



## **AAS Controls Technology Stackable Degree Education Requirements for Employees by Highly Automated Manufacturing Companies Drives a Collaborative Pathway at Weber State University**

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#### Abstract

Highly automated manufacturing facilities in northern Utah are placing requirements on maintenance personnel to obtain associate degrees in Controls or Automation Engineering Technology that enhance their existing training and skills to be considered for advancement in automation technology positions. A demand to fill these technical positions has led local companies to hire engineers and technicians outside the community and out-of-state to find applicants that possess required qualifications. This resulted in little success in retention and became costly and frustrating. In January 2016, a summit was organized by local industry to discuss the option of developing an educational pathway within the community that prepares employees for automation technician positions. To be considered for the automation technician position, an associates of applied science degree is being made mandatory due to the complexities of the automated manufacturing environment. An emphasis was stressed by industry on the importance of investing in their employees to assist them with educational needs and support their advancement. Over the next year, a strong collaboration with industry partners, the local Applied Technology Colleges (ATC), and Weber State University (WSU) led to the development of an educational pathway resulting in a stackable Associates of Applied Science (AAS) degree in Controls Technology.

The Engineering Technology Department provided a solution for our industry partners by implementing a collaborative pathway in conjunction with the local Applied Technical Colleges. The purpose of the pathway is to assist maintenance personnel working in industry with a seamless technical education that will allow them to progress within their company. The AAS Controls Technology (AAS CT) degree is a two-year stackable degree that builds on the 900+ hour Industrial Automation Technician (IAT) certification from one of the three local ATCs. It is a 69-credit hour degree that includes a block of 25 credit hours for the completion of the 900 IAT certification. Maintenance technicians are typically required to obtain the IAT certification to provide an introduction into basic industrial technologies including safety, electrical, pneumatics, hydraulics, machining, programmable logic controllers, robotics and troubleshooting. The AAS CT degree is a blend of Electronics Engineering Technology and Manufacturing Engineering Technology courses supplemented with science, math and general education requirements, yielding a solid theoretical foundation supported with applied learning. Together, with industrial experience, the IAT certification and the AAS CT degree produce a knowledgeable, skilled employee capable of constructing, programming, maintaining, troubleshooting and supporting equipment in the highly automated industrial environment.

The success of the Controls Technology pathway will be determined by number of graduates from the AAS CT program over the next four years. Industry partners will provide input on challenges and successes for each institution at the annual advisory board meetings.

## Introduction

Weber State University is a public university situated at the base of the Wasatch Mountains in the northern part of the state, located in Ogden, Utah, with nearly 1000 faculty members serving over 26,000 students. There are eight applied technology colleges (ATC) that comprise the Utah Systems of Technical Colleges, three that serve Northern Utah: Bridgerland ATC, Ogden-Weber ATC, and Davis ATC. Manufacturing in Northern Utah is diverse and includes but not limited to aerospace, automation, automotive, composites, medical devices, military defense, and sports equipment. Todd Bingham, President of the Utah Manufacturers Association, states that one of the challenges we have in manufacturing today is “the increasing demand for a much more skilled and advanced workforce [1]”. Collaborations between industry and academia are necessary to provide a workforce that meets the needs of our community.

## Development of the Pathway

In 2016, program coordinators from the local ATCs and Weber State University attended a summit that was organized by local industry partners with a mission to discuss the development of a pathway specifically aimed at maintenance employees to obtain an AAS degree in a seamless transition from the ATC certification program. The degree would specialize in automation or controls technology and would qualify personnel to fill automation engineering technician positions at local companies. At the time, an associate degree in a field related to automation did not exist in northern Utah. Employers attempted to hire qualified applicants from out-of-region and even out-of-state with little success in retention and determined that it would be more cost effective to support educational development and promote within the company. The industry partners documented specific technologies that candidates would need to possess in theoretical knowledge, technical skills, and technical abilities to be successful as automation engineering technicians. The representatives from the educational institutions evaluated the existing courses in their programs that applied to the documented industry requirements. The outcome of the summit was the development of a new pathway that would be a unique collaboration between institutions involving stackable credentials with labor market value.

## Pathway Design

The design of the pathway streamlines the educational process and expedites the student progress, giving them multiple entry and exit points, Fig 1. The pathway begins with the IAT certification from one of the local ATCs and concludes with the AAS Controls Technology degree. Optionally, students can exit the pathway at any time for employment opportunities and reenter to obtain the AAS CT degree with the choice to complete a Bachelor of Science in Electronics Engineering Technology (BS EET) offered at Weber State University. The AAS Controls Technology degree is a non-accredited degree that serves the needs of local industry.

