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Direct Assessment Without Tears

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Direct Assessment Without Tears: Using Canvas LMS to Support Direct Assessment of a Software Engineering Program

Abstract

This paper describes the development and implementation of a direct assessment system leveraging the Canvas™ Learning Management System (LMS) for a Software Engineering program designed for ABET accreditation. This assessment process has been designed to support two levels of continuous improvement: 1) guiding student formation (focused on first and second year courses), and 2) formative program assessment (focused on third and fourth year courses). Courses required of the program contribute direct assessment data at the end of the semester, typically 1-3 'key assignments' are collected and assessed against relevant program performance indicators. Faculty use Canvas™ LMS rubrics for assessing program performance indicators, both selecting the assignment and related indicators, and assessing student work. Data pertaining to student performance at both levels are collected, disambiguated, analyzed, and reviewed at the end of every semester. This paper presents the data collection and analysis process, an illustration of these processes with data from three semester-cycles of evaluation, and a description of how they support continuous improvement of a software engineering program.

Introduction

Program assessment to support continuous improvement (CI) is a requirement for ABET accreditation of engineering and computing programs in the United States. Engineering programs, such as software engineering, are governed by the Engineering Accreditation Commission (EAC) [1], while the Computing Accreditation Commission (CAC) rules apply to computing programs such as Computer Science. These commissions define broad sets of student learning outcomes that programs are required to assess and use for the CI of the academic program. Direct assessment requires that the program quality is assessed by examining student artifacts to see how well the program is meeting its student learning objectives [2][3]. While the CI requirements from ABET permit a large variation in the number and frequency of assessed work, the emphasis is on collecting and using assessment information on a regular basis for program improvement [1]. Even though the minimum requirements are to evaluate courses that span the set of student learning objectives for program graduates, many programs also assess earlier, or even most courses, as a means of assessing and improving student learning throughout the course of the degree program [4].

One of the difficulties with program assessment is the effort involved in the collection and analysis of information suitable for informing program improvement [3][4][5][6][7]. Direct assessment requires the collection of statistically significant samples of relevant student work, and assessing the work by one or more domain experts able to judge the work under review in the context of the program (student) learning objectives [4][7]. This work is often over and above the work of instruction and the formative or summative assessments of student learning, as their focus is not on student performance with the course learning objectives, but rather with the assessment of program effectiveness [4]. Improving the program requires looking for information showing where the current methods (e.g., courses, content, teaching approaches) could stand improvement, and direct assessment asks for this information to be rooted in student work. This requires someone with enough knowledge to select and examine student work that sheds light on student performance in the program. This examination comes at a cost, since every evaluation of student work not directly connected to student performance (which is problematic for effective program assessment) requires effort, time, resources, and infrastructure. The higher the evaluation effort/cost, the less likely a program is able to sustain the effort [8]. Hence, effectiveness of the program's CI depends on balancing the cost of assessment against the its effectiveness in enabling CI. The more assessment, the more detail, the higher the cost [4][5].

Necessary Precursor Work: Establishing an Assessment Process

Systematic assessment requires sustainable processes integrated with the delivery of the programs being assessed [4]. At Franciscan University of Steubenville (FUS), the Department of Engineering and Computing (E&C) supports three majors designed to meet ABET accreditation standards: Software Engineering (SFE), Mechanical Engineering (MEC), and Computer Science (CSC). It also supports a two-year Pre-Engineering (PREG) program, where students do their first three years at our institution and then complete their degree at a larger partner university. SFE and MEC are new programs, and at the time of writing just completed their first ABET EAC self-study and visit. While this paper focuses on the SFE program, the Canvas-supported assessment process and tools described herein are used for all programs in the E&C Department, and they support both university-required assessment and ABET CI requirements.

Since the engineering programs (including SFE) were new to FUS, there was a need for the department to develop systematic program assessment, which is required for ABET programs [1]. Thus, developing an assessment process and supporting tools that met faculty needs was critical to the programs' success. For new and established faculty with no history of program-level assessment, the desire was for assessment that supported student success; however, the truth that the more assessment, the more detail, the higher the cost meant that a 'sweet spot' in the tradeoff in assessment fidelity vs. value for program improvement was very much needed.

Finding a Sweet Spot

The E&C Department's program assessment is a faculty-driven exercise that targets multiple opportunities at a lower level of detail, with the aim (quality attribute) of permitting faculty insight into lower-level and upper-level student performance in the programs. The faculty agreement to these goals informed the assessment program design. In general, the design of a direct assessment process should enable faculty to continuously have a stake in the information generated and be able to determine if more or less fidelity is needed.

First, it was decided that the assessment approach should be continuous (e.g., once per semester) so as to better be able to adjust to the changing (and often different) needs of the different student cohorts (e.g., first- and second-year students). With program assessment reviews on a once-per-semester basis, the next design points were to determine the breadth and depth of assessment instruments. In this case, a broad approach (e.g., most courses, all faculty) with a low depth (e.g., simple rubric instrument) was established. Hence a lower-cost direct assessment effort distributed widely across the program was preferred in order to support two levels of CI: guiding student formation (focused on first and second year courses), and summative program assessment (focused on third and fourth year courses). As described in Figure 1, the quality attributes (design goals) elicited and agreed upon for the assessment framework were determined to be informative, easy-to-use, and more frequent.

1. *Informative:* Supporting formative and summative program evaluation; hence a broad use in most (all) courses.
2. *Easy-to-Use:* As automated as possible, easy to apply, easy to remember, easy to reuse.
3. *More Frequent:* Review twice per year; easy to correct mistakes, forgiving of missed or partial results.

Figure 1. Department Assessment Goals

From this framework, a set of annual 'Continuous Improvement (CI)' steps outline the effort involved. The faculty meet in the Spring semester to review direct assessment results from the previous semester, and in Summer or Fall to review the annual rollup which also includes indirect assessment data. Figure 2 shows the typical cadence of assessment and improvement efforts during a typical academic year.

