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BOARD # 384: ITE Innovation and Technology Ecosystems: The Adult Learning Ecosystem in a Semiconductor Workforce Development Program

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ITE Innovation and Technology Ecosystems: The Adult Learning Ecosystem in a Semiconductor Workforce Development Program

1. Introduction

1.1 Context

Manufacturing has historically been the economic engine of the Midwest. Globalization led to the decline in traditional manufacturing. In recent years, there has been a resurgence of manufacturing activity in the Midwest [1, 2]. Supply chain pressures, national security threats and shortages of microchips emerging during the coronavirus pandemic created the political will for the U.S. to increase domestic manufacturing capability for microchips. Passage of P.L. 117-167 Creating Helpful Incentives to Produce Semiconductors and Science Act of 2022 – the "CHIPS Act" presented national goals to lead in the "research, development, manufacturing, and workforce development" in semiconductors by catalyzing U.S. regional innovation and providing workforce development and equity in STEM [3]. Illinois has incentivized development of the microelectronics manufacturing and jobs creation through the passage of SB3917, the Manufacturing Illinois Chips for Real Opportunity Act (MICRO) [4]. Illinois has also recently created a public-private partnership to develop the Illinois Quantum & Microelectronics Park (IQMP) and the creation of the midwestern Digital Innovation Semiconductor Center (DISC) to focus on workforce development in the sector.[5]

1.2 Program overview and purpose

The National Science Foundation recently funded the project, "Pivots: Chicagoland Partnership for Semiconductor and Microelectronics Experiential Learning (Mic2ExL)" (NSF: ITE Innovation and Technology Ecosystems Award #2322734). Mic2ExL is a partnership between Chicago State University (CSU), a small, Predominantly Black Institution (PBI), Quilt, a non-profit community organization, Argonne National Laboratory and industry partners designed to prepare individuals with the skills necessary to start new careers in the semiconductor and microelectronics industry in the Chicagoland area. The project focuses on reskilling workers through a series of compensated experiential learning activities. The impetus for the program arose from work at CSU's Center for Information Security Education and Research (CINSER), which is an Intelligence Community, Center for Academic Excellence (IC CAE) [6]. A strategic goal of CINSER is to prepare individuals for careers in critical and emerging technologies and to diversify the national security workforce by providing educational programs and community outreach [7]. The concerns over the security of the supply chain of semiconductor components and the need to develop and engage a local talent pool led to the creation of the Mic2ExL program which supports the national security interests of the U.S.

This paper presents a preliminary assessment of Mic2ExL's progress, highlighting key achievements, challenges encountered, and early indicators of success. This paper will also briefly present Mic2ExL as an example of the Adult Learning Ecosystem model [8].

2. Program activities and implementation

2.1 Program design

Mic2ExL relies on a model of experiential learning for adults. Adult learning is an iterative, cumulative process "*that is noncompulsory, purposive, and undertaken for the purpose of skill training, career advancement/development, or other occupationally relevant goals* (e.g., maintaining employability)."[9] A recent framework model has been suggested by Lyndgaard [8] which describes adult experiential learning as processes that include " (1) knowledge and skill acquisition, (2) the development and maintenance of motivation and wellbeing over time, and (3) transfer of learning to career-related goals."

The Mic2ExL program consists of a four-phase model of experiential education along with a mentorship and support program. There are four phases. Phase 1. *Classroom/laboratory Based Learning:* Foundational knowledge is acquired through 100 hours of hands-on learning in projects provided in a classroom/small laboratory setting. Phase 2. *Application for Learning:* Completion of a 100-hour project at Argonne National Laboratory. Phase 3. *Experience at Employer Workplace*: Participants spend 50 hours at an employer in the semiconductor and microelectronics industry. Phase 4. *Job Fair/Professional Development:* Participants participate in a job fair and professional development. This model, which includes a mentorship and a wraparound support component, includes all the processes described by Lyndgaard [8]. A key project goal is to reskill 60 adults in small cohorts over three years. Project participation targets U.S. citizen, working adults with a minimum high school diploma (or equivalent).

The Mic2ExL program is driven by the following five project goals: Goal 1 is to increase awareness of career opportunities in the Chicago area semiconductor and microelectronics industry; Goal 2 is to increase participation in the U.S. semiconductor and microelectronics industry; Goal 3 is to provide experiential learning opportunities and support for working adults to transition into new careers; Goal 4 is to support economic development of the Chicagoland region and Goal 5 is to support national security interests of the U.S. by developing a robust domestic workforce prepared to work in semiconductor and microelectronics.

2.2 Partnerships and collaboration

Mic2ExL is a partnership, so in addition to project goals, there are also three partnership goals: (1) to increase cooperation and collaboration between higher education, nonprofit/community development organizations, government research facilities and local industry in support of workforce development for careers in advanced technology; (2) to expand workforce development opportunities for careers in semiconductors and microelectronics, and (3) to support the establishment and continued development of a Chicagoland semiconductor and electronics manufacturing sector by ensuring a pipeline of qualified workers.

