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Streamlining the Assessment Process with the Faculty Course Assessment Report*

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The Faculty Course Assessment Report (FCAR) presents a methodology that allows instructors to write assessment reports in a standardized format that is conducive for use in both course and program outcomes assessment. The FCAR document is structured as a sequence of reporting categories that include what course modifications were made, the outcomes assessment information obtained, reflection on the part of the instructor, and suggestions for course and/or program improvement. Through this method, the instructor documents critical portions of the "closing the loop" process while being guided through a systematic review of the course. The FCAR approach facilitates program-level assessment through use of a "components" category containing collected evidence in support of the set of metrics used with the program outcomes. For each component, the instructor provides a vector that categorizes aggregate student performance on a set of assignments along with details regarding the assignments used for acquiring the data. When the FCAR document is submitted, the assessment coordinator enters all of the reported performance vectors into a spreadsheet or database; this information is then organized into tables presenting the set of performance vectors for each metric. The evaluation of the program outcomes can now be quickly processed by inspection of the tables. If one or more performance vectors indicate non-compliance, one can refer back to the associated FCAR; an examination of the component in question, along with the reflection and course improvement sections, provides appropriate background information that can be used to understand the nature of the non-compliance and present appropriate solutions.

Keywords: assessment; evaluation; faculty course assessment report; FCAR; modifications; outcomes; performance vector; reflection

ASSESSMENT EXPECTATIONS

THE ABET CRITERIA [1] constitute an expression of expectations that the various affiliated professional societies have with regard to the assurance of the quality of education in a program that satisfies the needs of its constituencies. Among the listed criteria are outcomes and assessment; specifically, the establishment of program outcomes that describe what students are expected to know and are capable of performing by the time of graduation, and the corresponding assessment of these outcomes through use of a continuous improvement process containing documented results. As part of the Self-Study Report that is submitted before an accreditation visit, the institution must provide evidence that there is an implemented process to achieve the desired outcomes, that there are metrics in place to assess the outcomes, and that the results from these metrics have been analyzed and applied to the further development and continuous improvement of the program. Much has been written and discussed regarding the formulation of program educational objectives as called for in Criterion 2 and the supporting program outcomes that encompass the listed expectations of Criterion 3. Ideally, the learning objectives, assessment methods, and instructional techniques for individual courses have been developed in such a way as to address Criterion 3 outcomes, with the results being fed back into both the program and the individual courses as part of the continuous improvement process. A paper by Felder and Brent [2] provides an excellent introduction to designing and teaching courses such that students are equipped with the skills and attitudes specified in those outcomes. Additionally, the continuous improvement process must incorporate the documentation of changes that have been implemented to further develop and improve the program. It is therefore beneficial for a program to develop appropriate documentation practices as part of the assessment processes for their courses.

Many programs tend to implement their assessment processes by focusing on data collection instead of on information processing. As a consequence, one is forced to wade through reams of paper containing raw data in an attempt to determine if the program's outcomes are or are not being met. Sometimes this practice extends to the site visit, where the unfortunate program evaluator is greeted with a multitude of binders full of raw, unprocessed data, and is expected to find the needle of proof in a haystack of evidence within a very limited amount of time. This classic approach to the assessment and evaluation process

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results in too much paperwork and an inordinately high amount of stress for all persons involved. A better approach is needed, one that focuses on streamlining the assessment process so that the amount of work required from any one individual is lowered, the amount of paperwork generated is lessened, and the stress levels of those involved in the process are kept down to manageable levels.

FACULTY COURSE ASSESSMENT REPORT

The Faculty Course Assessment Report (FCAR) was developed as the key reporting mechanism in an assessment process designed to address the aforementioned problems with traditional assessment practices. The FCAR is based on the structure of a traditional course assessment report that is submitted after the completion of a course offering, but with some additional items and conceptualizations. First, the FCAR is structured as a sequence of reporting categories that is meant to guide the instructor through a systematic review of the course in a format that succinctly documents critical portions of the closing the loop process. Second, the instructor is asked to directly contribute to the assessment of program outcomes by processing the appropriate raw data collected in the course into useful information provided in support of a particular metric. This serves the two key tenets of the author's approach to streamlining the assessment process:

1) Spread the workload as much as possible.
2) Convert data into information as soon as possible.

By spreading the workload as much as possible, no one person is asked to perform a large portion of the assessment process; instead, all of the instructors in the program are asked to individually perform a small portion of the assessment process. This methodology requires some additional work to be contributed by each individual instructor; however, it has the benefit of involving each instructor in the continuous improvement process. As a consequence, instructors are engaged as active participants in a bottom-up approach to both course and program outcomes assessment, which also serves to improve faculty acceptance of the assessment process.