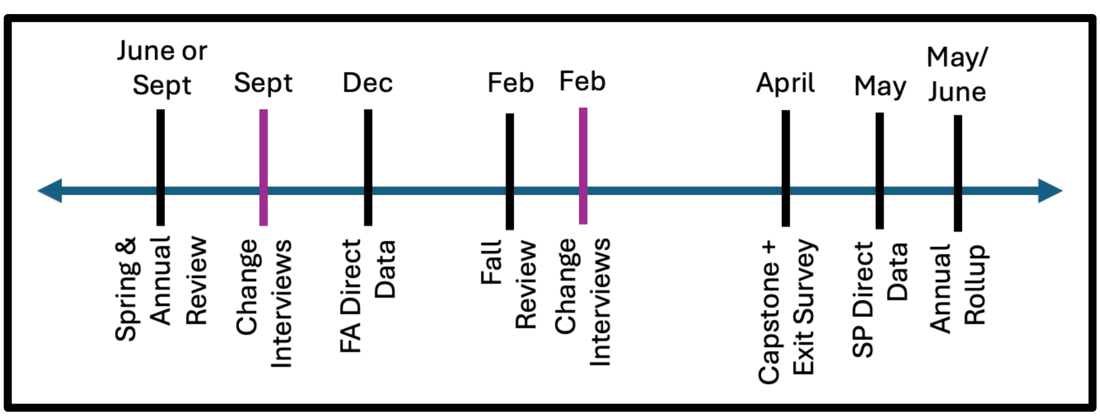

Figure 2. Annual SFE Assessment and Continuous Improvement (CI) Activities

At the review and rollup meetings, broader program changes (and assessment process improvements) are discussed and/or planned. Each faculty member determines individual course improvements based on their experience of their courses, and feedback from students and program evaluation findings. These change plans and results are collected and documented twice per year at a change interview, which is a series of meetings with the department assessment coordinator. During these interviews, faculty record (or update) planned changes and document the results of previous changes. These 'frequent' meetings are also opportunities for faculty to see their contributions as well as to improve the assessment system, identify missed assessment opportunities, and continue to streamline the process.

Data pertaining to student performance at the two levels are reviewed at the end of every semester. A key aspect of direct assessment is that the student work examined contributes to the assessment of the program's effectiveness. The department's approach is to distribute this responsibility to the faculty of record (instructor) who selects an assignment in which they can assess a subset of program outcomes in the student work collected in that particular course. Courses required of the program are asked to contribute direct assessment data at the end of the semester via one to three 'key assignments' which are assessed against relevant performance indicators using institutional Canvas™ LMS rubrics.

Performance Indicators (PIs)

Program assessment is centered around the assessment of performance indicators (PIs) that the department has developed for assessing the program's Student Learning Outcomes (SLOs). Currently, there are 30 department-wide PIs designed to provide 3-5 assessable touch points wherein aspects of one (or more) SLOs can be seen in student work.

Table I presents the 2025 mapping of the eight SLOs to the 30 PIs that form the operational definition for the engineering SLOs.

Table I. SLO Mapping to Department Performance Indicators

Student Learning Outcome	Performance Indicator	Description
Engineering Problem Solving an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics. (EAC-1)	EAC-1-1 Problem Definition	Appropriate exploration and identification of problems
	EAC-1-2 Problem Formulation	Appropriate specification of objectives and constraints
	EAC-1-3 Creative ideation	Creatively connects problems and opportunities for solutions
	EAC-1-4 Application of Engr, Math & Sci Principles	Applies engineering, math or science principle(s)
	EAC-1-5 Analysis and Implementation	Demonstrates analysis and implementation of models, design and/or code.
Design Solutions an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. (EAC-2)	EAC-2-1 Engineering Design	Application of engineering fundamentals in conception, design, implementation and operation in the development of deliverable, product, process
	EAC-2-2 Creative ideation	Creatively connects problems and opportunities for solutions
	EAC-2-3 Wider impacts	Demonstrates consideration of the impacts of a deliverable, product, or process
	EAC-2-4 Analysis and Implementation	Demonstrates analysis and implementation of models, design and/or code
	EAC-2-5 Quality Management	Employs techniques to drive quality into the project deliverables
Communicate Effectively an ability to communicate effectively with a range of audiences. (EAC-3)	EAC-3-1 Oral Communication	Effective oral communication with a range of audiences
	EAC-3-2 Written Communication	Effective written communication with a range of audiences
	EAC-3-3 Communication Technology	Effective use of communication technology for a range of audiences

Engineering Ethics an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts. (EAC-4)	EAC-4-1 Ethical Responsibilities	Recognize ethical responsibilities in engineering situations
	EAC-4-2 Professional responsibilities	Recognize professional responsibilities in engineering situations
	EAC-4-3 Engineering Judgment	Formulate and make informed engineering judgments
	EAC-4-4 Global, economic, environmental, and societal impact	Consider the impact of engineering solutions in global, economic, environmental, and societal contexts
Project Teamwork an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives. (EAC-5)	EAC-5-1 Role Management	Take on and manage different team roles
	Commitment	Responsibility, initiative, conscientiousness, commitment
	EAC-5-2 Team Communication	Process for communication among team members that allows for efficient and open information sharing
	EAC-5-3 Leadership & Collaboration	Engaged contributor; effective collaboration
Experimentation, Analysis and Judgement an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions. (EAC-6)	EAC-6-1 Experimentation	Develop and conduct useful experimentation
	EAC-6-2 Analyze and interpret data	Designs experiments/tests to produce useful data
	EAC-6-3 Engineering judgment	Appropriately frames quality of performance
Acquire New Knowledge an ability to acquire and apply new knowledge as needed, using appropriate learning strategies. (EAC-7)	EAC-7-1 Need for knowledge	Analysis to connect data to the design goals/quality
	EAC-7-2 Knowledge sources	Develop and use engineering judgment
	EAC-7-3 New knowledge/ technology	Recognize/act need for new/better knowledge
Connect Engineering to Catholic Tradition an ability to apply Catholic ethical principles guided by virtue to questions in industry and of technology development. (FUS-8)	EAC-8-1 Share Catholic Position	Find and appraise knowledge and its sources
	EAC-8-2 Integrates Faith & Reason	Effectively implement/use new knowledge/ technology
	EAC-8-3 Catholic Ethical Principles	Demonstrate ability to interpret or illustrate the integration of truth in the development of technology

