Experience Implementing an Automated Assessment System for Accreditation

Stephen W. Turner*, Tyler Judd†, Suleyman Uludag‡
Dept of Computer Science, University of Michigan, Flint, MI, USA 48502-1950
Email: *swturner@umich.edu, †tjudd@umich.edu, ‡uludag@umich.edu

***Abstract*—This innovative practice full paper introduces an automated assessment system, Michigan System of Automated Assessment for Accreditation (MSA^3), designed for computing and engineering programs to meet both external accreditation and internal university requirements while minimally increasing faculty and staff workload. The system integrates with Canvas, enabling instructors to input assessment data directly during grading, streamlining the process by eliminating the need for separate data entry and report dissemination. Key features include automated data export and the generation of visual analytics, securely hosted on university servers.**

Additionally, the paper presents a preliminary study on how this system affects faculty attitudes towards the assessment workload required by ABET. Our preliminary survey results indicate a favorable perception by faculty, which should increase their buy-in and engagement with assessment, supporting assertions made in the literature. Our findings also suggest that the system may help align faculty efforts with accreditation demands more seamlessly. Its code will be made available on GitHub, allowing for easy adaptation by other institutions using Canvas. Our future work includes increasing the level of automation, extending our methodology to other learning management systems, and conducting a larger evaluation to gauge MSA^3's efficacy on the perception of the accreditation and faculty/staff buy-in.

***Index Terms*—ABET Accreditation, Assessment, Canvas LMS, Web-based Tool, Automation**

I. Introduction

ABET accreditation includes a process of yearly assessment, so that program faculty may measure student success [1], analyze outcome data, and improve the programs. It is a necessary part of ABET accreditation but requires a certain amount of work beyond the normal teaching and learning. A common faculty opinion is that the ABET accreditation process adds rules necessitating uncounted extra time to our yearly duties. The challenges are two-fold [2] : (1) A lack of buy-in and involvement from faculty [3]–[6], (2) resistance [7], [8] of faculty and staff [9] as a result of a negative perception [10], due to a shortage of time [11], [12], presumed lack of benefit to learning and teaching, insufficient expertise [11], and inadequate incentives for tenure and promotions [13].

This widespread opinion is supported in literature reviews [14]–[17], indicating that inefficient implementation of the assessment process adds more time to our typical teaching, research, and service duties.

Yet, ABET is of paramount importance, with positive effect [18] for Engineering programs and gaining popularity in Computing programs. It demonstrates a program's commitment to meet certain quality standards and guarantees that we follow a program of continuous improvement. It also provides assurance [19] to students and their families that the program is of high quality.

A cause-analysis study in [2] adopts the Updated Behavioral Engineering Model (BEM) from [20], based on the original in [21], for the accreditation process; with reasons for resistance shown in Figure 1, and the influence of environmental and personal factors in the overall accreditation approaches in Figure 2.

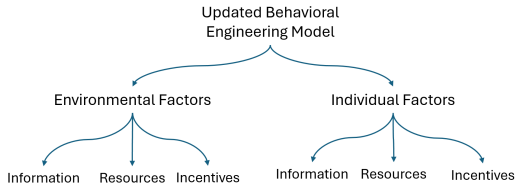


Fig. 1: Updated Behavioral Engineering Model to explain reasons for lack of buy-in or resistance to accreditation [2], [20], [21].

Consequently, the perspectives, perceptions, and assumptions of faculty are crucial for the effective planning and implementation of accreditation initiatives, including those related to ABET.

This paper addresses this perception of onerous extra time by describing a new system and its effects on faculty attitudes about assessment for ABET accreditation. We designed and built an assessment system,

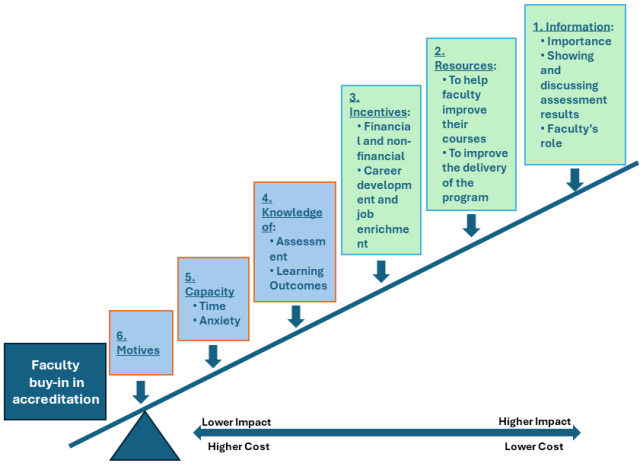


Fig. 2: Environmental and Faculty's Personal Factors that influence their buy-in and involvement in undertaking the departmental accreditation related tasks. [2], [20], [21].

