Semiconductor Integration 101: A Case Study of Equipping a 2-Year College System for an Emerging Technology

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Abstract

Semiconductor design, production, and application have gained priority as an emerging technology nationally, in the Midwest, and in Indiana. Nearly every modern industry, including automotive, medicine, aerospace, agriculture, and defense, critically relies on the production and utilization of semiconductors. Furthermore, the defense, biomanufacturing, battery production, and semiconductor industries are critical subsectors of manufacturing in Indiana; these industries all rely on the availability of semiconductors and microelectronics devices while also sharing a talent pool of skilled, high-tech workers. The significance of the growth in these sectors cannot be overstated. While the semiconductor and microelectronics industry is Indiana's smallest manufacturing subsector today, it is one of the fastest growing and most strategically important for the future [1]. To meet the scale of need for this sector requires collaboration, innovation, and a shared commitment to construct and execute workforce solutions.

As a part of this solution at Ivy Tech Community College, the institution has created a semiconductor fabrication short-term certificate that will lead directly to high tech, technician-level jobs in the semiconductor and microelectronics industries. Ivy Tech Community College is a statewide community college with 19 campuses across Indiana and over 200,000 students; the college's size and prominence in the state positions it well to meaningfully impact the manufacturing sector's need for the future workforce in Indiana. In addition to developing the semiconductor fabrication certificate, related engineering and technology programs have added additional skills enabling students to enter an increasingly high-tech workforce. This effort was not accomplished in isolation; to prepare both students and faculty to meet the needs of the future workforce, Ivy Tech Community College has partnered with Purdue University to rapidly accelerate the integration of project-based microelectronics activities and applications into various curricula. This has allowed faculty, and ultimately students, to learn how semiconductors and microelectronics relate to courses within programs ranging from engineering to engineering technology to industrial maintenance to IT. Continuing the momentum from the partnership, microelectronics robot competitions in which students across several programs utilize skills learned about microelectronics in an introductory course to create a robot to achieve a specific goal have been developed.

From this work in developing a program and curriculum for an emerging industry, has led to using semiconductors as a relevant application to prepare students to enter a technical field with successful engagement across several fields. While external political and economic factors have caused industry uncertainty as to when hundreds of new high-tech jobs will come to the state, the positive impact of this work has already brought to the sector community is palpable. This paper will describe further the mechanisms that have been employed to equip faculty and students to meet Indiana's growing semiconductor and microelectronics subsectors and highlight the results of work thus far.

Introduction

There has been an increasing demand for the United States to strengthen its capabilities in the semiconductor and microelectronics industries. Semiconductors and microelectronics are found in technologies utilized daily, such as smart phones, laptops, and vehicles. These technologies are also crucial for almost all industries; manufacturing industries rely on semiconductors to automate facilities, agricultural operations rely on smart sensors and drones to maximize efficiency and save weight, and biotech companies rely on semiconductor materials to make advancements with new products. Following this importance have been funding opportunities, which have occurred at the national, state, and local levels. Within the state of Indiana, funding from the CHIPS Act, the Department of Defense, and READI, a state-led initiative through the Indiana Economic Development Corporation, have supported the development of the semiconductor workforce. While 4-year colleges have been impacted by this funding, this paper will focus on the 2-year college system within the state.

Ivy Tech Community College is the largest singly accredited community college system in the United States, with 19 full campuses located across the state of Indiana. The college offers associate degrees, technical certificates, and certificates in programs ranging from manufacturing to nursing to education. While not all campuses offer all academic programs, the campuses share a catalog with consistent degree structures and course outlines. This structure promotes unity across the state while allowing each campus the ability to tailor their course assignments to their local students and stakeholders. To solicit feedback from local industries and transfer partners, programs each have an industrial advisory committee that meets at least biannually. Relating to the semiconductor and microelectronics industry, Ivy Tech Community College has programs in engineering, engineering technology, electrical engineering technology, electronics and computing technology, industrial technology, and advanced automation and robotics technology. Each of these programs offer either an Associate of Science or Associate of Applied Science degree; yet a shorter credential was determined necessary to more quickly adapt to the increased workforce demand that the semiconductor industry will bring to Indiana. To equip college faculty and administrators to respond to the needs of the semiconductor and microelectronics industries, professional development opportunities with actionable takeaways were developed through partnerships with the community college system and Purdue University. Lastly, so that students from a variety of programs had exposure to the semiconductor industry, microelectronics projects and curriculum have been integrated into courses across several disciplines. Through these avenues of integrating semiconductors and microelectronics, Ivy Tech Community College has broadened access to this emerging technology that is changing the future workforce. This paper hopes to provide context for the following items. In what ways does the design of a short-term Semiconductor Fabrication Certificate linked with cross-institutional professional development workshops influence the subsequent integration of microelectronics content across technical disciplines?