Using PIs for Direct Assessment Within Courses

The PIs operationalize the program SLOs; that is, they identify a means by which an SLO can be observed within student work and consequently assessed. Thus, they are authored in such a way as to support a standard rubric (e.g., a means by which each PI is intended to be observed through student work in individual courses). The same PIs inform indirect assessment (e.g., program exit surveys given to students in their senior year) and faculty assessment of student capstone projects.

While this later data is compiled at the end of each year, course-level direct assessment and review occurs at the end of each semester (as described above; Figure 2). As the assessment and CI processes are designed to inform the progress of students through the program from freshman to senior level, faculty use a five-valued rubric (Figure 3) designed to support the evaluation of student work (i.e., the key assignment) submitted in a course.

Score		Label	Expected Performance
0	=	Not observed	
1	=	Novice	Not up to sophomore standards
2	=	Developing	Good sophomore
3	=	Satisfactory	Good senior or junior undergraduate
4	=	Excellent	Exceeds upper-division expectations (e.g., someone already out in the workforce)

Figure 3. Five-Valued Assessment Rubric

The rubric is intended to be easy to remember and used for assessing student work for program evaluation (not grades). The scaling presented in Figure 3 is based on the upper numbers, where 'Satisfactory' (3) indicates performance/mastery as expected of a good senior or junior undergraduate. 'Excellent' (4) is reserved for a student's performance/mastery that is better than what is expected of a good upper-division student (e.g., someone already out in the workforce). 'Developing' (2) is reserved for lower-division student expectations, with "Novice" (1) indicating that the observed performance was below that expected of a good sophomore student.

The values are set so that a consistent rating can be learned and used to help distinguish student work into four categories, with the goal of helping to distinguish the introductory/developing student performance expected of the first two years of undergraduate work from that expected of upper classmen. Similarly, it is framed so that the PI competency that is above, at, or below expectations can be easily distinguished. This style of rubric is easy to remember and differs from other published systems that use detailed assignment rubrics [6] to support assessment.

Canvas™ LMS Integration

Courses required of the program contribute direct assessment data at the end of each semester, via key assignments which are assessed against relevant PIs. Similar to other programs [2][3][5][6], the Canvas™ LMS provided a number of advantages for achieving the second design goal, particularly for automation, data collection, and easy reuse.

Through Canvas™, every course in the program is eligible and (per the first design goal) requested to contribute to program assessment. This is simplified by the integration of the direct assessment mechanisms into the LMS leveraging the "Institutional Outcome" and "Rubric" features. While this requires some effort to set up programmatically and for the faculty to set up for the first time, once established in a course shell it is quite easy to reuse and modify the selected program assessment rubrics. The instructions for how the PI-generated outcomes and associated rubrics are integrated into a particular course, and assignments are shared each semester with faculty. The assessment coordinator also offers individual guidance to help faculty select assignments and PI rubrics. As the PI rubrics are prebuilt, Canvas™ provides standard 'Outcomes' features for integrating these rubrics into a course shell.

The 'Outcomes' feature of Canvas™ allows instructors to import the PI rubrics into their class and connect them to assignments. Once a set of PIs is imported into the course, each of these rubrics is available to be associated with one or more assignments; the combination of an SLO Outcome Rubric (e.g., the 5-Value Rubric in Figure 3) with an assignment becomes a single assessment instrument. Faculty may select any number of assignments for assessment, but the norm is to select 1-3 representative assignments that represent summative work toward the course learning outcomes. Any assignment identified for program assessment is considered a 'key assignment', as it is evaluated twice: once for a course grade and once for program assessment (instrument use). These 'key assignments' are essentially used as "Targeted Assessments" [7]. This secondary assessment (i.e., application of the PI rubrics) can happen during the course or immediately following the course.