Each successive step provides students access to advanced credentials and associated higher wages, allowing an individual to progress along a career pathway. Students taking advantage of the stackable credential track from one of the ATCs through WSU will obtain the technical skills necessary to be employed by a northern Utah manufacturer as an automation technician and

eventually as an automation engineer. Each stage of the pathway directly supports economic growth in the manufacturing industry cluster in Northern Utah.

The pathway was constructed by evaluating the courses in the IAT certification program for technical content. Coursework in the certification program offered technical skills, but lacked the supporting theoretical knowledge. A combination of coursework from each institution provides both the technical skills and the theoretical knowledge that employers require for the level of automation engineering technician.

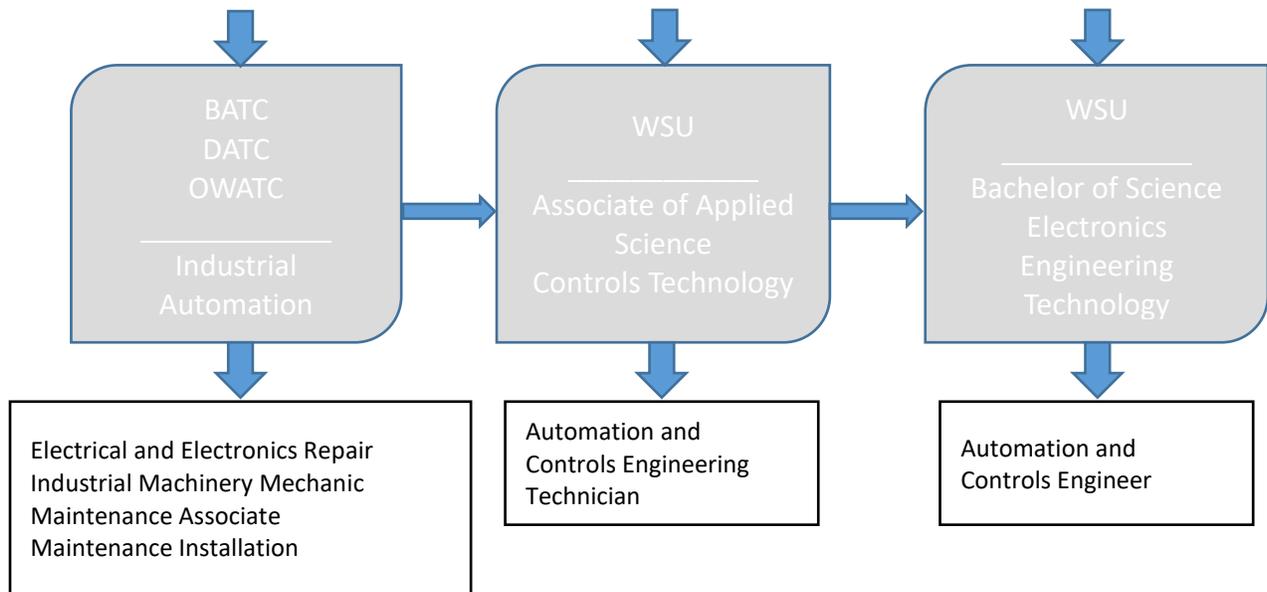


Figure 1 Controls Technology Pathway

### Approach

A strong connection between educational institutions and industry is crucial in the collaboration process. In this case, the relationship was primarily driven by industry, who demonstrated a purpose and demand for the Controls Technology Pathway. The partnership covered post-secondary academic levels, including high school Concurrent Enrollment, Career and Technical Education (CTE), technical colleges, Salt Lake Community College, and Weber State University joined by several Wasatch Front manufacturing industry partners. Employer engagement is essential during the design process of the pathway; they offer leadership and ongoing support for the programs. As partners, they provide work-based learning experiences that are essential in the technology programs.

All educational entities involved in the process recognized worth in their efforts for their institution such as an increase in enrollment, curriculum development around new technologies, and opportunities for funding of new equipment. Faculty workload increase is minimal due to a small rise in class sizes.

The Utah State Board of Education (USBE) recommended upon the approval of the AAS Controls Technology degree that all post-secondary institutions develop similar pathways as part of the USBE strategic plan, Education Elevated, that result in credentials with labor market value.

## Collaboration

Northern Utah manufacturing is a diverse group that includes industries in aerospace and defense, energy and natural resources, outdoor products, and automotive safety. The state of Utah encourages collaboration between industry and education to develop opportunities for high-demand and high-wage occupations with funding through the Governor’s Office of Economic Development to support these efforts.

Weber State University has a student body of over 26,000 students with seven academic colleges offering over 230 programs. The Engineering Technology department has four programs: Design, Manufacturing, Mechanical, and Electronics Engineering Technology. Most of technology students work out in industry while attending school.