Literature Review

The microelectronics and semiconductor industry has gained attention across the United States as the CHIPS and Science Act has funded initiatives to strengthen the country's prominence in the field. Educational institutions will play a pivotal role in supporting this initiative because bringing microelectronics and semiconductor jobs to the country will require additional skilled workers with background in engineering, engineering technology, electronics, and machine maintenance. Specifically looking at the technician level, where community colleges can play a large role in training workers, it is predicted that over 100,000 additional jobs will be created across the country to meet the expected semiconductor workforce demand [2]. Leveraging the strengths of community colleges will be crucial for meeting this demand. Community colleges excel in offering short, career-focused credentials and training to students. Partnering with industry to develop and improve these offerings will therefore only strengthen the workforce pipeline for graduates [3].

Another strength of community colleges is their tie to the local community. In the United States, 72% of community college graduates work within the metropolitan area of their college [4]. Therefore, when a city learns that an industry may soon be coming to or growing in an area, catering to students at the community college level, whether they graduate and go into the workforce or transfer to a 4-year university, strengthens the local workforce pipeline.

Within Indiana, four main subsectors are leading innovation and growth. The aerospace, automotive, life sciences, and microelectronics sectors are drivers of innovation and productivity [5]. These sectors have common needs and adoption principles; all are fueled by the adoption of automation technologies to control and monitor manufacturing and industrial processes. Further fueling these processes is the adoption of Artificial Intelligence, AI, as part of the fabric of these industries. Some of the highest forms of automation occur within chip making facilities. Chip sales and growth have been fueled by the adoption of AI. As an outcome of these factors, Indiana’s advanced manufacturing and logistics industries are continuing to grow, but a trained workforce is lagging.

Structured Professional Development has long been a central tenant of change of intent for structured learning. Allowing faculty to engage in structured learning that is relevant to the discipline is a primary strategy to create change in course direction. For faculty, enacting a new idea is not a matter of simple adoption but rather a matter of figuring out whether, when, and how to incorporate that new idea into an ongoing system of practice which is already satisfactory, and may be largely habitual [6]. One of the best ways to facilitate change within an institution or program of study is facilitating enactment through strategies carried out by faculty. Professional development for faculty members can help to foster insight which in turn requires individuals to reshape understanding and reframe behavior in the form of course content adoption, assessment principles, and analysis of outcomes.

Methodology

Program Integration

To account for the growing demand of jobs related to semiconductors and microelectronics, Ivy Tech Community College developed a new credential, revised outdated courses, and revitalized lab facilities so all three aligned with local industry needs.

In 2023, Ivy Tech Community College developed a new certificate under the Electronics and Computer Technology program. The new 21 credit-hour certificate was labelled as the

“Semiconductor Fabrication Certificate” and was designed so that it would stack into the Electronics and Computer Technology Technical Certificate, a 31-credit hour credential, and the Associate of Applied Science AAS degree, with semiconductor courses counting as electives in both the Technical Certificate and AAS degrees. These pathways will give students the flexibility to choose the level of knowledge they pursue. Ranging from the core, semiconductor-specific set of courses to a broader array of electronics, STEM, and general education classes. While six Ivy Tech campuses offer the Electronics and Computer Technology program, based on local industry need, only three campuses were approved to offer the new certificate. The Semiconductor Fabrication Certificate was launched at one campus in spring of 2025 and at another campus in the fall of 2025. There is not a date set for the third campus to start offering the courses for the Semiconductor Fabrication Certificate.

The Semiconductor Fabrication certificate is 21-credit hours and contains courses already found in the College catalog; these include two foundational electronics courses and five courses specific to semiconductors and microelectronics. The two core electronics courses cover basic electronic circuits and digital logic. Both courses are dual credit courses, allowing Indiana high school students utilizing the electronics high school pathway to complete six-credits of the certificate before they graduate high school. This sets up another pathway for high school students to enter the semiconductor and microelectronics field of study. The five microelectronics specific courses had been created in 2022 to discuss Micro-Electro-Mechanical systems (MEMs) but still included topics that were relevant to semiconductor fabrication such as photolithography, deposition, etching, packaging, and vacuum systems. The titles, course descriptions, learning outcomes, and content topics were reviewed for these courses by faculty leading the programs and members of the Electronics and Computer Technology program advisory boards to ensure that they were relevant to our students today and remained relevant as technology changes. Based on the review, both minor and major changes were proposed to update all five of these courses. These changes were proposed during the 2025-2026 academic year and were approved through academic routing and are now in place to start the fall 2026 academic semester.