By converting data into information as soon as possible, one minimizes information loss. Ideally, this conversion is performed by those who are closest to the data. In the assessment process, those who are closest to the data are the course instructors; as they are the people who are most knowledgeable and therefore most capable in performing an evaluation of these data, why not utilize their expertise to both benefit and streamline the overall process? In the FCAR methodology, most metrics are used to identify courses where data are gathered in support of the program outcomes. The instructors of these courses collect the evidence, usually from a set of one or more course assignments, and then process the data into information presented in the form of a 4-tuple performance vector, conceptually based upon a performance assessment scoring rubric developed by Miller and Olds [3], that categorizes aggregate student performance. The performance vector constitutes a direct measure that neatly encapsulates information into categories which can then be quickly reviewed for "red flag" indicators. In addition to the performance vector, the instructor reports details regarding assignments used for acquiring the data along with any pertinent observations. Note that ABET's assessment process requires programs to measure the degree to which the students are achieving the outcomes; these data should not be reported in a binary-type format, such as "70% of our students are performing at an acceptable level." By providing four classification levels, the performance vector successfully meets this reporting need. Performance vectors are to be constructed with data from only those students who received a passing grade in the course, as one of the primary questions that the assessment process has to address is whether students are graduating without achieving one or more of the specified program outcomes. Accordingly, there is no need to report the data from the students who failed the course, just as long as they are required to subsequently pass the course in order to graduate.

Figure 1 provides a condensed, example illustration of an FCAR document. Normally, for each course an instructor teaches, an FCAR is written up and submitted immediately following the completion of the course. If a faculty member is teaching multiple sections of the same course, it is preferable to submit one FCAR that summarizes the assessment of all of the sections for which that instructor is responsible. To further streamline the process, for courses with multiple sections and multiple instructors, the program's assessment committee can designate a specific instructor as being responsible for writing a single FCAR. In such cases, it may be sufficient to use the data gathered in just the designated instructor's section for reporting the performance vectors, if it is considered statistically valid to do so.

The Faculty Course Assessment Report document consists, in order, of the following sections.

1) **Header.** This section is used to provide identification as to what course this report is for, in what academic term it was taught, and the instructor of record for the course. The course should be identified by both the subject code and course number, followed by course title. If this course is offered in multiple sections by different faculty, then the pertinent section number(s) should also be included.
2) **Catalog Description.** This section provides the catalog description under which this course was

Faculty Course Assessment Report
ECCS 000 – Introduction to ECCS (sections 00 and 01) – 1.00 credit
Fall Quarter 2006 - John K. Estell

Catalog Description:

Orientation to the department. Familiarization with requirements for the majors, planning program of courses, university catalog, and library. Exposure to TLAs such as PHP, ASP, PLC, BJT, etc. Philosophical discussion of the metavariables foo and bar.

Grade Distribution:

A	B	C	D	F	W	Total
3	5	11	4	2	1	26

Modifications Made to Course:

1. Dropped lecture on introduction to computer use on campus; students found the material redundant. Source: FCAR for ECCS 000 sections 03-04 Fall Quarter 2005 by Dr. Geithmann.
2. Included lectures on professional ethics based upon the ACM and IEEE Codes of Ethics. Source: 2006 Faculty Retreat, Action Plan #4 (Ethics Across the Curriculum)
3. Included information on using OhioLink for library searches as this technology is now available.

Course Outcomes Assessment:

The construction of the EAMU vectors used for course/program assessment applies the following metric in all cases: Excellent is scoring 90% or better of the total points possible, Adequate is from 90-75%, Minimal is from 75-60%, and Unsatisfactory is anything below 60%.

CO-1: Define basic TLAs relevant to the major.
Sources: questions 10-19 on midterm exam; questions 1-10 on final exam.
EAMU vector: (18, 3, 0, 2)
CO-2: Apply the metavariables foo and bar as appropriate for various situations.
Sources: homeworks 3-5; questions 1-8 on midterm exam; questions 20 and 21 on final exam.
EAMU vector: (5, 6, 11, 1)

Oral Communications Component (Metric 3-g-2):

Each student prepared and presented a five-minute oral presentation on their favorite TLA. Instructions were given in lecture regarding how to present this material in a professional manner. EPAN vector: (0, 2, 4, 17).

Contemporary Issues Component (Metric 5-j-1):

Time was spent in lecture relating the development of TLAs to the development of abbreviations used in cell phone text messaging.

Ethics Component (Metric 6-f-1):

One lecture was dedicated to coverage of the ACM and IEEE Codes of Ethics and their role in daily professional life. A second lecture featured our Engineer-in-Residence discussing examples of ethics in the workplace. Final exam questions 14-17 were used to test retention of this information. EAMU vector: (15, 6, 1, 1).

Student Feedback:

On the student course evaluation forms, students indicated a general dissatisfaction with the lecture on career opportunities available to our majors. Some expressed an interest in having a mentoring program to ease the transition into college life. A couple of students indicated that we should spend less time on dealing with university paperwork and more on what it is like to be an engineer.

Reflection:

Overall, the course went well, but some areas need work. Half of the class demonstrated less than effective proficiency with metavariables. I don't think we did a sufficient job on explaining the rationale behind our common freshman core course sequences. We should advertise the successfulness of our alumni. The addition of the ethics lectures was well received; student enjoyed talking with a real engineer about the situations she's encountered in the workplace.

Proposed Actions for Improvement:

1. Dedicate one lecture to a panel discussion featuring alumni from each of our degree programs to discuss what they do on the job as engineers.
2. Develop new curriculum flowcharts that stress the commonality of the freshman year; use them to illustrate how students can freely change/decide their major within the department in the first year without any penalty.
3. Develop an active learning exercise featuring metavariables to provide students additional experiences with their use.