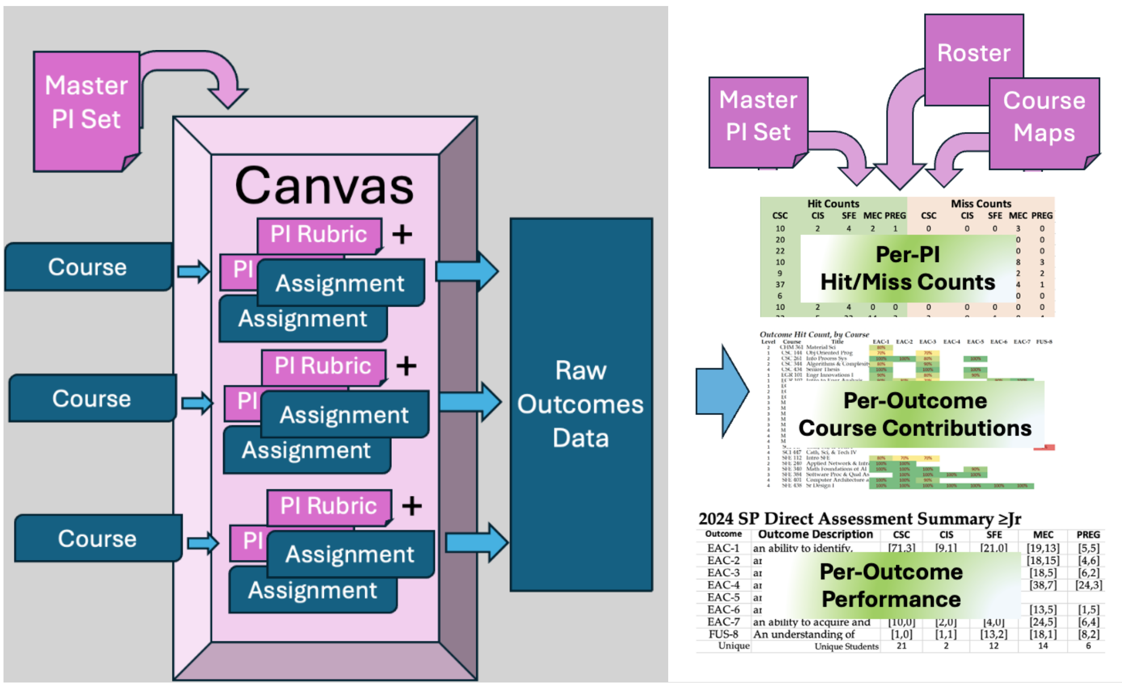

Figure 4. Direct Assessment Summary

Figure 4 presents an overview of the direct assessment process, and the integration of Canvas™ as the central point of data collection from individual courses. The key advantage of using the Canvas™ LMS 'Outcomes' feature is the relatively clean data that is generated, which is discussed in the analysis section below.

Connecting Direct Assessment Data to Program Effectiveness

Courses provide data through one or more assignments with one or more associated PI rubrics. The raw outcomes data is extracted from Canvas™, and then matched against department rosters, program course maps, and the department PI set to form various reports that support the SFE program direct assessment process. This ensures that data associated with students currently in the program are used to inform the CI process.

Canvas™ provides a very clear and consistent formatting of its output data. For each PI rated in each assignment, reports on institutional outcomes provide a single record noting both the course, student ID, PI, and rating. Figure 5 shows a sample data set showing nine entries from several Fall 2025 SFE courses.

student sis id	assessment title	learning outcome name	outcome id	outcome score	course name
2abcd94	Individual Reflections	EAC-1-1: Problem definition	238	3	Requirements Analysis
2abcd94	Project Presentation	EAC-1-3: Creative ideation	240	3	Requirements Analysis
2abcd94	Individual Reflections	EAC-4-2: Professional responsibilities	245	3	Requirements Analysis
2abcd94	FTR Reflection	EAC-5-3: Team Communication	246	3	Requirements Analysis
2abcd94	Quiz 5	EAC-1-4: Application of Engr, Math & Sci Principles	249	4	Mathematical Foundations AI and ML
2qrst56	Quiz 5	EAC-1-4: Application of Engr, Math & Sci Principles	249	2	Mathematical Foundations AI and ML
2abcd94	Project Presentation	EAC-3-1: Oral Communication	241	4	Cybersecurity III: Sftwr & Security
2abcd94	Project Report	EAC-3-2: Written Communication	242	4	Cybersecurity III: Sftwr & Security
2abcd94	Project Presentation	EAC-2-1: Engineering Design	251	4	Cybersecurity III: Sftwr & Security
2qrst56	Final Robotics Memo-Assessment	EAC-6-2: Analyze and Interpret Data	260	2	Engineering Analysis
2qrst56	Mythical Man Month Report I	EAC-3-2: Written Communication	242	2	Intro to Software Engineering

Figure 5. Sample Fall 2025 Raw Data from the Use of PI Outcome Rubrics

The data generated provides one data element per assessment score, uniquely associated with a student and a course. With potentially thousands of data points, these can be quickly summarized and shared with faculty to help avoid unexpected missing data. The value of the report is not in the raw data, but rather the analyses evaluating student performance which subsequently informs the program as whole. One of the more critical aspects, circled in Figure 5, is the "student sis id" field, which uniquely identifies the student within the University. This allows for the disambiguation needed when evaluating student data vis-à-vis programs (e.g., SFE, MEC, CSC).

Evaluating Student Performance

Using the outcomes-based rubrics feature in Canvas™ allows for the data from each course to be easily compiled. By using the list features of Excel 365, this data can be disambiguated and analyzed to provide useful reports on direct evaluations of student performance. In this case, performance (e.g., "Meets Expectations" field in Figure 6) is judged by matching the rubric value (e.g., 0-4) for a PI against its expected value. Students in sophomore level courses and below are expected to perform at a '2' level, whereas students in junior level courses and above are expected to perform at a '3' level (Figure 3). These levels are determined by the year in which students normatively take the course per the program flow schedule outlined in the University academic catalog. Thus, the evaluation process disambiguates the data by major and connects the outcome score (0-4 rating by the faculty) with the "Expected Performance" for that course. The rationale for this is two-fold. First, the faculty readily knows the performance expectations for their course, since when a course is normatively taken in the program is easily recalled. Second, the course level is more aligned with the program design and is independent of which student is actually in the course.

Setting up the data for appropriate analysis requires cross-referencing the outcome data with the department roster (containing the students' major as of the beginning of the semester) as well as the courses that make up the major. For example, the "Major" as well as the "Student Level" fields are disambiguated using the student ID from Figure 5. This is particularly critical, as effective outcomes work must clearly distinguish which program (major) that the data sheds light on, and in this case most SFE courses also have computer science, mechanical engineering, or occasionally other majors taking the course. Similarly, the "Course Code" is used to determine the normal offering of a particular course from the catalog flow schedule. This information is particularly useful in faculty reviews, as the primary conduit of improvement is through changes to the course units that make up the program. Figure 6 presents the cross-referenced data appended to the rubric scores for the same assessment opportunities shown in Figure 5.