To accommodate the new applications that the Semiconductor Fabrication certificate will cover in courses, the campuses that have adopted the certificate have updated lab facilities. The Bloomington campus was the first campus to launch the certificate and that campus has close industry connections to the defense and biotech industries. The Bloomington campus worked closely with a local industry partner to develop an industry lab space that Ivy Tech students would be able to utilize for projects. This supplements the electronics labs already on Bloomington’s campus, allowing students the opportunity to experience actual semiconductor fabrication and testing equipment while not drastically altering the campus’s facilities. The Lafayette campus was the second to launch the certificate and this campus has close connections to Purdue University and SK Hynix, a leader in the semiconductor packaging industry. The Lafayette Ivy Tech campus is installing an ISO 8 cleanroom for students to use in addition to the existing electronics labs. The cleanroom will prepare students to work as technicians in the semiconductor industry; it is forecasted that there will be hundreds of these jobs brought to the greater Lafayette area within the next 5 years [7]. In addition to training students, Ivy Tech is hopeful that the clean room in Lafayette can serve as a training facility for instructors and students from across the state that need to learn dedicated semiconductor fabrication processes and proper manufacturing gowning techniques. The Fort Wayne campus is the third campus with the certificate but due to faculty changes they have not yet implemented the program. Even though each campus has different lab facilities, the autonomy embedded within Ivy Tech allows the Lafayette and Bloomington campuses to tailor labs and coursework to local needs. This is an evident need considering community college students are likely to stay within the local area, catering specifically to local stakeholders at each campus will further develop the workforce pipeline that leads from the Electronics and Computer Technology program to semiconductor and microelectronics jobs [4].

<u>Faculty Integration</u>

To support faculty teaching inside and outside of the Electronics and Computing Technology program, Ivy Tech partnered with colleagues at Purdue University to create professional development opportunities each summer starting in 2024. These professional development opportunities were made available through CHIPS Act funding that was awarded to the Silicon Crossroads Microelectronics Commons Hub. This hub is an innovation ecosystem of diverse partners driven to accelerate expansion of America's microelectronics base by leveraging strong collaborative practices that strategically support innovation, workforce development, and infrastructure needs to achieve domestic microelectronics excellence [8]. This unique arrangement has allowed the Engineering Education discipline at Purdue to serve as a conduit to train faculty in microelectronics principles, equipment, and processes to drive change within the Community College system.

In the first summer, a 2-day workshop was developed for faculty at Ivy Tech to learn about microelectronics and how to create curriculum that discusses these topics. Since this opportunity was created specifically for Ivy Tech faculty, Ivy Tech leaders worked very closely with our colleagues at Purdue University to develop the workshop in a way that would meet faculty needs. These sessions included the basics of programing with microcontrollers, examples of more advanced microelectronics projects, pedagogical and andragogical strategies to implement microelectronics into courses, and collaborative time to develop curriculum. The event was hosted at Purdue University and received funding from Scalable Asymmetric Life Cycle Engagement (SCALE) which allowed faculty to receive stipends and reimbursement for travel and lodging.

In the second summer, Ivy Tech faculty and administrators were invited to join the larger professional development opportunity hosted by SCALE, allowing these instructors to join other faculty from across the country. Ivy Tech did not play a role in coordinating the workshop this year but instead led two breakout sessions. These two sessions focused on integrating microelectronics into courses from a variety of disciplines and determining the means of support faculty need to be able to execute ideas from the workshop. These breakout sessions were developed based on observations from the previous summer with the goal of catering unmet needs from the first year's participants while allowing faculty from other schools to benefit as well. Additionally, in each session data was captured through surveys to better understand the participants' takeaways and build on them to create opportunities in the future.

In the third summer, the workshop will take elements of the two prior ones, consisting of sessions with only Ivy Tech faculty and sessions faculty from other universities. Utilizing the feedback and data from the prior summer, these sessions will focus on giving faculty strategies of microelectronics integration and examples of activities they could implement. This year it will also highlight the ways AI can be integrated along with microelectronics. Ivy Tech faculty will be leading several of the sessions and assisted in coordinating the portions of the workshop Ivy Tech faculty will be attending.