3. Progress and Outcomes

Recruitment activities for cohort 1 began in January 2024 and consisted of outreach by partners and word-of-mouth. The first cohort of twenty participants began Phase 1 on March 15, 2024. There were 32 applicants for cohort 1. Candidates were selected based on an analysis of their

interest in semiconductor careers, their eligibility to participate in the program and their availability to participate in program activities. Most participants were working at least part-time; a few were not working or were in formal education programs. Phase 2 (cohort 1) began at Argonne National Laboratories on September 9, 2024. Phase 3 (cohort 1) began on October 1, 2024, at Flextron Circuit Assembly, a PCB manufacturer in Wood Dale, IL. Phase 4 for cohort 1 began in March 2025 and is ongoing. Cohort 2 (Phase 1) began on March 15, 2025, with 25 individuals accepted into the program (94 applications for the cohort).

3.1 Key metrics of success

Although the project has been in implementation for a little over a year, some progress has been achieved (see Tables 1 and 2).

Table 1. Project Success Metrics

Project Goal	Key Success Metric	Result
Increase awareness of career opportunities in Chicagoland semiconductor and microelectronics industry for individuals from underrepresented groups	Success of cohort recruitment	Cohort 1 – 32 applicants Cohort 2 – 94 applicants **Awareness is increasing**
Increase participation of individuals from underrepresented groups in the U.S. semiconductor and microelectronics industry	Completion of program by underrepresented groups	Cohort 1: Phase 1 - 17 completers; Phase 2 - 10 completers; Phase 3 – 9 completers; Phase 4 – in progress. Cohort 2: Phase 1 – 21 still in program **Program completion is mixed**
Provide experiential learning opportunities and culturally responsive support for working adults to transition into new microelectronics careers	80% participants and mentors report effective and valued learning opportunities	**Final survey will be completed at the end of phase 4 – In progress**
Support economic development of the Chicagoland region in high technology	Active engagement of industry partners	**Engagement of all initial partners; new partners engaged** (see below)
Support national security by developing a diverse domestic workforce in semiconductor and microelectronics	Placement of program graduates	**In progress** 4 job offers so far

The original partnership members included CSU's CINSER and Office of Continuing Education, The Illinois Manufacturing Association (IMA), Quilt (a community non-profit organization), Argonne National Laboratory and an industry partner NanoAffix. In less than a year, the partnership has grown to include the Chicago Cook Workforce Partnership Information Technology Sector Center, Phalanx Family Services (a community non-profit organization),

Flextron Circuit Assembly (local PCB manufacturer), CSU's Trio Programs, the University of Illinois' Illinois Semiconductor Workforce Network (ISWN), UIUC's Illinois Semiconductor Student Alliance and the Ohio Southwest Alliance on Semiconductors and Integrated Scalable Manufacturing (OASiS). The Intel Corporation has contributed webinars on career preparation.

Table 2. Partnership Success Metrics

Partnership Goal	**Key Success Metric**	**Result**
Increase cooperation and collaboration between higher education, nonprofit/community development organizations, government research facilities and local industry in support of workforce development	Number of Collaborators Types of Collaborations	Original Collaborators: 6 Current Collaborators: 13 Collaborations in jobs fairs, site tours, webinars/speakers, and external grants. **Collaboration is growing**.
Expand workforce development opportunities for careers in semiconductors for target group	Placement of Participants in Semiconductor Careers	**In progress** 4 Job Offers
Establishment and development of a Chicagoland semiconductor and electronics manufacturing pipeline	Completion & placement; Partner engagement	**In progress**

Two significant signs of early project success are the ability to expose individuals from an informal learning program to Argonne National Laboratory. Typically, internship experiences at national laboratories are available to individuals participating in formal education so the success of Mic2ExL is providing working adults exposure to the national laboratory environment who would not otherwise have access. A second success was the opportunity to partner on a grant that was awarded to University of Illinois by the National Semiconductor Technology Center (NTSC) to the Illinois Semiconductor Workforce Network (ISWN). Small universities like CSU don't have the capacity alone to be competitive applicants on grants at this level.

3.2 Challenges and lessons learned

Minority serving institutions like CSU are under-resourced by definition. The compounded inequities of diminished and sometimes inadequate institutional resources combined with a project that serves an economically disadvantaged population make project success difficult in the best of circumstances. The project has experienced some expected and unexpected challenges. The challenges included the struggle for timely payouts from the university to participants for stipends and wraparound support (e.g. transportation allowances). Timely payouts are critical for individuals attempting to reskill. Another challenge is locating industry partners who are willing to take on short-term interns; semiconductor companies have concerns about legal liability and must protect the security of their processes. The project is now experimenting with introducing elements from Phase 4 along with Phase 1 for cohort 2 based on informal feedback from cohort 1; exposure to jobs and job searching at earlier phases supports

the motivation of participants to persist. A final major struggle has been ensuring access to transportation for participants from underserved communities. The program is exploring many options to overcome challenges.

4. Conclusion

Mic2ExL has demonstrated promising early results in addressing the workforce needs of the Chicagoland semiconductor industry. The program's curriculum, strong partnerships, and focus on experiential training have contributed to the program success of the first phases.

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