Major	Outcome Score	Course Code	Course Level (Normative year)	Expected Performance	Meets Expectations	Outcome Encoded	Student Level
SFE	3	SFE 224	2	2	TRUE	EAC-1	JR
SFE	3	SFE 224	2	2	TRUE	EAC-1	JR
SFE	3	SFE 224	2	2	TRUE	EAC-4	JR
SFE	3	SFE 224	2	2	TRUE	EAC-5	JR
SFE	4	SFE 340	3	3	TRUE	EAC-1	JR
SFE	2	SFE 340	3	3	FALSE	EAC-1	JR
SFE	4	SFE 366	3	3	TRUE	EAC-3	JR
SFE	4	SFE 366	3	3	TRUE	EAC-3	JR
SFE	4	SFE 366	3	3	TRUE	EAC-2	JR
SFE	2	EGR 160	1	2	TRUE	EAC-6	JR
SFE	2	SFE 112	1	2	TRUE	EAC-3	JR

Figure 6. PI Cross-Reference Data Used for Disambiguation

Most importantly, the immediate analysis of the "Meets Expectations" field implemented in the script is used to translate outcome scores to countable 'hit' (TRUE) or 'miss' (FALSE) values. A key decision was the determination of expectations; the faculty decided to count the "Expected Performance" from the "Course Level" in the program (e.g., year 1, year 2, etc.), as opposed to the "Student Level". This was an advantage for achieving goal 2, easy-to-use, as the assessor only needs to know the level of the course, rather than the level of the student when examining the work against the Figure 3 rubric.

Raw Canvas-supplied data augmented with the program and outcome and program expectations serves as the basis for analysis. This information is then rolled up into broad outcomes reports that support faculty evaluation for CI in several ways: two internally facing sets of reports (PI findings, and major/course findings) and a set of externally facing reports (e.g., program-wide findings).

Internal Review: Per-PI Hit/Miss Counting

The reports at the lowest level detail examine the semester/yearly PI results, organized by major and by student levels. More detailed reports provide results for all students, others for each cohort year (Freshman, Sophomore, Junior, Senior) and the "≤ Sophomore" and "≥ Junior" groupings. Figure 7 shows a summary of the engineering majors for all courses and all PIs from the Spring 2024 courses assessed.

Performance Indicator Analysis Spring 2024 All Courses, All Levels

Outcome Assessed	Hit Counts			Miss Counts			Ratio Count			No. Instruments	No. Students
	SFE	MEC	PREG	SFE	MEC	PREG	SFE	MEC	PREG		
EAC-1-1	4	4	1	0	15	1	100%	21%	50%	8	48
EAC-1-2	5	27	7	0	18	3	100%	60%	70%	10	69
EAC-1-3	6	2	0	0	0	0	100%	100%		7	13
EAC-1-4	22	105	25	7	61	8	76%	63%	76%	19	124
EAC-1-5	15	43	10	3	32	3	83%	57%	77%	13	105
EAC-2-1	34	10	1	1	15	1	97%	40%	50%	12	59
EAC-2-2	9	0	0	0	0	0	100%			1	16
EAC-2-3	4	0	0	0	0	0	100%			2	8
EAC-2-4	44	51	10	4	38	5	92%	57%	67%	22	136
EAC-2-5	17	5	1	1	3	1	94%	63%	50%	7	35
EAC-3-1	14	30	5	1	3	1	93%	91%	83%	11	84
EAC-3-2	27	35	9	7	21	2	79%	63%	82%	17	122
EAC-3-3	8	8	2	1	17	2	89%	32%	50%	7	59
EAC-4-1	9	8	6	0	0	0	100%	100%	100%	2	18
EAC-4-2	17	8	6	0	0	0	100%	100%	100%	6	39
EAC-4-3	18	17	6	0	6	3	100%	74%	67%	11	41
EAC-4-4	13	7	6	0	1	0	100%	88%	100%	4	24
EAC-5-1	8	3	1	0	9	0	100%	25%	100%	5	42
EAC-5-2	19	10	3	2	20	0	90%	33%	100%	8	92
EAC-5-3	21	17	2	0	15	0	100%	53%	100%	10	51
EAC-5-4	20	13	1	1	19		95%	41%	50%	10	51
EAC-6-1	7	13	1	9	16	5	44%	45%	17%	4	52
EAC-6-2	11	32	6	5	26	4	69%	55%	60%	9	87
EAC-6-3	14	48	9	2	20	1	88%	71%	90%	9	88
EAC-7-1	3	16	4	1	2	2	75%	89%	67%	4	32
EAC-7-2	7	24	4	1	1	1	88%	96%	80%	5	57
EAC-7-3	7	21	3	0	13	1	100%	62%	75%	6	50
FUS-8-1	2	15	0	3	2	0	40%	88%		3	45
FUS-8-2	17	34	9	2	2	2	89%	94%	82%	5	59
FUS-8-3	11	24	5	6	4	4	65%	86%	56%	6	59

Figure 7. Spring 2024 PI Analysis Showing All PIs Contained in Spring 2024 Data

From an assessment perspective, in Figure 7, the 'hit' column shows the number of students who met or exceeded the level of expectation for that PI in their work (i.e., successful). The 'miss' column shows the number of students who did not meet the expectations (i.e., 2 for freshman/sophomore courses, 3 for junior/senior courses). The ‘ratio count’ column documents the ratio of ‘hit’ counts to ‘miss’ counts. Since good assessment is best done leveraging expectations [4], the agreed-upon program expectations are that each PI should have a 70% ratio of hit/miss counts.