Fig. 1. Example of an FCAR Document.

taught. Providing this information will, over time, document changes made to the catalog description without the need for keeping previous university catalogs on file and forcing the visiting program evaluator to search for specific pages in several catalogs to find this evidence. Instead, by maintaining a binder containing FCAR documents organized first by course and then chronologically, it is easy for all of the changes in a course to be reviewed, including those reflected in the catalog description. Additionally, a comparison of entries in separate catalogs only shows that the course description was changed; it does not document why it was changed, nor does it indicate what feedback elements of the assessment process led to this change. The FCAR format documents this activity in the "Modifications Made to Course" section.

3) **Grade Distribution.** This section provides an overall summary of course performance through an aggregate listing of the distribution of grades for the course, including withdrawals. While it is possible to obtain most of this information from one's Office of Instructional Research, it is preferable that the instructor

directly provide this data so that it is obtained in a timely manner, and that, by actively engaging in this computation, the instructor can better reflect upon the results. At no time is any information included in the report that would reveal the identity of individual students or their respective grades for the course.

4) **Modifications Made to Course.** When the continuous quality improvement process is working, changes are fed back into the program, this action is often referred to as "closing the loop" on the assessment process. However, without appropriate documentation, changes made to the organization or operation of individual courses will go unrecognized. Accordingly, this is an important section as it provides contemporaneous documentation of improvements made to the current course offering because of the assessment process. This section should be used to list only the substantive changes made to the current offering of the course; each entry should cite the source of the improvement (e.g. a previous FCAR, an assessment committee's action plan, or minutes of a department meeting), especially if that action has been documented. These references are necessary so that each modification can be traced back to its source if so required. By combining this information with the relevant portions of the referenced items documenting the assessment process, one can easily demonstrate how the loop was closed for any particular modification.
5) **Course Outcomes Assessment** – Each course outcome is stated, and then addressed, separately. Appropriate documentation stating what items were used for the assessment and the results of that assessment are to be provided. Keeping with the goal of streamlining the assessment process, there is no need to assess every question on every assignment; one keeps the workload manageable by picking an appropriate representative selection of items (e.g., specific exam questions or noteworthy assignments) for assessing each outcome. In order to have a uniform reporting method, the four categories presented in Table 1 are used for the specification of the performance indicator levels associated with the outcomes.

Table 1. Specification of performance indicator levels

Category	General Description
Excellent	Student applies knowledge with virtually no conceptual or procedural errors.
Adequate	Student applies knowledge with no significant conceptual errors and only minor procedural errors.
Minimal	Student applies knowledge with occasional conceptual errors and only minor procedural errors.
Unsatisfactory	Student makes significant conceptual and/or procedural errors when applying knowledge.

The determination of the course-specific measures that correlate to these categories is left up to the instructor. Additionally, the instructor specifies the boundaries used for delineating the performance indicator levels. This information can be presented in an introductory paragraph if the same boundary values are used for all outcomes. For conciseness, the results are reported as a performance vector, which can be also referred to as the "EAMU" vector. This vector contains the following four fields, as specified in the categories presented in Table 1, in descending order: Excellent, Adequate, Minimal, and Unsatisfactory.

6) **Program outcome assessment documentation (the "Components" sections)**. The assessment of course outcomes is, by itself, insufficient to meet the criteria for program outcomes and assessment. The data presented for satisfying the requirements for Criterion 3 have to be relative to the adopted program outcomes. However, this does not mean that the course outcomes assessment process cannot be used to assist in the program outcomes assessment process. This section of the FCAR is organized into "components" that roughly correspond to the individual items listed in the Criterion 3 outcomes of the various ABET Accreditation Commissions. While writing metrics for some of these outcomes border on the trivial and a wide variety of assessment data are readily available, some outcomes are more difficult to deal with and are not easily documented save at the course level. As an example, the Engineering Accreditation Commission's Criterion 3(b) specifies that, by graduation, students must achieve "an ability to design and conduct experiments, as well as to analyze and interpret data." How does one sufficiently prove to a program evaluator that by the time of graduation a student enrolled in that degree program has developed sufficient experience and expertise in designing experiments? Merely stating that this activity is being accomplished is insufficient and would likely result in the citing of a shortcoming. Documentation is needed to back up the claim. This can be provided in the courses where design of experiments is occurring through the inclusion of a "Design of Experiments Component" in the submitted FCAR documents for those courses. When writing this portion of the FCAR, the instructor presents a synopsis regarding the assignment(s) in question and what steps were undertaken by students in order to design the experiment, along with assessment of the results. The person performing program outcome assessment in this area is thereby provided with both written documentation that this activity is taking place and a measure to the extent that this outcome is being achieved. Therefore, the Self-Study Report can demonstrate proof by citing the FCAR documents of the relevant courses.