Michigan System of Automated Assessment for Accreditation (MSA^3), that integrates with the Canvas LMS and subsequently automates much of the visualization activities associated with reporting on yearly assessment. We also conducted a preliminary survey of faculty attitudes concerning the assessment process, with a set of faculty representing "before" and "after" using our new system.

An early framework of the system was described in [22]. New work presented here includes the full implementation that adds functionality including the web portal, as well as the introduction of the taxonomy of related work on faculty buyin and the survey on faculty attitudes. It has been developed for two Computing programs pursuing initial ABET accreditation: Computer Science and Computer Information Systems. In the following years, we will continue to expand its use, with other programs in Cybersecurity, Data Science, Artificial Intelligence, Software Engineering, Information Technology, and Human-Computer interaction, as well as Mechanical Engineering, Electrical/Computer Engineering, and Engineering Technology.

The remainder of the paper is organized as follows: Section II presents a brief overview of the organizational structure of ABET accreditation. Section III provides an overview and comparison with prior work in this area. Section IV presents the framework of the system's design and operation. Section V presents a discussion of the survey and its results, and finally, Section VII discusses our conclusions and plans for future work.

II. Overview of ABET

ABET [23] is an outcomes-focused, nonprofit, and non-governmental accreditation organization that employs an ISO 9001:2015-certified quality management system in STEM fields, including applied and natural sciences, computing, and engineering, at the associate, bachelor's, and master's levels. As of May 2024, ABET accredits 4,674 programs across 920 colleges and universities in 42 countries [23]. Its highly regarded peer-review process involves contributions from over 2,200 experts representing more than 35 member societies [24] drawn from industry, academia, and government. ABET aims to establish standards that ensure external, impartial, and independent quality assurance for academic programs.

ABET is a member of both the Washington Accord [25] and the Seoul Accord [26]. The Washington Accord is an international accreditation agreement for undergraduate professional engineering degrees, while the Seoul Accord focuses on professional computing and information technology degrees. Both involve accreditation bodies from their respective signatory countries.

ABET operates through four accreditation commissions: (1) Computing (CAC), (2) Engineering (EAC), (3) Engineering Technology (ETAC), and (4) Applied and Natural Science (ANSAC).

To assess programs, ABET employs eight general criteria: (1) Students, (2) Program Educational Objectives, (3) Student Outcomes, (4) Continuous Improvement, (5) Curriculum, (6) Faculty, (7) Facilities, and (8) Institutional Support. In addition to these, specific criteria may be applied to the Student Outcomes, Curriculum, and Faculty standards as necessary.

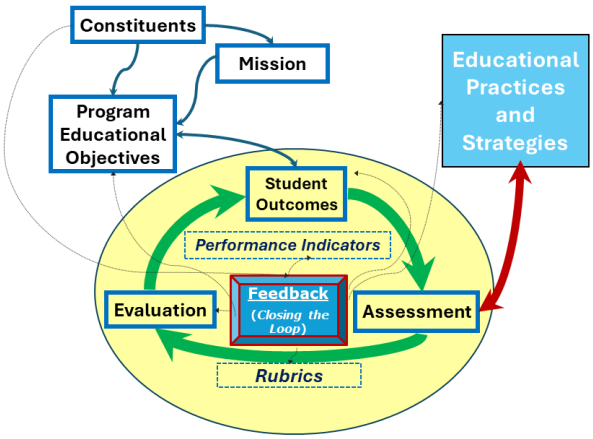


Fig. 3: The ABET Continuous Improvement Process.