The three Applied Technology Colleges in Northern Utah are Davis ATC (DATC), Ogden-Weber ATC (OWATC), and Bridgerland ATC (BATC). Each of the schools offer the Industrial Automation Technology certification ranging from 900 credit hours to 1300 credit hours and are composed of common core coursework.

Advisory Board members for each institution are representatives from local companies comprised of HR managers, technical support managers, and engineers that assist with the curriculum development process. Advisory Board meetings occur annually to discuss program development and to obtain guidance and support from industry through continuous improvement.

## Stackable Credentials

Stackable credentials are defined by the United States Department of Labor as a “part of a sequence of credentials that can be accumulated over time and move an individual along a career pathway or up a career ladder [2]”. Bailey & Belfield discuss three key elements to be considered for stackable credentials that provide economic value. First, the credentials forming the stack should individually be obtainable in a short duration. Second, each credential should have economic value that adds to an individual’s earning power (Table 1). Third, the structure of the stackables should provide a distinct pathway to obtain certifications and ultimately the completion of a degree, without loss of any credits from previous credentials [3]. The AAS CT pathway adheres to the three key elements.

IAT Technician	Electrical and Electronics Repairers, Commercial and Industrial Equipment	\$26.90
	Industrial Machinery Mechanics	\$16.80
	Maintenance Workers, Machinery	\$20.80
	Maintenance and Repair Workers, General	\$16.20
	Installation, Maintenance, and Repair Workers, All Other	\$21.70
Associate of Science in Controls Technology	Electrical and Electronic Engineering Technician	\$27.30
	Engineering Technicians	\$31.30
Bachelor of Science in Electronics Engineering Technology ( <i>needed for promotions and job transferability</i> )	Local Engineering Technology Majors	\$55,000-\$65,000 \$75,000 with experience <i>Source: WSU Faculty and Utah Department of Workforce Service</i>

Table 1 Associated Utah Wages

Students are more likely to complete a segment in the pathway in a reasonable time frame with proper advisement, guidance, and support [4]. An educational degree map is provided in Figure 2

which is used for student advisement to develop an academic strategy that fits the needs of the individual student. The Engineering Technology department at Weber State University has an academic advisor dedicated to assisting students with academic issues in the technology programs.

The degree map is complimented by a degree plan, shown in Figure 3, giving students a perspective on the time required to complete the AAS CT degree with courses outlined for each semester. The academic advisor can assist students with a custom-fit plan adjustable to balance with their life schedule.

<p><u><i>Required Engineering Technology Courses (23 credit hours)</i></u> <i>EET 1130 - Digital Systems Credits: (4)</i> <i>EET 1140 - DC Circuits Credits: (3)</i> <i>EET 2010 - AC Circuits Credits: (3)</i> <i>EET 2120 - Power and Motors Credits: (4)</i> <i>EET 2170 - Industrial Controls Credits: (3)</i> <i>MFET 2410 - Quality Concepts and Statistical Applications Credits: (3)</i> <i>MFET 4580 - Process Automation Credits: (1)</i> <i>MFET 4580L - Process Automation Lab Credits: (2)</i></p> <p><u><i>Required Support Course (25 credit hours)</i></u> <i>Students must complete the Industrial Automation Maintenance certification consisting of at least 900 hours at the collaborating ATCs: DATC, OWATC, and BATC. The certificate will transfer as a block of 25 credit hours toward the Controls Technology degree.</i></p> <p><u><i>Required General Education Courses (21 credit hours)</i></u> <i>COMM 2110 HU - Interpersonal and Small Group Communication Credits: (3)</i> <i>ECON 1010 SS - Economics as a Social Science Credits: (3)</i> <i>ENGL 1010 EN - Introductory College Writing Credits: (3)</i> <i>MATH 1010 - Intermediate Algebra Credits: (4)</i> <i>MATH 1060 - Trigonometry Credits: (3)</i> <i>PHYS 1010 PS - Elementary Physics Credits: (3)</i> <i>WEB 1701 TA - Document Creation Credits: (1)</i></p>
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*Figure 2 Degree Map*

Students can meet with the advisor at any time but are encouraged to visit at least once per semester to stay connected and on track. Weber State University adopted the Starfish system as a retention tool to assist students and keep them engaged and informed.

The ATCs use the Northstar student information system to maintain retention through strategic planning. Excellent counselling is available to ensure that the student has the resources to be successful in their programs. Academic advisors work with students, monitoring their educational milestones to completing their IAT certification in a reasonable time frame.

