Office to recent graduates. It is used to measure the starting salaries of Kettering graduates (a measure of the demand for Kettering graduates) and the intention of the students to pursue graduate degrees.

2. Co-op Survey – Employer (Senior) – Every student's co-op supervisor fills out this form during their senior term measuring the satisfaction with the student's performance. It also contains EC2000 specific questions.

3. Thesis Evaluation – Employer – This survey measures the employer's satisfaction with a student's thesis work. It is considered to be an objective measure of the student's ability to function as an engineer and hence is a particularly useful tool for program assessment.

4. Education Benchmarking Inc (EBI) – This survey addresses student's attitudes and EC2000 outcomes. Ten questions specific to Kettering have been added to the survey. The results can be compared to 50 other participating institutions. They can be narrowed to make more specific comparisons with 5 universities comparable to Kettering. This survey is particularly useful because it is nationally normed.

5. Alumni Survey – Kettering graduates are surveyed 3 years after they graduate, to determine their satisfaction with their Kettering education. The levels of their promotions are used to evaluate their leadership success. They are also polled on their postgraduate educational experiences.

The above selected assessment tools are used to determine if the Program Educational Objectives and Program Outcomes are meeting the needs of the M.E. program constituents. They are used explicitly to determine if the ABET criteria are being met.

Table B – Summary of Methods Available for Assessment

METHODS USED TO ASSESS PROGRAM OUTCOMES	DESCRIPTION	TIME LINE	F or S	A or O	Nat. Norm	RESPONSIBLE	DEPARTMENT RESOURCES NEEDED
Department Tools							
1. Program Exit Survey (conducted in capstone)	Outcomes-based, intended to assess Program Outcomes.	Each course, each term	F	A	N	Faculty to distribute, Staff to compile	Scantron machine, Staff to compile data
2. Outcomes-Based Course Survey	Outcomes-based targeting a specific course	Each course, each term	F	A	N	Faculty to distribute, Staff to compile	Scantron machine, Staff to compile data
3. Capstone Portfolio	Students will complete a portfolio during their capstone project course.	Senior year	S	O	N	Faculty team assigned by department chair.	Staff to compile data
4. FE Exam	Students will be **encouraged** to take FE Exam.	Senior year	S	O	Y	SAB to promote, Staff to compile	Staff to compile data
University Tools							
1. Employment Survey	Salary, continuing education data	Recent graduates	–	O	Y	Academic Services Office	Staff to compile data
2. Co-op Survey – Employer (Upper class i.e. Senior)	W/ EC2000 specific questions	Senior year	S	O	N	Enrollment Management	Staff to compile data
3. Thesis Evaluation – Employer	W/ EC2000 specific questions	Senior year	S	O	N	Thesis Office	Staff to compile data
4. Education Benchmarking Inc (EBI)	W/ EC2000 specific questions	Graduating Seniors	S	A	Y	Academic Services Office	Staff to compile data
5. Alumni Survey		5 years after graduation	S	A	N	Academic Services Office	Staff to compile data

Key: *F = Formative ; S = Summative; A = Attitudinal; O = Objective; N = No, and Y = Yes.*

Table C – Linkages Between Assessment Methods and Program Outcomes

	PROGRAM OUTCOMES (PO's)																			
Assessment Method:	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**	**p**	**q**	**r**	**s**	Other
Department Tools																				
1. Program Exit Survey (conducted in capstone)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	A
2. Outcomes-Based Course Survey	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	A
3. Capstone Portfolio	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
4. FE Exam	X					X														
University Tools																				
1. Employment Survey									X											B
2. Co-op Survey – Employer (Senior)	X	X	X	X	X	X	X	X	X	X	X									
3. Thesis Evaluation – Employer	X	X	X	X	X	X	X	X	X	X	X	X		X						
4. Engineering Bench-marking Inc (EBI)	X	X	X	X	X	X	X	X	X	X	X									
5. Alumni Survey									X											C

Other:

A. A similar course survey will be used to monitor student satisfaction with the instructor's delivery, usefulness of text, etc.
B. Will also monitor employment surveys for percentage of graduates with jobs and starting salary. Both are indicators that Kettering graduates are in demand.
C. Will continue to monitor alumni surveys for percentage of graduates in leadership positions and salary. Both are indicators that Kettering graduates are in demand.