The most significant criterion, as evidenced by the substantial number of citations during accreditation reviews, is continuous improvement.This study centers on the continuous improvement process (highlighted in yellow in Figure 3), which comprises three essential components: outcomes, assessment, and evaluation. These are adapted to meet specific requirements and differ based on the particular accreditation program. For instance, the student outcomes outlined in the 2024-2025 ABET Computing accreditation criteria include analyzing complex computing problems, designing and evaluating computing-based solutions, demonstrating strong communication skills, understanding professional responsibilities and ethical principles, and collaborating effectively in teams. These outcomes comprehensively address various aspects of the student learning process, offering a framework to improve educational quality and enhance the learning experience for students enrolled in the program.

III. Related Work

A survey of related literature identified several categories of efforts, including: learning management system (LMS) integration and plugin development; standalone systems; spreadsheet-based automation; and security/compliance issues in assessment tools.

Several works report on automated assessment and LMS integration. One study identified gaps between LMS functionality and accreditation requirements, leading to the development of a plugin for Moodle [27]. This plugin aligns course grades with learning outcomes and enables comprehensive reporting. The Multi-program Assessment System (MPAS) was implemented for CAC and EAC accreditations on both Blackboard and Canvas platforms [28], [29]. MPAS automates data entry and performs outcomes assessments.

The literature also features a number of standalone systems. The ABET Automation System (ABETAS) facilitates the collection of accreditation-related data [30]. Another work reports on a framework to automate decisions, processes, and activities related to the ABET assessment process, though it remains a conceptual framework rather than a fully operational system [31]. Automated Program Review Management System (APRMS) [32] manages and schedules program reviews at a macro level, focusing on broad program assessments rather than individual assessments. The ABET Course Assessment Tool (ACAT) provides automated report generation but lacks automated data entry and comprehensive outcomes assessment [33]. The Course and Student Management System (CSMS) includes outcomes assessments and the capability to generate reports automatically, though it does not integrate with any LMS and does not automate data entry [34]. A proof-of-concept web application introduced automated data entry and report generation but did not include capabilities for outcome assessment or analysis of student majors [35].

Some tools leverage spreadsheets to facilitate automation in the assessment process. These are primarily developed as macros for Microsoft Excel, assisting in the measurement of student performance on assignments and automating collection of assessment data [16], [36]

Due to the requirements imposed by the USA Family Educational Rights and Privacy Act (FERPA), security of student information remains a critical concern that has received only a little attention in the surveyed literature. Specifically, MPAS addresses these concerns through the use of OAuth2 tokens and protective measures like campus firewalls, ensuring data security and compliance [29]

The review also revealed that prior systems either necessitated considerable manual data input from instructors [19], [33], [34] or allowed data extraction from Canvas (or another LMS) through separate interfaces [28], [29], [35]. In contrast, our system leverages Canvas as the primary interface, providing instructors with a familiar and intuitive platform. While instructional videos and articles explain using Canvas features for ABET accreditation [37], [38], none integrate these features with our comprehensive program attributes that include secure data storage, structured organization, and thorough analysis and visualization.

Overall, these studies highlight a diversity of approaches to automating the assessment process. Our system enhances our framework for continuous improvement by incorporating a nearly automated assessment process. It is secure, leverages a widely adopted learning management system, and requires minimal additional effort from the faculty within our computing programs with the goal of improving the overall perception of the accreditation efforts by the program faculty. Compared to previous initiatives, we contend that our system offers an expanded, simplified, and automated array of features while upholding necessary privacy standards and ensuring comprehensive system security.

IV. MSA^3 Design and Implementation

System Design Goals: To combat the ABET process's reputation of being cumbersome and taxing, our primary goal is ease of use. The next goal that must be adhered to in any (USA) system is preservation of student privacy,

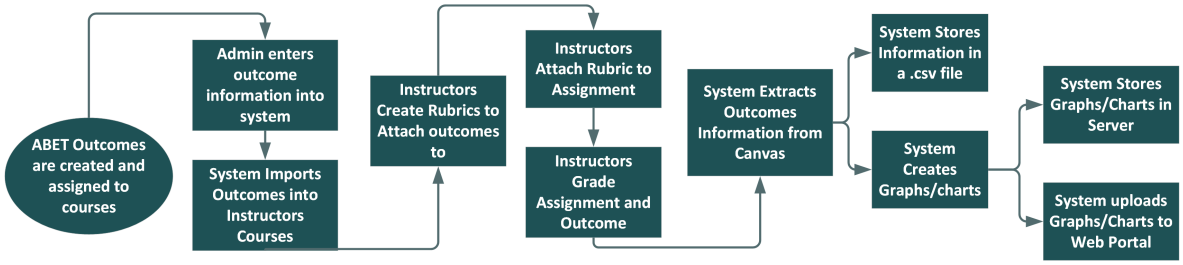


Fig. 4: MSA^3 Flow Chart.