Student Integration

To relay the relevance of microelectronics and semiconductors to students, topical course integration began into a variety of courses through labs and projects.

The Lafayette campus faculty utilized the ASEE TYCD 2026 model design competition as the basis for the projects used in the introductory engineering and engineering technology courses. This year, the model design competition required students to develop an autonomous robot that could take three different colors of golf balls that were scattered across a mini-golf course and sort them into bins by respective color. The engineering introductory course requires students to design and construct an autonomous robot, aligning with the objective of the model design competition. The mechanical engineering technology introductory course does not require students to create a robot, or even a project. At the Lafayette campus, projects historically have been used to teach the other learning objectives in the course, which include engineering processes, theory, and tools. Past course projects have ranged from rubber-band-powered race cars to gearboxes solving the problem of a local industry partner. Therefore, this was the first year the mechanical engineering technology students had been given an autonomous robot project.

At the Fort Wayne campus, the labs in the digital electronics course were revised to use microcontrollers instead of standalone components. By using microcontrollers instead of traditional logic gates, students were given a more practical example of how digital logic affects modern electronics and how engineering and computer scientists write programs to interface with these devices. The subsequent movement towards programmed devices as opposed to designed logic has followed the overall adoption of automation from fixed, to flexible, to programmable. Industrial adoption of devices and automation continue to rely on semiconductor microprocessors as the basis for programmable logic within devices. This adoption scheme has forced the earlier integration of programming languages and methods into coursework and pathways. This switch from designed logic to programmed logic has been a large undertaking by the faculty member.

These initiatives were disseminated across the state to other Ivy Tech campuses, allowing other faculty the opportunity to integrate microelectronics in their own courses.

Results and Discussion

Program Integration

Within the Electronics and Computing Technology program, Ivy Tech has implemented changes to the credentials offered, curriculum, and lab spaces across Indiana. With these changes, Ivy Tech has begun assessing the impact on students and faculty to determine the broader effect on industry skill needs.

Reviewing the enrollment for the Semiconductor Fabrication certificate, there has been slight growth for both campuses. In the first semester of the program, the Bloomington campus had three students, and the Lafayette campus had five students. In the second semester, the Bloomington campus had six students, and the Lafayette campus had four students. In the third semester, the Bloomington campus had five students. Currently, the Bloomington campus has had 2 students complete the certificate credential. The expected number of semiconductor technician, industrial engineering technician, electrical and electronics repairer, and electro-mechanical and mechatronics technician jobs in Lafayette and Bloomington in 2030 is expected to be 225 and 295, respectively [9]. Furthermore, the number of jobs between 2023 and 2030 is expected to increase 14.8% in Lafayette and 12.2% in Bloomington [9]. All four jobs were considered together because there is currently insufficient data to forecast the number of semiconductor technician positions alone and the semiconductor certificate could lead into any of these roles. Therefore, to fulfill this need, the programs will need to continue increasing their enrollment over the next 5 years.

Through implementation of the Semiconductor Fabrication Certificate, it was determined over time with input from industry that the courses utilized from the Electronics and Computing Technology Program needed to be updated significantly. Updates were made so the course descriptions, learning objectives, and content topics were robust enough to withstand technological advances. Specifically, this included removing mention of micro-electromechanical systems (MEMs), specific software, such as LabView and Minitab, and specific devices, such as actuators and cantilevers. To demonstrate the relevancy of these courses to stakeholders, the following topics were added to the courses: current fabrication processes, relevant applications, automation and quality, and safety. Monitoring student success in these courses before and after the changes will be a crucial element in determining course strategic direction moving forward. Three cohorts of students between the two campuses completed each course prior to the changes. Prior to the changes, the percentage of students completing the courses with a passing grade was 83% for one course and 100% for the other four. The changes will be fully implemented with the release of the 2026-2027 catalog, in the fall semester of 2026. Course success data will be reviewed from the first three cohorts, keeping in mind the small sample size which ranged from two to twelve students depending on the course. This outcome data will be reviewed at subsequent curriculum committee meetings and with industry partners to gauge impact and efficacy.

The course changes will also impact course enrollment because these changes were meant to demonstrate the relevance of the courses to industry partners. The expectation is that the course name changes will have the large effect on enrollment; one course name was changed from

“Introduction to Microsystems” to “Introduction to Semiconductor Fabrication” and the name of another changed from “Microsystems and Electronics” to “Microsystems Testing and Process Control”. These course name changes better reflect the content in the course and translate how the content applies to current workforce demands, making it easier for employers and support staff to determine the relevance of these courses with respect to their industry.