Consequently, any PI where the hit/miss ratio is ≤70% warrants a deeper review by the faculty. Similarly, as the department manages multiple majors, significant differences between majors also becomes a concern, as do other types of issues like a low instrument count or low student count. These are all potential opportunities to improve the program and/or streamline program assessment. For example, see the EAC-2-2 and EAC-2-3 lines for the MEC and PREG programs, which are circled in Figure 7. This lack of assessment would be discussed, and in some cases ignored (e.g., if other courses next semester will address these) or considered for improvement.

This PI Analysis report normatively includes a list of each course that provided data, so that faculty can also see how the PIs and SLOs are being reported from the courses assessed. The ability to roll up all outcomes, courses, and programs, it is relatively easy to develop reusable analysis reports. This PI data is then used to generate the second set of internal-review reports: semester (and annual) outcomes reports (all majors, all courses) that support program CI.

Internal Review Samples: Per-Outcome Course Contribution

While PI-specific data ties well to course instances and the faculty’s experience of the semester, it does not provide a clear program-level view. With design goals 1 and 3 (breadth and frequency of assessment), it is particularly important to examine program-level formative findings buried in the PI findings. The program level view is best seen at the outcome level, accomplished through a roll-up of the PI data. This program-level information can be broken down in multiple ways: by SLO, by major, by course year, by student year, etc. As previously mentioned, the primary student groupings used are the “≤ Sophomore” (formative) and “≥ Junior” (summative) groupings. Figure 8 compares the formative (e.g., ≤ Sophomore) program assessment with the course contributions from Fall 2024 to Fall 2025 showing results for the four different programs tracked.

2024 Fall Direct Assessment Summary ≤ Sophomore

Outcome Label	CSC	SFE	MEC	PREG	Instru-ments	Students	Courses Contributing Data						
EAC-1	89%	77%	87%	87%	13	166	CHM 361	CSC 144	CSC 344	SFE 240	SFE 112	CSC 261	EGR 102
EAC-2	93%	86%	84%	80%	6	92	SFE 240	SFE 112	CSC 261	EGR 102			
EAC-3	80%	55%	82%	72%	11	155	CSC 144	CSC 344	SFE 112	CSC 261	EGR 102	EGR 101	EGR 215
EAC-4		80%	96%	100%	2	36	EGR 160	EGR 215					
EAC-5	100%	40%	96%	100%	4	73	CSC 261	EGR 101	EGR 160				
EAC-6	100%	71%	92%	92%	3	76	EGR 102	EGR 160	EGR 215				
EAC-7	100%	83%	97%	100%	1	44	EGR 102						

FUS-8			0%		1	11	SCI 147						
Unique	51	20	67	7									
2025 Fall Direct Assessment Summary ≤ Sophomore													
Outcome Label	**CSC**	**SFE**	**MEC**	**PREG**	**Instru-ments**	**Students**	**Courses Contributing Data**						
EAC-1	87%	95%	89%	100%	10	157	SFE 224	CSC 144	CSC 344	EGR 101	EGR 102	EGR 215	EGR 160
EAC-2	93%	94%	90%	100%	9	110	SFE 224	CSC 261	EGR 102	EGR 160	SFE 240		
EAC-3	98%	94%	92%	88%	13	146	SFE 224	CSC 344	EGR 101	EGR 102	EGR 215	SCI 147	SCI 247
EAC-4	100%	85%	94%	100%	4	69	SFE 224	EGR 215	EGR 160				
EAC-5	78%	84%	88%	100%	5	84	SFE 224	CSC 261	EGR 101	EGR 160			
C/EAC-6	87%	92%	86%	100%	4	89	EGR 102	EGR 215	EGR 160				
EAC-7	100%	100%	93%	100%	3	59	SFE 224	EGR 102					
FUS-8		91%	89%		1	17	SCI 247						
Students	50	18	77	6									

Figure 8. Formative Program Assessment Results for Fall 2024 and Fall 2025

Without comparison to the prior year, the findings from Fall 2025 would show very little, as they appear only positive. The real CI value comes out when compared to the Fall 2024 findings, which indicate that several intervening program changes had some effect. A few interesting differences are circled in Figure 8. For example, changes in CSC 261 assessment (EAC-3 and -5 improvements for SFE students), assessment of FUS-8 in other courses, the inclusion of CAC[1]-related PIs (CAC-6 vs EAC-6 in Fall 2025) for CSC majors, and changes in course offerings.

Other information reviewed and compared includes the PI-course maps, which are dynamically created. Each year the mapping of courses to where PIs (and thus SLOs) is automatically generated from the data. Faculty can then discuss if they think this is appropriate (e.g., asking where a particular PI should be assessed) and then decide where in their course they will assess which PIs/SLOs.

These types of findings are a normative part of the reviews, and as the data is consistently and frequently presented, it is easier for faculty to ask, and answer questions that help determine what, if any, program changes need to be implemented. Overall, the ability to transform data into views useful to faculty is a benefit to the program's CI process and facilitates relatively frequent (twice/semester) reviews in support of CI efforts.

External Review Samples: Program Report Generation

Assessment of student learning is not just in service of CI, which primarily has internal stakeholders. The SFE program outcomes reports have university assessment officers, advisory board members, and ABET self-studies as routine external stakeholders. Figure 9 depicts the

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[1] Our SFE program falls under the EAC rules[1], while the CSC program falls under CAC. The program criteria are similar, and our SLOs parallel the two commission's requirements. While not the focus of this paper, by leveraging our PI structures, our method has been adapted to enable both EAC- and CAC- driven SLOs to be assessed.

SFE program-level summative Direct Assessment semester results (Fall 2025) suitable for external stakeholders generated in Excel 365. This figure shows the number of hits and misses for the total opportunities by level for a specified semester.