in conformance with our FERPA law. The system must be secure and able to hide student details so that only those requiring the knowledge (such as course instructors) can access student records. The third goal is that the system easily produces reports that include visualizations of data. The yearly assessment process requires statistical analysis and reporting, so it is important to simplify and streamline this process. Our final goal is to establish a web portal as a centralized platform accessible to staff and ABET program evaluators for viewing reports and to close the feedback loop from assessment (data collection), evaluation, and taking actions for the improvement of the program offerings.

Features and Capabilities: MSA^3 provides several key features designed to enhance the efficiency of managing outcome data including:

- Seamless Data Entry, integrated directly with Canvas and allowing instructors to easily input outcome data while grading assignments.
- Accessibility and Security, operating as a virtual machine on our university's secure servers, ensuring secure storage and easy access to data.
- Automation by facilitating the direct import of outcomes into courses and the export of results through the Canvas API.
- Web interface through a portal that provides a comprehensive platform for faculty and staff to access all results and serves as a tool for ABET program evaluators to review data.

System Overview: As seen in Figure 5, our system employs the Canvas LMS as its primary interface, enabling program faculty to enter their outcome data through the Canvas platform using its Canvas Outcomes feature. Transfer of outcomes information to and from Canvas is facilitated through the Canvas API.

The system operates on a virtual machine hosted within the university's servers, identified as the ABET Assessment Server (AAS). It ensures secure storage of data and serves as the platform for the web portal, displaying outcome data visualizations for staff review.

Figure 4 illustrates the entire process, showcasing the main steps from importing the outcomes to uploading the visualizations onto the web portal.

Use of Canvas Outcomes: The Canvas outcomes feature enables creating and customizing specific outcomes for different assignments. These are presented in a rubric format, enabling instructors to select a level that accurately reflects students' performance.

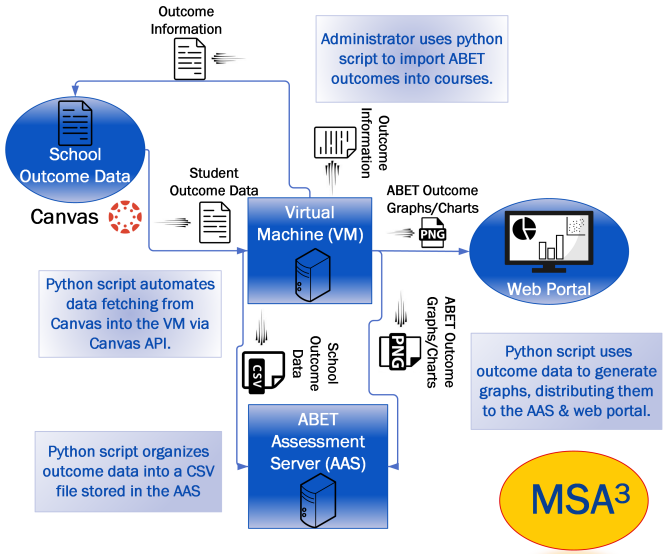


Fig. 5: MSA^3 High-Level System Design.

At the beginning of each semester, administrators employ the Canvas API to import outcomes directly into instructors' courses from the AAS. Our Canvas (LMS) administrators have established an account endowed with Teaching Assistant (TA) privileges across all courses in which ABET outcomes are used. With this account, we generate a personal access token, granting us API access to directly integrate outcomes into the respective courses. To streamline this process, we've developed a script that automates many tasks.