To support the enrollment in the Semiconductor Fabrication certificate, both the Bloomington and Lafayette campuses have undergone marketing efforts to produce student and industry centered materials linked to the sector area. These materials highlight the current and expanded lab capabilities of the campuses. Both campuses held summer camps for learners interested in semiconductors and microelectronics over the summer of 2025. The Lafayette campus ran a similar camp the prior 2 summers; all three years were funded by the Indiana Economic Development Corporation’s READI grant and catered to rising high school sophomores and juniors. The Bloomington campus held two camps, one for adults and one for students; both gave participants hands on experience with microelectronics and semiconductor industry foundations and equipment. Outside of industry partnerships with program advisory boards, the Lafayette campus has done outreach with local schools and dual credit courses to perform microelectronics demonstrations in related high school courses. Success from these efforts will be documented through increased program enrollment and tracking of interested students over the next several years.

Faculty Integration

To provide 2-year faculty with professional development opportunities to learn about integrating semiconductors and microelectronics into their courses, Ivy Tech had participation across a wide array of disciplines. Faculty ranged from the Engineering, Engineering Technology, and Electronics and Computing Technology programs to the Industrial Technology, Information Technology, and Advanced Robotics and Automation programs. The number of participants also increased between the first and second workshops. At the first workshop, 16 participants from Ivy Tech attended and at the second there were 20 participants. The third workshop headcount currently is at 17 participants and is scheduled for May 20th and 21st, 2026.

In the first year of the workshop, there were many administrators in attendance. This was likely due to faculty being off contract over the summer, while administrators are still working at least part time. The first workshop focused on adding Arduino technology to coursework and a broader understanding of changing coursework to include information about semiconductor manufacturing and utilization of microelectronics components during daily life. Going into the second workshop, a session was led that specifically looked at the administrative side of integrating microelectronics into courses and how those in administrative roles could support faculty. To capture the ideas participants brought to the session, we asked attendees to complete a brief survey and then lead a discussion to brainstorm solutions to problems faculty and administrators foresaw. Summarizing the results from the survey questions, the participants’ understanding of microelectronics varied substantially, as did needs, which ranged from funding to materials knowledge. Looking into financial need, the participants had varying levels of concern (or lack thereof) about the budget; this varied by campus. The expected results were that two cost factors that arose would be for additional equipment and project supplies and for compensating faculty for their time spent re-developing courses and learning about how microelectronics fit into those course modalities. These factors were validated through survey responses. This lead to the request some faculty had for additional support to increase their expertise in microelectronics and related applications. Overall participants requested additional support from those in administrative positions and that the college lead a more cohesive effort to integrate microelectronics into courses. In our discussion about how these means of support could be obtained, several avenues of sharing course content were mentioned, ranging from a shared Canvas course shell where faculty could share their microelectronics content with other faculty to a database managed by the deans of each campus. Some Ivy Tech courses already use consistent Canvas course content statewide which was noted might hinder the implementation of microelectronics since there are already non-microelectronics applications and projects in those courses. These statewide courses are contrasted with courses that are run independently by campuses; this format allows faculty more flexibility to modify assignments to use microelectronics but can be challenging for a new faculty teaching a course for the first time. Currently, for both statewide and campus-controlled courses, faculty are not compensated by the college for time they spend integrating microelectronics and semiconductors into their courses. This will likely be a significant barrier to faculty as they consider integrating microelectronics into the classes they teach.

Additionally, going into the second year of the workshop the expectation was that there would be many Ivy Tech faculty who taught outside of the engineering programs and that participants from other schools would be faculty almost exclusively from technology programs. To support the variety of programs, another session to allow participants to work together to draw connections between their courses and microelectronics was conducted. Based on the data collected during the session, it was determined that all classes could benefit from integrating microelectronics, subliminally introducing students to it as the industry gains prevalence. More specifically, discussions around how microelectronics could be integrated into specific Ivy Tech courses took place. This seemed to yield more actionable takeaways than the activity done in the first year of the workshop where faculty were asked to come up with ideas to integrate microelectronics themselves into individual course sections. For many of the courses that participants brainstormed, faculty emphasized that computational thinking and applications of microelectronics, such as AI and microcontrollers, should be the focus. Additionally, participants noted that in courses with strong ties to industry such as automation, industrial technology, and information technology were prime course sections in which the presence of microelectronics should be made known. The last key takeaway participants mentioned was the integration of AI competencies into courses with occasional and intentional references to semiconductors and microelectronics as the backbone for the implementation of this technology. Participants noted that some courses may benefit from adding microelectronics and semiconductor applications to their catalog records. Additional work would be needed from across the college to implement these types of changes.