Table D – ME Courses Contribution to Program Outcomes

		Program Outcomes (PO's)																		
Course Number	**Course**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**	**p**	**q**	**r**	**s**
MECH-100	**Engineering Graphics**			P	P		S	P	P	S		P				P				
MECH-200	**Introduction to CAE**			P	P	S	S	S	S	S		P	P	P		P		P		
MECH-210	**Mechanics I**	P		S		P			S	S		P	S	S			S			
MECH-212	**Mechanics II**	P		S		P			S	S		P	S	S			S			
MECH-230	**Intro to Mechatronic Design**			P	P	P	S	P		S	S	P			P	P		P	S	P
MECH-310	**Mechanics III**	P		S		P		S	S			S	S				P			
MECH-312	**Design of Mechanical Components I**	P		P	S	P	S	S	S	S	S	P	S	S			S	S	S	S
MECH-412	**Design of Mechanical Components II**	P		P	S	P	S	S	S	S	S	P	S	S			S	S	S	S
MECH-320	**Thermodynamics**	P	S	P		P			S		S	S	P	S		S	S			S
MECH-322	**Fluid Mechanics**	P	S	P		P			S		S	P	P	P		S	S			S
MECH-330	**Dynamic Systems I**	P		S	S	P						P	P	P		S				P
MECH-350	**Introduction to Bioengineering App**	P	S	S		S	P	S	P	S	P	P	S	S	S	S	S	S		S
MECH-420	**Heat Transfer**	P	S	P		P			S		S	P	P	P		S	S			S
MECH-422	**Energy Systems Lab**	P	P	S	S	P	S	P				P	S	S	P		S	S	S	
MECH-430	**Dynamic Systems II**	P	P	S	S	P						P	P	P	S	S				P
MECH-448	**Vehicle Design Project**			P	S		S	P			S	S				P		P		
MECH-490	**Fluid Power**	P	S	P	S	P	S		S	S	S	P	S	S	S			S	S	P

		Program Outcomes (PO's)																		
Course Number	**Course**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**	**p**	**q**	**r**	**s**
MECH-510	**Analysis & Design of Machines**	P		P	S	P				S		P		P		P				
MECH-512	**Mechanical Systems Design Project**			P	S		P	P			P	P				P		P		
MECH-515	**Fatigue**	P		S	S	P	P		S	S	S	P		S				S	S	
MECH-516	**FEA with Structural Applications**	P	S			P								P						
MECH-520	**Buildings & Facilities**			P	S		P	P			P	P				P		P		
MECH-540	**Introduction to Combustion Engine**	P	P	S		P		S			S	P	S	S	P			P	S	S
MECH-541	**Automotive Power Systems**	P	P	S		P		S			S	P	S	S	P			P	S	S
MECH-542	**Chassis Systems Design**	P	S	P		P	S	S				P	P	P		S		S	S	
MECH-544	**Vehicle Performance & Transmission**	P	S	P		P	S	S				P	P	P		S		S	S	
MECH-546	**Vehicle Systems Dynamics**	P	S	P		P	S	S	S		P	P	S	P		P	S	P	S	S
MECH-550	**Bioengineering: Occupant Protection**	S		S		S	P	S	P	P	P	P	S	S	S	S		S		
MECH-554	**Bioengineering Applications Project**			P	S		P	P			P	P				P		P		
MECH-570	**Metal Forming Simulation**	P		P	P	P		P		S		P		P		P				
MECH-580	**Properties of Polymers**	P	S	S	S	P	S		S	S	S	P		S	S	S	P	S	S	
MECH-584	**Plastic Product Design**			P	S		P	P			P	P				P		P		

Table E – Support Courses Contribution to ME Program Outcomes

		Program Outcomes (PO's)																		
Course Number	**Course**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**m**	**n**	**o**	**p**	**q**	**r**	**s**
MATH-101	Calculus I	P																		
MATH-102	Calculus II	P																		
MATH-203	Calculus III	P																		
MATH-204	Differential Equations	P																		
MATH-305	Numerical Methods and Matrices	P												P						
MATH-408	Probability and Statistics	P	P											P						
CHEM-135/136	Principles of Chemistry	P	P		P												P			
CHEM-145/146	Intro. Ind. Org. Chemistry	P	P		P												P			
PHYS-114/115	Physics I – Newtonian Mechanics	P	P		P												P			
PHYS-224/225	Physics II – Electricity & Magnetism	P	P		P												P			
COMM-101	Written-Oral I						P	P												
COMM-301	Written-Oral II						P	P		P										
HUMN-201	Introduction of the Humanities						P	P		P	P									
	Humanity Elective						P	P		P	P									
	Social Science Elective						P	P		P	P									
LS-489	Senior Seminar				P		P	P	P	P	P								P	
SSCI-201	Introduction to the Social Sciences						P	P	P	P	P									
ECON-201	Economic Principles						P			P								P		
MFGG-135	Interdisciplinary Design & Mfg.			P	P	P						P								
MFGG-370	Engineering Materials & Processes	P	P	P		P														
EE-210	Circuits I	P	P			P														
IEN-333	Engineering Statistics III - DOE	P	P	P		P						P								

Legend: P – Primary focus: This course should *strongly* contribute to this particular Program Outcome.