Upon execution, users can select a CSV file containing

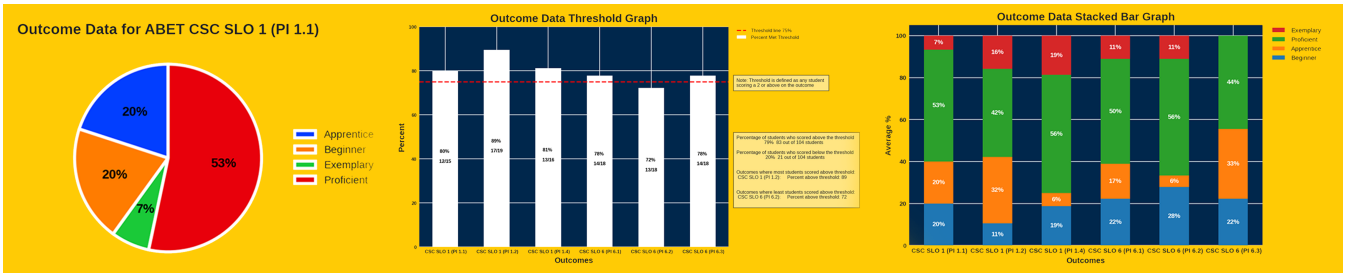


Fig. 6: MSA^3 Graphs and Charts

the outcome information for the courses they wish to upload to. The script then initiates a push request to the Canvas API, creating the outcomes in the courses corresponding to the provided course IDs. An example of this is shown in Figure 7.

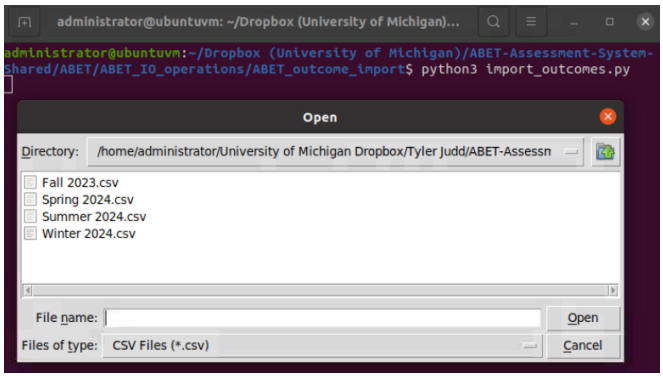


Fig. 7: MSA^3 interface to insert outcomes to Canvas.

Reporting, Analysis, and Visualization: The Canvas report process, depicted in Figure 8, outlines how instructors use and evaluate the outcomes imported by administrators into their courses. Instructors are able to choose student outcomes and their alignment with assignments. They can integrate outcomes into existing rubrics and assess them alongside regular assignments, or alternatively, create dedicated assignments for evaluating outcome data.

Throughout each semester, Canvas temporarily stores this outcome data until our system retrieves it from Canvas using its API during scheduled runs.

At the end of each semester, outcome data is automatically extracted from Canvas using the Canvas API through a Python script. This script retrieves information from multiple Canvas API endpoints.

After extracting outcome data from Canvas via its API using Python and Pandas, the data is placed into a data frame where it is refined to include only essential information, such as course names, outcome names, scores, UMIDs, student user names, learning outcome ratings, and majors. All personal information is scrubbed and deleted to preserve student anonymity. A CSV file is then created to store the information for each course, as well as a program-level CSV file that stores the results for all of the courses for each semester.

After extracting, analyzing, and processing outcome data from Canvas, our scripts employ the Seaborn and Matplotlib Python visualization libraries to generate a variety of visualizations. These include bar graphs, stacked bar graphs, threshold charts, and pie charts for each course, offering insights into the outcome data. Additionally, we create graphs to present the overall results for the entire semester.

These visualizations are then saved to the server and uploaded to the AAS web portal, allowing faculty and staff to access them at any time. Examples of some of these graphs are provided in Figure 6.

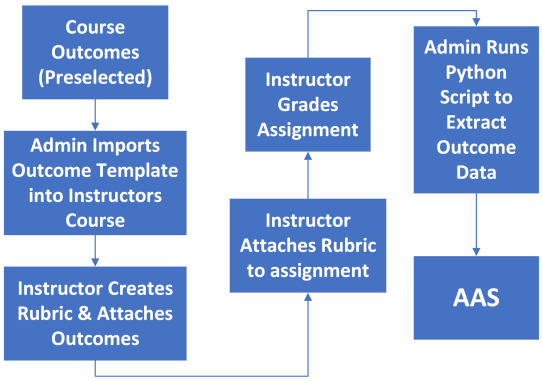


Fig. 8: Canvas Report Process.