The reporting of components can be performed as follows:

a. The assessment committee may select a small set of courses where a particular ability, knowledge, or understanding that supports one of the program outcomes is demonstrated. This may not necessarily be part of the course outcomes; an example would be a written communications component being measured in a course where the contents of a particular report are used to demonstrate knowledge of a course outcome whereas the mechanics of the same report (such as spelling and grammar) are used to demonstrate the level of proficiency in written communication skills. The assessment of these items is performed in the same manner as a course outcome assessment, using the performance vector reporting categories provided in Table 1, with the performance indicator levels being tailored specifically for that particular metric.
b. The assessment committee may select a small set of courses where a student's growth in a particular ability, knowledge, or understanding is demonstrated. In this instance, cohort longitudinal analysis (CLA) is being utilized, where the performance indicator levels for the evaluation are held constant throughout the curriculum and are set for the performance expected from a student by the time of graduation. CLA is used to determine the effectiveness and appropriateness of specific elements of the curriculum by measuring the ability of students as they progress through the curriculum. In order to have a uniform reporting method, and to distinguish CLA reporting from an EAMU performance vector, the four categories presented in Table 2 are used for the specification of the performance indicator levels associated with cohort longitudinal analysis measures. For conciseness, the data are reported in a performance vector format; the "EPAN" vector contains the following four fields in order: Expert, Practitioner, Apprentice, and Novice. Note that this approach takes a different viewpoint in its judgment of student performance. In an introductory course, it is perfectly acceptable, even desirable, for an overall rating of "novice" to be reported by an EPAN performance vector. The goal here is to show that the curriculum is providing useful instruction by targeting areas where the incoming cohorts are novices; if all is going well, the cohort will initially rate as novices, and will graduate with at least a practitioner performance rating. If the cohort enters with a rating higher than that of novice, then that could indicate that the introductory course could be too basic and not serving as an appropriate challenge to the students. If a cohort graduates with a less than proficient rating, then that could indicate a failure in some portion of the curriculum to deliver appropriate instruction. Ideally, at the time of graduation, a cohort should rate as either proficient or exemplary, and no member of a cohort should reside at either the novice or apprentice level. As with an EAMU vector, each EPAN vector should present a count of the number of students who passed the course in each of the four categories.
c. The third situation is where the instructor voluntarily reports component information, either as a statement of fact or with assessment information in one of the two specified formats. This is done to provide additional documentation, albeit of a secondary nature as either no measurements are involved or the course is not among those listed in support of that particular metric. This does document that these activities are occurring in the course, should that evidence be needed later.

For added convenience, the header for each component should briefly state the specifics of what is being measured and parenthetically include a reference to the specific metric for which this information is being collected; in this way, the corresponding performance vector can be easily extracted from the FCAR document and categorized under the appropriate program outcome. In the example provided by Fig. 1, the "Ethics Component" contributes to Metric 6-f-1 in that program's assessment plan. The nomenclature being utilized succinctly indicates first the program-specific outcome (6), the corresponding ABET Criterion 3 outcome (f), and the specific metric in that category (1), as there may be multiple metrics used in support of a particular program outcome and criterion outcome pairing. This approach allows for the reported performance vectors to be entered into a spreadsheet or database, then organized either by the program-specific outcomes or by the ABET Criterion 3 outcomes.

Table 2. Specification of CLA performance indicator levels

Category	General Description
Expert	Student applies knowledge with virtually no conceptual or procedural errors.
Practitioner	Student applies knowledge with no significant conceptual errors and only minor procedural errors.
Apprentice	Student applies knowledge with occasional conceptual errors and only minor procedural errors.
Novice	Student makes significant conceptual and/or procedural errors when applying knowledge.

7) **Student Feedback.** When performing assessment, input should be obtained from all of the appropriate constituent groups; accordingly, it is reasonable and proper to incorporate student feedback from a course evaluation into an FCAR for this purpose. While some of the

PO-3: By the time of graduation, those students majoring in computer engineering will have the ability to function in an engineering environment requiring communications between team members possessing separate skills and responsibilities yet working toward a common goal.

3(d): an ability to function on multi-disciplinary teams

Metric 3-d-1: The FCAR reports for the senior design sequence (ECCS 404-405-406) will document that students understand the concepts of, and as necessary are able to apply principles of, constructive conflict management to interactions with others.

Metric 3-d-2: The FCAR reports for the senior design sequence (ECCS 404-405-406) will document the students' use of peer-to-peer evaluation to provide specific and constructive feedback to other team members.

Metric 3-d-3: The FCAR reports for the following courses will document the results of student participation in team projects where members have separate skills and responsibilities: ECCS 362, ECCS 411, ECCS 464.

3(g): an ability to communicate effectively

Metric 3-g-1: Students will work together to demonstrate effective communication of information, concepts and ideas in writing as documented in technical reports written in GE 106, ECCS 321 and ECCS 411, Senior Design project written proposal evaluation in ECCS 404, and Senior Design final written report evaluation in ECCS 406.

Metric 3-g-2: Students will work together demonstrate effective oral communication of information, concepts and ideas as documented by the Senior Design project proposal oral presentation in ECCS 404 and both the oral components of the Senior Design poster session and the Senior Design final oral presentation in ECCS 406.

Metric 3-g-3: Students will work together to graphically communicate information, concepts and ideas in an effective manner as documented by the Senior Design poster board evaluation and the graphical components of Senior Design written proposal, final report and oral presentations in ECCS 406.

Fig. 2. Example of program outcome and corresponding metrics.

comments received from students are of dubious quality, or are directed in some way toward the instructor, there are other comments regarding course content and organization that are worthy of being shared. This section of the FCAR allows an instructor to publicly document and share these constructive comments from the students concerning the course. By sharing this information, the student comments regarding the course now reach a wider audience, increasing the likelihood that these comments will find their way into an action plan for improving the course content. In order to streamline this section of the report, it is best to provide a synopsis of the course evaluation form feedback as it relates to the course, and leave out all comments that relate to the instructor. If one's institution does not utilize student course evaluations, or if the evaluations are not returned in a timely fashion, then this section can be removed without causing harm to the overall assessment process.