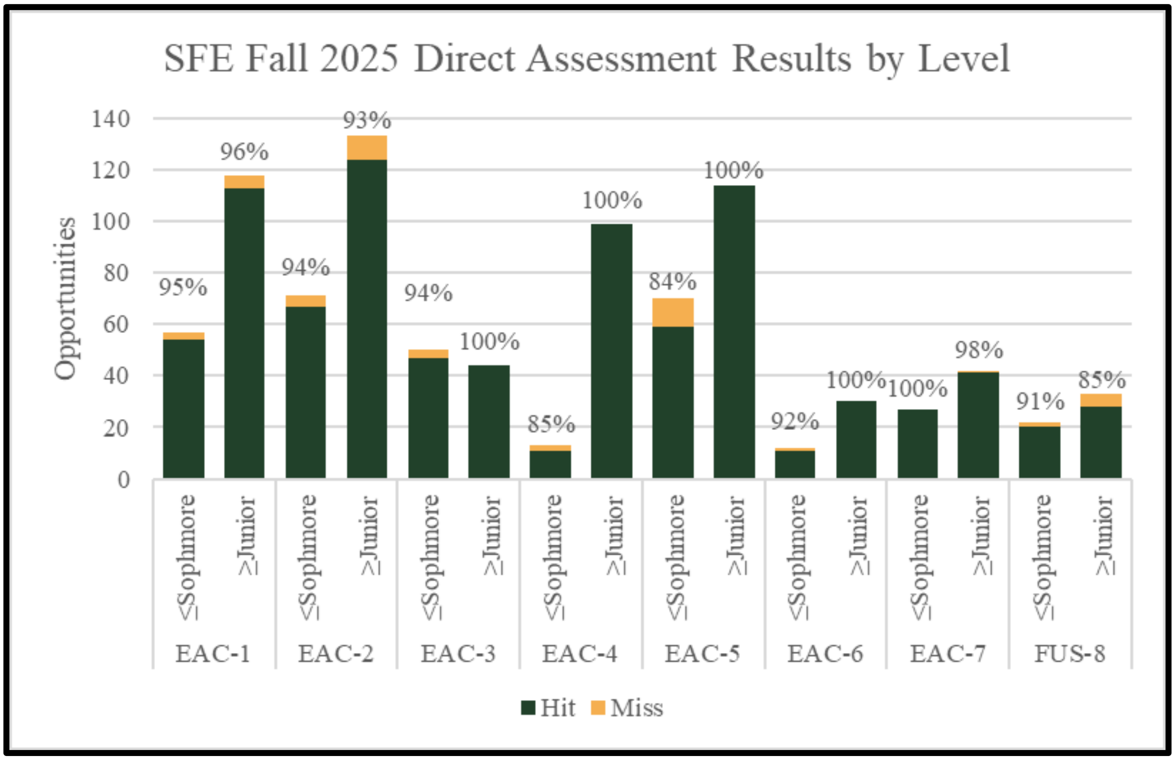

Figure 9. SFE Summative Outcomes Fall 2025 Summary

Another more standard view is to show direct assessment findings in parallel to other program assessment instruments. The SFE program utilizes three such instruments: direct, exit surveys (indirect) and project evaluations. Figure 10 depicts the SFE program 2024-25 Outcomes Summary as shared with the program's external stakeholders, including in the 2025 SFE ABET Self-Study Report.

2024-25 Software Engineering Outcomes Summary						
SLO Assessed	**Measurement**	**Number of Students**	**Number of Hits**	**Number of Misses**	**Percent Hit**	**Target Achieved**
EAC-1: an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	Course Assessment	11	15	1	96%	Achieved
	Exit Survey	6	18	6	75%	Achieved
	Capstone Projects	6	83	1	99%	Achieved
EAC-2: an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	Course Assessment	14	63	6	91%	Achieved
	Exit Survey	6	18	6	75%	Achieved
	Capstone Projects	6	83	3	97%	Achieved
EAC-3: an ability to communicate effectively with a range of audiences	Course Assessment	13	59	3	95%	Achieved
	Exit Survey	6	13	5	72%	Achieved
	Capstone Projects	6	67	1	99%	Achieved
EAC-4: an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	Course Assessment	14	136	0	100%	Achieved
	Exit Survey	6	19	5	79%	Achieved
	Capstone Projects	6	48	2	96%	Achieved
EAC-5: an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	Course Assessment	14	118	3	98%	Achieved
	Exit Survey	6	20	2	91%	Achieved
	Capstone Projects	6	64	4	94%	Achieved
EAC-6: an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	Course Assessment	14	42	3	93%	Achieved
	Exit Survey	6	12	6	67%	Near
	Capstone Projects	6	78	8	91%	Achieved
EAC-7: an ability to acquire and apply new knowledge as needed, using appropriate learning strategies	Course Assessment	14	18	0	100%	Achieved
	Exit Survey	6	15	3	83%	Achieved
	Capstone Projects	6	76	8	90%	Achieved
FUS-8: an ability to apply Catholic ethical principles guided by virtue to questions in industry and of technology development	Course Assessment	14	43	5	90%	Achieved
	Exit Survey	6	14	4	78%	Achieved
	Capstone Projects			Not Assessed		

Figure 10. Generated SFE Fall 2025 Summative Outcomes Report

Reviewing internal and external reports both facilitate and inform faculty discussion on topics such as how each semester progressed, what worked with students or did not, examining issues in the data that might be real student issues (or not), or issues in the assessment process. These opportunities are at the heart of effective CI but come with the cost of time and faculty engagement in the assessment process. This is important, as faculty often are disinclined to actively participate in the assessment [9][10][11].

Assessing the Assessment Process

Assembling program assessment data for CI requires a design approach that matches the intention of the review stakeholders, in this case the program faculty. Sustaining an effective assessment process requires that faculty continue to feel ownership and value-added, making it worth their efforts.