ABET Assessment Server (AAS): The ABET Assessment Server is the operational platform for storing critical information. It specifically stores the ABET student outcome data, ensuring its integrity and accessibility. Additionally, a depository stores the visual outputs, including the graphs and reports generated by the Python scripts.

The server's security is bolstered by its placement within our internal university network. The network is safeguarded by a robust and secure firewall, which acts as a protective barrier against unauthorized access and potential security threats. This fortified infrastructure provides an additional layer of protection to AAS, ensuring data confidentiality and integrity.

The server implementation includes a web portal accessible to faculty, staff, and ABET personnel. It is capable of displaying various visualizations generated by Python scripts using outcome data extracted from Canvas. Hosted directly on our virtual machine, access is restricted to individuals either on our campus or connected remotely via VPN. Despite the absence of personal information on the web portal, this setup ensures an additional layer of security. Figure 9 depicts the appearance of the web portal.

Concrete Initial Phase: Table I presents an overview of a specific course, CSC 335, detailing computing outcomes and their corresponding performance indicators. In the table, a check mark signifies that the outcome is linked to the course, while an 'X' indicates otherwise.

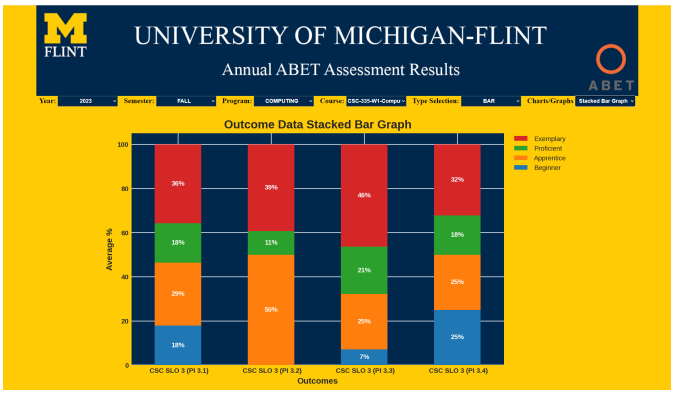


Fig. 9: Our ABET Assessment Web Portal.

Figure 10 illustrates a sample assignment in Canvas that instructors may employ for assessment purposes.

The system has been built to align with ABET's CAC standards for programs in Computer Science, Computer Information Systems, Information Technology, Data Science, and Cybersecurity. MSA^3 can be easily extended to other programs. We have been using it since September 2023.

V. Faculty Perceptions Survey

Engineering and Computing faculty were given a preliminary survey to gain insights related to their time

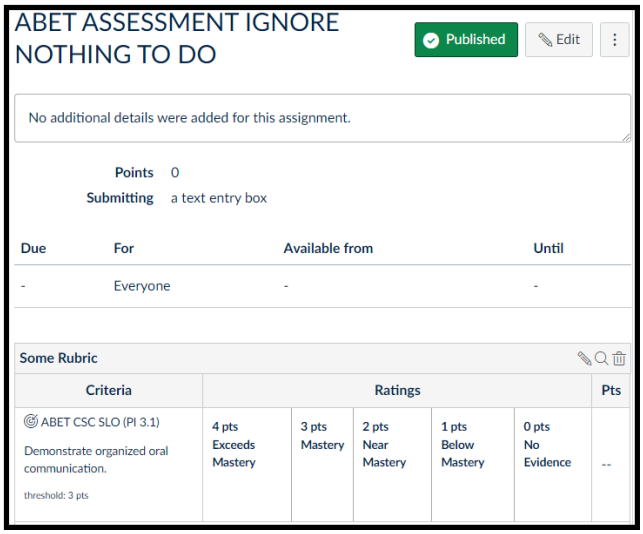


Fig. 10: ABET Example Assignment in Canvas

spent in assessment, their attitudes and perceptions toward workload imposed by assessment activities, and the degree to which they liked the new software. The Engineering faculty included those in Mechanical, Electrical, and Engineering Technology, with our Mechanical Engineering program currently accredited by ABET. Computing faculty included Computer Scientists and Software Engineers, with programs in Computer Science and Information Systems currently pursuing ABET accreditation.