8) **Reflection.** The primary purpose of this section is to promote self-awareness on the part of the instructor. Given that the goal of assessment is to improve the program, it is imperative on the part of the instructor to keep an open mind while looking at the results so that shortcomings can be identified and corrected. Reflection is placed near the end of the report in order to utilize the human factors concept that the best way to ask someone to perform a task is to take into account how a person normally does things; one performs reflection best after having reviewed all of the evidence, such as the description of the course, the grade distribution, changes made to the course, various performance vectors, and student feedback. The reflection section also provides the instructor the opportunity to document impressions regarding the effectiveness of instruction, extenuating circumstances that might have affected student performance, or items that fall outside the scope of the current set of course and program outcomes. For example, an ice storm causing the cancellation of classes for a week (which happened at the author's institution) may disrupt the presentation of some concepts and prevent the presentation of others; mention of such an event can provide contemporaneous documentation as to why the corresponding outcomes were not met. Having the opportunity for reflection on the part of the instructor is very beneficial for the improvement of both course and program, as well as for the improvement of the instructional methods used by the instructor. From an assessment standpoint, it allows for the documentation of those things that are not easily measurable, if at all, and of things that are measurable but not encapsulated into the current set of course or program outcomes.

9) **Proposed Actions for Improvement.** The specification of proposed actions for course and/or program improvement begins the closing the loop process, as these items constitute the result

of the instructor's evaluation of the effectiveness of the course via outcomes assessment, student feedback, and reflection. There are no restrictions as to what can be proposed; it could be as simple as a note to include material on a certain subject in an assignment the next time the course is taught, or a recommendation to the curriculum committee to create a new course to better deal with some of the subject material. Whatever suggestions are recorded by the instructor, it is essential that the appropriate parties in the department review these suggestions; to that end, it is desirable to incorporate the review of FCAR documents into the overall continuous improvement process as a regularly scheduled activity.

USING PERFORMANCE VECTORS IN OUTCOMES ASSESSMENT

Under the FCAR methodology, a program develops its set of program outcomes, in support of the program educational objectives, that they expect their students to be able to achieve by the time of graduation. Metrics are defined to provide specific, measurable statements identifying the various performance attributes required to determine to what degree students have achieved the outcomes. Figure 2 provides an example of a program outcome, the corresponding ABET Engineering Accreditation Commission's Criterion 3 outcomes that complement the program outcome, and the metrics that measure the results. Please note that the exact format used regarding the incorporation of the Criterion 3 outcomes depends on the current viewpoint expressed by the Commission that supervises the program in question. At the time of this writing, the author is dealing with two ABET Commissions for the accreditation of the three programs within his department. One Commission currently states that it is acceptable to adopt the Criterion 3 outcomes "as is" or you can use own definitions; however, when the program is visited, the program evaluator must be presented with clear evidence of documented, measurable compliance with the Criterion 3 outcomes. The other Commission insists that the program must develop its own program outcomes, making sure that a simple "matrix checkbox" correlation exists between those outcomes and those listed in Criterion 3. The methodology shown here is the simplest way to satisfy both groups by using one common approach.

Instructors are provided with two types of documents at the beginning of the academic year. The first is the Assessment Plan where the current program outcomes and corresponding metrics are listed. However, while this document provides a mapping of a list of courses for each metric, it does not provide concise information as to what metrics are to be measured in a particular course. To address this potential problem, a correlation matrix showing the relationship between courses and metrics is also distributed. An example of such a correlation matrix, as implemented in an Excel spreadsheet, is presented in Fig. 3. The rows of this matrix constitute the required courses in the curriculum, the course is identified by both its name and its subject code and number combination appearing in the appropriate columns. The "When" column is used to specify the nominal time that the course is offered in the curriculum. Data are of the form *year.term* where the year values are 1 for the first year in the curriculum, 2 for the second year, and so on. The term values are 1 for the first term in that academic year, 2 for the second, and 3 for the third; this allows the term specification to be used under either the quarter or semester system. By organizing the course entries by when they are normally taught in the curriculum, it is easier to visualize when the various program outcomes are being covered. The