As identified, the difficulty with most assessment systems (another quality attribute) is the need for the perceived effort not to exceed the perceived benefits. In the E&C Department, which sports a diverse faculty supporting multiple majors, the ability to both see the student performances together (e.g., Figure 8 and similar reports) as well as program-specific reports and summaries (e.g., Figure 9 and similar reports) are perceived as useful reports (benefit) that support useful CI discussion. This is both a reminder of, and review of assessment goal 1. Following design goal 1 (easy-to-use), Canvas™ integration allowed faculty to own simple, reusable tools for which department experience and university support was available. In turn, this supported department faculty in agreeing to assess something in each of their courses. Additionally, these reports can be generated in relatively few person-hours, the time for each faculty to assess one assignment in each course, plus approximately 3 hours to add new data to the Excel 365 reports.

One measure of department support has been faculty participation rate. Across the department, all full-time and half-time faculty have participated by their third semester teaching in the program. An indirect measure of faculty acceptance has been the growth in volume (student x instrument x PI count) and sections participating. Figure 11 depicts the volume growth over the three academic years that this assessment system has been in place.

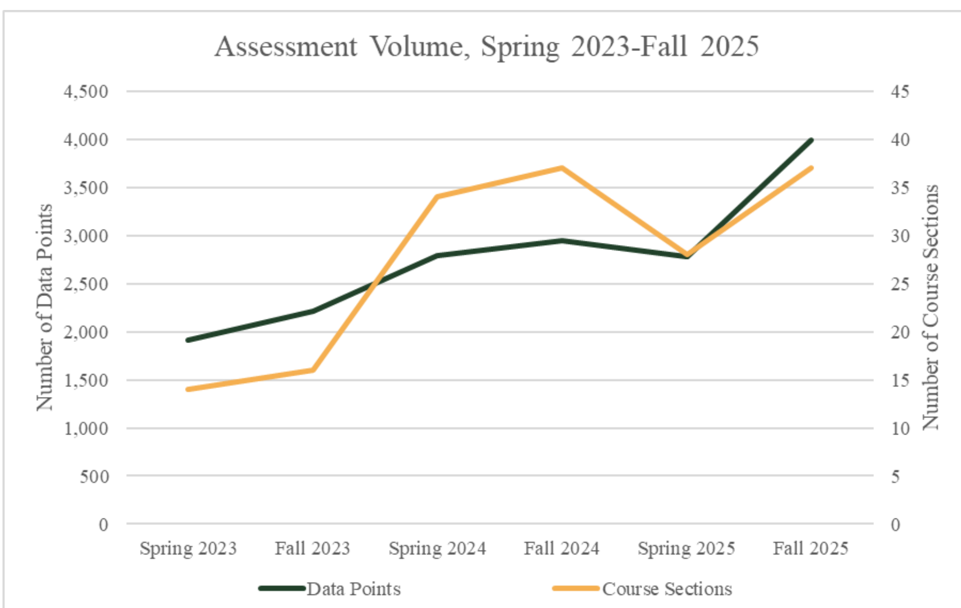

Figure 11. Assessment Volume Growth 2023-2025

Good assessment is expensive, time-consuming work [4][5]. This approach, while data-intensive, does not ask much of faculty, just self-directed targeted assessment, essentially “Find an assignment to assess, and assess aspects of the program through the lens of that assignment.” The faculty then review both the student performance and the overall effectiveness of the assessment process. Any holes or gaps in the assessment work are visible to all faculty, and open to discussion and correction in the next cycle. These discussions are also opportunities to look for inter-rater reliability (IRR) concerns as well as the need for calibration workshops or rubric norming among the participating faculty.

With a frequent (every-semester) review cycle, it is easier to observe semester-to-semester and year-to-year changes, both in the effectiveness of the program and of the collective assessment. Both encourage participation, and openness to flexibility. Similarly, the questions raised by missing data or below-expectation findings are exactly the types of discussions that faculty need to share for program improvement. Therefore, one of the effective points of this approach has been its continued usefulness in helping the faculty as a team continue to learn from the students’ performance or occasionally lack thereof.

This paper describes the overall department process, but does not cover establishing IRR, calibration and faculty training, rubric norming, nor does it provide detail on the actual analysis performed by the faculty (e.g., statistical tests), and subsequent change efforts. The framework and tools developed to support this process are readily replicated for use for other programs/departments. This reuse of the framework and tools hinges on a program establishing their own outcomes, PIs, and rubrics, such as the ones presented as well as faculty ownership.

Summary

The Canvas™ LMS -supported SFE program direct assessment process presented in this paper can be summarized as follows:

- *Structuring*: PI rubrics for course use are built from the department PI set (Table I. SLO Mapping to department Performance Indicators) for the program outcomes.
- *Planning*: faculty select 1-2 assignments for each course to be assessed using a custom PI rubric.
- *Collection*: direct assessment is completed in each course in Canvas™, which collects raw outcomes data for each semester.
- *Reporting*: raw outcomes data is assembled at the end of each semester. Program rosters, the SFE program map, and the department PI set are used for sorting and filtering the raw assessment data into a series of reports on PI performance, course contribution, and SLO performance (and others).
- *Review*: assessment results are reviewed and discussed during or prior to the next semester (Figure 2).
- *Action*: in the change interviews each semester, outcomes reports, reviews and course changes from prior semesters inform the next round of course, program, and CI process changes.

The approach has shown growth in faculty acceptance, and effectiveness in supporting CI efforts. Success of the system is based on a reusable 5-valued metric that can be used with each PI, and the deployment of PI-centered questions using the outcomes mechanism available in Canvas™. Data analysis then isolates all students by major, and from the major the expectation-level of the course, so that faculty can leverage broad and detailed information to support continuous improvement of the program and of the assessment system.

If this process or the data collation tools would be of interest, please contact sfrezza@franciscan.edu.

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