After each workshop, participants were encouraged to integrate microelectronics in coursework and share this curriculum with the larger group to disseminate efforts across the college. Faculty teaching engineering and engineering technology courses submitted curriculum that embedded microelectronics in coursework that previously did not include these topics. As an example, one of the workshop participants, an engineering faculty member, integrated hands-on circuit activities into first year courses. The faculty member described these fundamental course changes as enhancing student learning and engagement. These course enhancements can be mapped directly back to expected program outcomes for students. From the workshops, two faculty members in engineering and engineering technology shared curriculum after the first year and three faculty members from engineering, engineering technology, and advanced robotics and automation shared curriculum after the second year. These ranged from individual lab assignments to course projects to course curriculums.

Furthermore, workshop participants from other programs from the School of Information Technology upgraded course materials in computer hardware and software coursework to relate back to semiconductor fabrication and AI initiatives. One faculty participant continued work after the second workshop to coordinate and design a new certificate program that focuses on Internet of Things, IOT, components and programming. This new certificate program consists of electronic circuit and digital logic courses coupled with computer networking and programming coursework that directly leads to the integration of networked microcontroller devices in a project-based format. This hands-on certificate continues to be worked on with the intention that students from a series of different pathways, industrial, electronics, engineering, and information technology, can benefit from the coursework.

<u>Student Integration</u>

From the first semester of integrating microelectronics through the ASEE TYCD model design competition, teams from both the engineering and engineering technology courses successfully developed robots that could complete part of the required task. Students were engaged in the project and were able to fulfill the learning objectives of their respective courses. This specific project robot was the catalyst to show how the engineering "theory" students learned in the course could be applied to actual hardware and software components. For example, a practicing engineer came to the preliminary design review, and asked students questions about motor torque and current output, both were topics students had learned about already but had not yet thought to apply to project constraints. Comparing this project to the prior ones from the mechanical engineering technology course that did not utilize microelectronics, the project did not seem to impact student success in the course. In previous projects with industry partners, students faced a high barrier to entry, where they needed to learn information specific to the industry before being able to develop plausible designs. In turn, with the robotic project, there seemed to be a smaller barrier to understanding the constraints of the project. The downside to this process was the loss of students' exposure to industry, which had been one of the largest takeaways from the course in previous years. To compensate for this loss, industry partners performed design reviews for the microelectronics project and provided students with an outside perspective.

Reviewing the data from the digital electronics course before and after microelectronics were added to the labs, there was not a significant change in student course success. However, there was a notable difference in programming skills required for the coursework. In the past, the digital course was focused on chip logic design, not on programmed logic design. This process of moving programmed logic up in the course sequence is aligned with current and past industry trends of integrating smaller forms of microprocessor-based components that are programmed for a function as opposed to designing a component and navigating through build and test of the device [10].

Conclusion

Ivy Tech has integrated a new program of study, opportunities for faculty to learn, and course content for students to adapt to the emerging semiconductor and microelectronics industries. Several institutional approaches have yielded significant results which have influenced the subsequent integration of microelectronics content across technical disciplines. Developing and leveraging strong industry partnerships has been crucial for implementing the Semiconductor Fabrication certificate and updating the courses within the certificate. Catering to the needs of these partners will lead to increased enrollment in the program, eventually fulfilling the growing workforce demand. The greatest downside to this early adoption approach has been the discrepancy between when students graduate from the certificate program and when actual jobs are available. While 4-year universities and graduate schools may feel pressure to output enough bachelor's, master's and doctor's degrees in the next 5 years, the shortened timeline to complete a certificate or associate's degree at a community college presents the opposite problem. Students can complete the program, but job opportunities may lag. Therefore, while working with 4-year university partners in the future, this difference in graduation timelines should be recognized and addressed. Support for faculty professional development and course development has been identified as a positive means of support most need to continue integration. Lastly in integrating microelectronics into courses, students from a variety of programs and courses have benefitted from seeing examples of how courses topics relate to emerging industries. There are further opportunities to expand current efforts in the introductory engineering and engineering technology coursework to other programs and campuses. Overall, the directed efforts in integrating semiconductor awareness and microelectronics utilization have begun to show success. These efforts will be able to be duplicated for future emerging technologies and strategies utilized remain a strong framework as work continues to adapt to the changing workforce needs.

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