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1	**Computer Engineering 2006-2007**				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
2	**Name**	**Course**	**When**	**Who**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**4**	**4**	**4**	**4**	**5**	**5**	**5**	**5**	**5**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	
3					**a**	**a**	**a**	**e**	**e**	**k**	**k**	**k**	**8**	**8**	**c**	**c**	**c**	**d**	**d**	**d**	**d**	**g**	**g**	**g**	**b**	**b**	**g**	**g**	**i**	**i**	**i**	**j**	**j**	**f**	**f**	**f**	**h**	**h**	**h**	**h**	
4					**1**	**2**	**3**	**1**	**2**	**1**	**2**	**3**	**1**	**2**	**1**	**2**	**3**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**1**	**2**	**1**	**2**	**1**	**2**	**3**	**1**	**2**	**1**	**2**	**3**	**1**	**2**	**3**	**4**		
5	Programming 1	ECCS 164	1.1	WC							X																														1
6	Freshman Enrichment	GE 100	1.1	DH																														X							1
7	Freshman Engineering 1	GE 104	1.1	JE					X				X												X	X	X					X		X					X	8
8	Programming 2	ECCS 165	1.2	WC				X							X																										2
9	Freshman Engineering 2	GE 105	1.2	LT		X				X																															2
10	Programming 3	ECCS 166	1.3	JE		X										X													X												3
11	Freshman Engineering 3	GE 106	1.3	JE													X			X		X	X					X	X									X			7
12	Circuits 1	GE 201	2.1	KA		X																																			1
13	Data Str. & Algorithms 1	ECCS 268	2.2	JL		X			X					X															X												4
14	Circuits 2	GE 202	2.2	KA			X			X	X														X	X															5
15	Digital Electronics	ECCS 261	2.3	SV							X			X											X																	3
16	Data Str. & Algorithms 2	ECCS 269	2.3	JL			X	X						X																											3
17	Signals & Systems 1	ECCS 314	3.1	DH		X				X																			X												3
18	Analog Electronics 1	ECCS 321	3.1	LT				X														X						X													3
19	Microprocessors	ECCS 362	3.1	SV							X		X			X											X		X			X					X				7
20	Comp. Architecture	ECCS 365	3.2	SV			X		X																		X														3
21	Networks & Data Comm.	ECCS 366	3.3	DR										X																											1
22	Operating Systems	ECCS 466	3.3	WC			X						X	X	X																										4
23	Adv. Digital Electronics	ECCS 363	4.1	SV						X																X												X			3
24	Senior Design Seminar	ECCS 404	4.1	JH								X					X	X	X		X	X	X							X							X		X	10
25	Senior Design	ECCS 405	4.2	JE					X							X		X	X																						4
26	DSP	ECCS 411	4.2	LT		X				X					X					X		X			X		X				X										8
27	Embedded Comp. Sys.	ECCS 465	4.2	SV			X	X															X					X	X			X									6
28	Engineering Economy	ECCS 472	4.2	DH																								X										X			2
29	Eng. Technical Comm.	ECCS 406	4.3	JH														X	X			X	X	X										X							6
30	Software Engineering	ECCS 464	4.3	DR				X	X					X						X																		X				4
31						6	5	5	5	5	4	1	3	6	3	3	2	3	3	3	1	5	4	1	4	3	4	4	6	1		4		3			1	4		2	104

Fig. 3. Excel spreadsheet containing correlation matrix between courses and metrics.

"Who" column contains the initials of either the instructor of record for the course or the course coordinator if multiple instructors are involved; this is used to indicate who is responsible for submitting the FCAR document for that course. The remaining columns, except for the last, constitute the list of metrics. The metrics are organized by program outcomes, with background color being used in alternate ABET outcomes to better help the visualization of each outcome and its metrics. Note that some columns are grayed out; this is because these particular metrics do not utilize FCAR results but other sources of information, such as results from the Fundamentals of Engineering (FE) Exam, and so there is no course correlation. These non-FCAR metrics are included for the purpose of showing a complete representation of this portion of the assessment process. The correlation between a metric and a course is indicated by the appearance of an 'X' in the appropriate cell. Separate counts, located in both the final column and final row of the spreadsheet, are made for both the number of courses that information for a particular metric is being collected and for the number of components that a particular course has to report. As assessment is an iterative process, these individual totals can be considered when reviewing the evaluation results. If things are going well for a particular outcome, a program could choose to reduce the number of measurements; conversely, paying attention to the total number of components to be reported by a particular course can be critical in making sure that the assessment workload is fairly distributed amongst the faculty.

When an FCAR document is submitted, the assessment coordinator enters all of the reported performance vectors into a spreadsheet or database, this information is then organized into tables presenting the set of component-based performance vectors for each metric. A copy of the Assessment Plan can then be edited and, by inserting the vector tables into the appropriate locations, one creates the framework for the Evaluation Report. The evaluation of program outcomes can now be quickly processed by a simple inspection of the tables. Figure 4 provides an example of a metric and its accompanying table of performance vectors. An interpretation of the table can be conducted by observing which performance indicator level is dominant in a particular EAMU performance vector. If the "U" (unsatisfactory) level dominates, then this reflects a shortcoming that definitely needs to be examined. As an example, in Fig. 4 the EAMU vector for GE 106 shows U-level dominance as 45% of the students performed at an unsatisfactory level. If the "M" (minimal) level dominates, then there might be a need, based on the measures reported for the other levels, for further investigation, but does not necessarily indicate an actual shortcoming. For example, the vector for ECCS 404 demonstrates M-level dominance, but all of the students are performing at a minimal level or better. While this can be cause for concern and therefore serve as a reason for taking an action, as no one is performing at an unsatisfactory level it does not necessarily require that action be taken. The ideal performance is achieved when the "A" (adequate) level dominates, an example of which is shown in the performance vector reported for ECCS 406. This statement may surprise some readers, as being rated in the top category is generally considered to be the best. However, take as an example the performance vector given for ECCS 411, where the "E" (excellent) level significantly dominates. Just as U-level dominance gives cause for concern that one's students are not meeting the performance standards, an excessive amount of E-level dominance in an EAMU vector should serve as an indicator that the performance standards for the associated assignments might not have been set high enough to properly challenge the students. In the traditional evaluation of assessment data, feedback mechanisms are triggered only by student underperformance. With the FCAR performance vector approach, an additional feedback mechanism is established for recommending that the standards be raised due to student overperformance, which is a unique feature of this approach to program outcomes assessment.