The questions in the survey were designed to be easy to complete and to gain a broad understanding of the faculty mental state, both before and after use of the MSA^3 system. We must emphasize the preliminary nature of this survey. It was completed by a relatively low number of faculty (13), indicating low statistical significance. However, the survey provided initial insights into the usefulness of the new software, which were also supported by some anecdotal comments mentioned by survey respondents. The question categories included background, assessment, workload, and attitude. Background questions queried the faculty on their rank, discipline, and their experience with assessment. Assessment questions focused on the faculty experience with assessment and their perceptions of its importance. Workload questions asked about actual and perceived workload, with some emphasis placed on assessment. The attitude questions focused on the degree to which the faculty value or agree with the importance of assessment activities, as well how they value the new software.

Faculty Motivation and Initial Attitude Toward

TABLE I: Outcome Table for a Specific Course.

CSC 335 SLO #3 (Communicate effectively in a variety of professional contexts)	Performance Indicator Used in Course
PI 3.1 Demonstrate organized oral communication.	✓
PI 3.2: Provide verbal responses that are appropriate for the audience.	✓
PI 3.3: Demonstrate organized written communication.	✓
PI 3.4: Demonstrate organized visual communication.	✓
PI 3.5: Uses evidence and logic purposefully in communication.	X
PI 3.6: Uses technology to enhance the communication of ideas and information.	X

Assessment: Generally, the faculty demonstrated high motivation and familiarity with assessment processes, which likely accounted for the lack of significant change in their attitudes before and after implementing the new assessment tool. Their preexisting positive attitude suggests they were well-prepared and aligned with the objectives of our pursuit of program-level accreditation, which minimized potential shifts in perception of its importance. This is supported in Figure 11a, which showed that a high percentage of faculty disagree with the contention that assessment goes beyond normal duties[1]. The figure indicates two faculty who felt assessment was "above and beyond", but the vast majority of the faculty either strongly disagreed or felt neutral on the question. Further support is provided in Figure 11b, which indicated the vast majority of our faculty agreeing with the contention that student outcomes assessment are necessary for program and course improvement.

Impact of Sample Size on Assessment Results: The small sample size in the study limited our ability to detect significant changes between pre-assessment and post-assessment groups, or to find trends that might be more apparent in a larger group. This limitation is also highlighted by the absence of at least one faculty member with a known negative perception toward the ABET accreditation process, who did not participate in the survey. However, inclusion of such individuals in future studies could potentially reveal a broader range of attitudes and a more pronounced difference in pre and post-assessment results, offering a clearer picture of the overall faculty perception.

User Experience with Assessment Software: Generally, the faculty found the software introduced for managing the assessment process to be user-friendly and easy to use, as supported in Figure 11c, where 86% of the faculty liked or strongly liked the system, with the remaining 14% neutral on its use[2]. This positive feedback on the usability of the software suggests that it effectively supports the faculty in performing necessary tasks without adding complexity to their workflow. Anecdotal evidence also supports this, with two faculty members reporting that once the Canvas Outcomes rubric incorporating performance indicators for ABET student outcomes was set up, the actual assessment activity took roughly 15 minutes for large classes (averaging 34 students in the section). This also scaled down linearly to smaller sections; we found that the assessment required roughly 30 seconds per student. Those faculty also reported that setting up the rubrics was straightforward and did not take significant time once the process was understood. Such ease of use is crucial for the adoption and sustained use of new technologies in academic settings, where the primary focus of faculty should remain on education and mentorship rather than managing cumbersome new tools.