Evaluation of the level to which students are meeting the attributes specified by the metric is conducted through an examination of all of the reported performance vectors. A quick glance is all that it takes to determine if everything is going

Metric 3-g-1: Students will work together to demonstrate effective communication of information, concepts and ideas in writing as documented in technical reports written in GE 106, ECCS 321 and ECCS 411, Senior Design project written proposal evaluation in ECCS 404, and Senior Design final written report evaluation in ECCS 406.

Course	E	A	M	U	%E	%A	%M	%U
GE 106	8	1	2	9	40%	5%	10%	45%
ECCS 321	27	12	5	3	57%	26%	11%	6%
ECCS 404	5	5	10	0	25%	25%	50%	0%
ECCS 406	6	12	2	0	30%	60%	10%	0%
ECCS 411	48	2	0	0	96%	4%	0%	0%

Fig. 4. Example performance vector table for a metric.

Metric 3-g-1: Students will work together to demonstrate effective communication of information, concepts and ideas in writing as documented in technical reports written in GE 106, ECCS 321 and ECCS 411, Senior Design project written proposal evaluation in ECCS 404, and Senior Design final written report evaluation in ECCS 406.

Course	E	A	M	U	%E	%A	%M	%U
GE 106	8	1	2	9	40%	5%	10%	45%
ECCS 321	27	12	5	3	57%	26%	11%	6%
ECCS 404	5	5	10	0	25%	25%	50%	0%
ECCS 406	6	12	2	0	30%	60%	10%	0%
ECCS 411	48	2	0	0	96%	4%	0%	0%

Discussion: FCAR for GE 106 indicated that U-level dominance for this component was caused by a failure to follow the specified format in the book for the technical article review. Instructor indicated in her reflection that she felt that about two-thirds of the class did not purchase the textbook. FCAR for ECCS 411 indicated satisfactory performance with this component; however, based upon the description of the assignment in the FCAR and a subsequent examination of the assignment in the course repository file, the committee believes that the assignment did not adequately test the abilities of a typical senior-level student.

Actions: GE 106 FCAR indicates that the instructor has plans in place to better utilize the textbook next time; no further action is needed. It was noted that this was the first time that the person teaching ECCS 411 has been an instructor for that course; a memo will be sent to him suggesting ways to improve his assignment so that it better challenges the students in his class the next time it is used.

Fig. 5. Example evaluation showing discussion and actions.

well, which greatly simplifies the task of those performing the evaluation. If one or more EAMU performance vectors indicate non-compliance, then a discussion takes place to determine the overall significance of those vectors when compared to the whole. If necessary, one can refer back to the associated FCAR document for additional information; an examination of the component in question, along with the reflection and improvement sections, provides appropriate background information that can be use by the evaluation committee to both understand the nature of the non-compliance and to potentially adopt appropriate solutions that have already been considered and specified. The evaluation of EPAN performance vectors is handled differently, as in these cases the ideal is a demonstration over time of the growth of a cohort from novices to practitioners. When completed, a summary of the discussion of the performance vectors and any resultant actions are then added to the Evaluation Report, as shown in Fig. 5.

At this point, the faculty are provided with a copy of the Evaluation Report, who then use the recommendations, if applicable, to implement improvements into their respective courses for the next time that they are offered.

OBSERVATIONS

The FCAR methodology was developed starting in the 2001–02 academic year, and has been refined over subsequent years into its current format. The methodology was first shared with the assessment community at large as a 50-minute presentation at the Best Assessment Processes (BAP) V Symposium, held in April 2003 at the Rose-Hulman Institute of Technology. It has been subsequently brought back as an invited presentation at the BAP VI, VII, VIII, and IX Symposia, and is currently offered as a three-hour interactive workshop. Over the years, many have attended this presentation/workshop and have implemented this methodology in their program at their respective institutions. Sufficient time has passed for the process to have matured at both the author's institution as well as at other institutions that have adopted this methodology.

A clearer picture as to the advantages and disadvantages of a system is best presented by those who have implemented, as opposed to invented, that system. The Department of Computer Science & Software Engineering at Southern Polytechnic State University (SPSU), located in Marietta, Georgia, was an early adopter of the FCAR methodology, with a representative from that department having attended the author's presentation at the BAP VI Symposium in March, 2004. Their training documents for this methodology, developed as a PowerPoint presentation by Morrision [4], include an impartial analysis of the process. The main disadvantage listed specific to the methodology was that "it's hard the first time." This is to be expected, as there is a considerable amount of infrastructure to be implemented. However, it was also noted on the next slide that it is "much easier the *n*th time." Essentially, the actual FCAR document for a course constitutes a template that, once created, needs no changes in the overall reporting structure and at best minor changes (such as the addition or removal of a component or outcome) in what items are reported. Accordingly, at the end of a term the instructor can simply make a copy of the previous

FCAR for the course, remove the data specific to the previous offering, and then insert the data specific to the current offering. The other major caveat appears in a paper by Dasigi [5], who is also a faculty member at SPSU, where it is mentioned that there is a need for an initial training phase as, "without such training and standardization, faculty members could produce FCARs that are inconsistent with each other and fail in their intended purpose." This has also been the author's observation as well. Occasional internet searches have discovered programs that have adopted the FCAR methodology and placed the resultant documents out on the web. In some cases, the instructor for a course mimicked the example FCAR document in the printed BAP documentation, but did not tailor the FCAR for the specific components to be measured in that course. A component should be listed for a course only when specifically instructed to do so as part of an assessment plan, the exception only being when the instructor believes that there is something additional that needs to be reported. The use of a well-designed training session plus a proactive review of the FCAR documents as they are submitted has been found to be the best approach for dealing with misconceptions regarding what is to be reported for a particular course and how the collected information is to be reported. When reviewing, one simply annotates the document, and then reviews it with the instructor so that a corrected version can be submitted. This has also been found to be an effective method in improving the consistency of the reports.