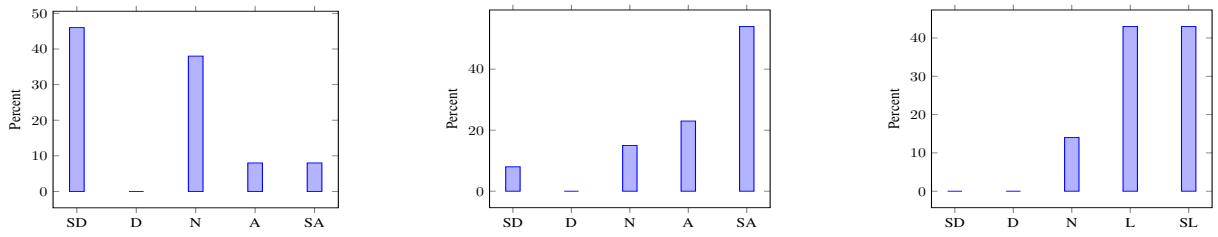
Distribution of Time Spent on Assessment Activities: The time faculty members spent on assessment was self-reported through the survey, and it varied significantly. Some engineering faculty reported spending 10-15 hours per semester, indicating a substantial investment in ensuring the alignment of curricula with accreditation standards. However, the time was fairly evenly distributed in ranges of 0-5 hours, 5-10 hours, and 10-15 hours, suggesting a diversity of engagement levels with the assessment process within the faculty. In contrast, most computing faculty reported spending less time on these activities, suggesting the tool may reduce time spent, but it merits further examination.

VI. Future Work

We are in the process of uploading our code to GitHub, making it accessible to other institutions for their respective purposes. Since the program integrates with Canvas as its primary interface, with all data input and extraction handled through the Canvas API, users will require minimal setup. They would simply need to obtain access to their courses in which outcomes would be used via a custom account, similar to our setup,

[1]SD=Strongly Disagree; D=Disagree; N=Neutral; A=Agree; SA=Strongly Agree

[2]SD=Strongly Dislike; D=Dislike; N=Neutral; L=Like; SL=Strongly Like



(a) Faculty Agreement: Assessment Goes Beyond Normal Duties.

(b) Faculty Agreement: Assessment is Necessary.

(c) Faculty Who Like MSA^3 Software.

Fig. 11: Selected Survey Results.

and input the API token for that account. Beyond this setup, most functionalities will be compatible with any university employing Canvas as its primary information management platform.

Furthermore, we anticipate that this will not only enable other institutions to leverage our program but also encourage feedback on potential enhancements and additions. This feedback will be vital for future iterations of the program, ensuring continuous improvement and adaptation to meet evolving needs.

We intend to further enhance the system by integrating it with our school's Student Information System (SIS) to retrieve students' major information. This data will allow us to identify students whose majors align with the ABET program corresponding to each outcome. Therefore, the system will be capable of removing students whose majors do not align with the ABET accreditation program relevant to the outcome under evaluation, thus refining the data model further.

We further plan to expand our infrastructure to track various student characteristics, such as economic status, standardized test scores, and academic backgrounds. This enriched data will help tailor assistance to students facing challenges and enable comprehensive trend analysis to identify potential areas of struggle. We also plan to explore Canvas integration to leverage engagement metrics and highlight areas where students could engage more effectively with course materials. This data will empower faculty to adapt teaching methodologies, enhancing students' learning experiences and shaping the system's future functionalities.

Our roadmap includes extending the database to encompass additional campuses, with a vision of a longitudinal study to evaluate system performance over multiple years, as well as different segments of the faculty population (e.g. those in administrative vs. pure faculty). This will guide future improvements in reporting, visualization, and ergonomics.

Finally, our initial focus has been on Canvas. We would like to extend the underlying methodology to other LMSs for wider adoption.

VII. Conclusion

This full paper introduces an innovative automated assessment system, the Michigan System of Automated Assessment for Accreditation (MSA^3), tailored for computing and engineering programs. The system is designed to meet both external accreditation requirements and internal university standards while minimally increasing the workload for faculty and staff. MSA^3 integrates seamlessly with Canvas, allowing instructors to enter assessment data directly during grading. This integration streamlines the process by eliminating the need for separate data entry and report distribution. Key features of MSA^3 include automated data export and the generation of visual analytics, with all data securely hosted on university servers.

Furthermore, the paper discusses a preliminary study on faculty attitudes towards the assessment workload mandated by ABET. Initial survey results reveal a positive faculty perception, which is likely to enhance their buy-in and engagement with the assessment process, corroborating claims found in existing literature. The findings also indicate that MSA^3 could more effectively align faculty efforts with accreditation requirements. The system's code will be made available on GitHub, facilitating easy adoption by other institutions using Canvas. Future work will focus on enhancing the level of automation, expanding the methodology to additional learning management systems, and conducting a more extensive evaluation to assess MSA^3's impact on perceptions of accreditation and faculty/staff engagement.

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