The advantages listed in the aforementioned PowerPoint presentation support the claims made in this paper. Morrison stated that the FCAR methodology "provides documentation of the modifications made to the program at the course level," it "contains recommendations for course improvements," and while there is a minor increase in instructor workload, there is a "major reduction in assessment workload" as one is "dealing with processed information instead of raw data." Additional support was found in a paper by Maxim [6], where he describes the implementation of an FCAR-based assessment plan at his institution. One of the conclusions he reported was that the "faculty finds it a little burdensome to complete the course report forms prior to the start of the next semester, " however, he then goes on to state that the subsequent discussions by the faculty over the submitted FCAR documents have been "lively" and that the faculty "generally feels that the process is a worthwhile use of their time." In another paper written by a member of the SPSU faculty, Thomas [7] reported that her faculty "found the FCAR to be an effective documentation tool" for the assessment process as it provided documentation of both "the modification made to the program at the course level and contained recommendations for future course improvements." It can be argued that, from an accreditation visit standpoint, the ability to provide concise, contemporaneous documentation of the closing the loop process is perhaps the strongest asset of the FCAR methodology, as it is normally the case that, while the proposal for change is often documented, the implementation of that change usually is not. Dasigi refers in his paper to the presence of the modifications made to course and proposed actions for improvement sections as a "significant benefit" because of how it makes the closing the loop process "remarkably well-documented." Thomas additionally pointed out that the FCAR methodology accomplishes the closing the loop process at three different levels. For the instructor, the act of inspection and reflection allows for the development of ideas for future offerings of the course. At the course level, it provides clear documentation of what occurred. Finally, at the program level, the review of the FCAR documentation provides insight into possible action items for the curriculum.

Additional support was found in a paper by Duggins [8], who serves as the ABET coordinator in her department at SPSU. Her paper states that the FCAR methodology "played a very important role in our evaluation and assessment process." Among the benefits specified were the standardized format, the ease of performing program-level assessment, the ability to give immediate feedback to the next instructor of a particular course which facilitates the continuous improvement process at the course level, and that it keeps faculty "actively engaged in and focused on assessment and evaluation as part of an on-going continuous process." This last point is reinforced in Dasigi's paper, where he notes that the implementation effort is "truly distributed among all faculty teaching the courses." As a consequence, it represents a "true grass-roots level approach" where the involvement of the entire faculty "makes the process more robust, adds a sense of community, and helps evolve the instrument for the better." One example of a different form of evolution of the FCAR approach is found in a paper by Beheshti, Nelson, Billis, and Drossman [9]. They mention early on that the FCAR methodology constitutes "an effective tool for direct assessment of course and program outcomes." Their observation that FCAR documents are, in essence, worksheets led them to utilize the FCAR philosophy as the fundamental component of a "ground up development" of an "automated version" of the FCAR document through implementation as an Excel spreadsheet. All of the elements of a FCAR document as given in this paper are present in the spreadsheet. The benefit of their approach is that each instructor, through the act of entering the various elements of the report in specific cells of a spreadsheet, is expediting the data entry process, as these values can now be directly accessed by a master spreadsheet containing the metrics for program outcomes assessment. The authors concluded that their FCAR implementation was

"deemed to be a good start" in the development of their own customized assessment methodology.

CONCLUSIONS

In Morrison's FCAR methodology training slides, she poses the following question as the title of one of her finishing slides: "is it worth it?" The first bullet point presented on that slide provides the following answer: "I know of no other technique that yields as much information (qualitative and quantitative) by spreading the workload among those directly responsible for the data." The FCAR methodology has been successfully implemented at not only the author's institution, but at other institutions as well, primarily because the methodology addresses many of the needs of both the assessment and the accreditation processes. Through the standardization and augmentation of the structure for a course outcomes assessment report, plus the establishment of a process that utilizes the features of this report, an effective and streamlined mechanism where the workload is distributed across the faculty has been developed. The person closest to the data—the course instructor—processes that data into concise pieces of useful information. In addition to the reporting of directly measured quantitative assessment data, the ability to present one's reflections of the course allows for the contemporaneous documentation of qualitative assessment data. Collectively, this information is used by the instructor to suggest future improvements for both course and program as part of the continuous improvement process. The information presented in the FCAR documents can be easily datamined, organized into tables, and then presented in an evaluation report from which an assessment committee can review the results and specify appropriate modifications to course or curriculum. Finally, when these improvements are implemented in a course, the FCAR document provides clear evidence of this occurrence. The FCAR methodology has proven itself to be an effective mechanism at organizing, streamlining, and evaluating the information necessary for a successful implementation of the continuous improvement process.

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