<i>Freshman Fall</i>			<i>Freshman Spring</i>		
<i>EET 1130</i>	<i>Digital Systems</i>	<i>4</i>	<i>EET 1140</i>	<i>DC Circuits</i>	<i>3</i>
<i>MATH 1010</i>	<i>Intermediate Algebra</i>	<i>4</i>	<i>Math 1060</i>	<i>Trigonometry</i>	<i>3</i>
<i>NTM 1701</i>	<i>Intro to Word Processing</i>	<i>1</i>	<i>NTM 1703</i>	<i>Intro to Spreadsheets</i>	<i>1</i>
<i>ECON SS1010</i>	<i>Econ as a Social Science</i>	<i>3</i>	<i>PHYS PS1010</i>	<i>Elementary Physics</i>	<i>3</i>
<i>Total</i>		<i>12</i>	<i>Total</i>		<i>10</i>
<i>Sophomore Fall</i>			<i>Sophomore Spring</i>		
<i>EET 2010</i>	<i>AC Circuits</i>	<i>3</i>	<i>MFET 2410</i>	<i>Quality Concepts and Stat Apps</i>	<i>3</i>
<i>EET 2120</i>	<i>Power and Motors</i>	<i>4</i>	<i>COMM HU 2110</i>	<i>Intro to Interpersonal Communications</i>	<i>3</i>
<i>EET 2170</i>	<i>Industrial Controls</i>	<i>3</i>	<i>ENGL 1010</i>	<i>Intro College Writing</i>	<i>3</i>
			<i>MFET 4580</i>	<i>Process Automation</i>	<i>1</i>
			<i>MFET 4580L</i>	<i>Process Automation Lab</i>	<i>2</i>
<i>Total</i>		<i>10</i>	<i>Total</i>		<i>12</i>

Figure 3 Degree Plan

### AAS Controls Technology Stackable Pathway

The AAS Controls Technology pathway consists of a stackable sequence of credentials that start with the IAT certification from one of the local Utah ATCs. Maintenance technicians are required to obtain a 900+ hour IAT certification or equivalent for their job position which can be accomplished in an average of 11 months. The completed IAT certification transfers to Weber State University as a block of 25 credit hours and counts toward the AAS CT degree as shown in the degree map. The AAS CT degree offers a reduced semester load over a typical AAS program due to the 25-credit hour application of the IAM certification. The degree plan outlines the sequence of courses allowing a student to finish the degree in four semesters.

Required engineering technology courses in the AAS CT degree total 23 credit hours. In addition, there are 21 credit hours of general education courses. General Education requirements can be completed online or during summer semester, leaving a much lighter load during the fall and spring semesters to accommodate student work schedules.

Students have the option of continuing their education to obtain a Bachelor of Science in electronics engineering technology (EET), an ABET accredited degree. They would have to complete a few leveling courses, such as Semiconductors and Communications, to be prepared for the upper division EET courses.

### Strategic Workforce Investment Grant

The Utah Governor's Office of Economic Development (GOED) is in full support of partnerships between higher education and industry to meet regional workforce needs and offers grants for such collaborative efforts. In the Strategic Plan 2016, the GOED administered the Strategic Workforce Investment (SWI) initiative, State Bill 103, (SB 103), to "regionally expand educational capacity for workforce development in a high-need strategic cluster that prepares students for high-growth and high-wage occupations [5]". It builds on previous initiatives that

were instituted to “strengthen collaborations between industry, education and economic development leaders to create talent pipelines for high-demand, high-wage occupations [6]”. The higher educational institutions involved in the AAS CT pathway met the criteria specified by the SWI program and were awarded sustainable funding for the next five years to purchase equipment, update lab facilities and increase faculty. To be considered for funding, the SWI proposal had to meet the following criteria [7]:

1. A collaboration of at least two or more educational partners from Utah higher education.
2. A focus on a strategic industry cluster defined by the GOED.
3. Support from an industry advisory board comprised of members from the selected industry cluster.
4. A defined non-duplicative, stackable credential pathway that culminates in obtaining an AAS or BS degree.
5. Support of the State Board of Regents.

The Engineering Technology department at Weber State University is receiving \$230,000 annually for the next four years to purchase equipment, hire a technical advisor to recruit and support the pathway, and to increase faculty. Each of the ATCs received \$90,000 per year to purchase equipment for their programs and to make improvements to curriculum.

### Enrollment

Before the grant was awarded and the degree was officially instated there were four students that enrolled in coursework working toward the AAS CT degree in spring of 2017. In the fall semester of 2017 six students declared the AAS CT degree as their major.

The Associate of Science in Controls Engineering was approved Summer 2016. Graduates are expected to earn above average pay of \$27 per hour and enjoy high placement rates due to the growing shortage of skilled labor in this field (Table 2).

Table 2 Pathway Student Data

Controls Engineering Technology Stackable Educational Pathway Student Data			
	Student Enrollment	Attainment Rates (2015-16)	Job Placement Rates
Certified Operator	Interim Certification		
Certified Maintenance Technician	BATC-14 DATC-n/a OWATC-n/a	BATC-13* DATC-n/a OWATC-n/a	BATC-93 DATC-n/a OWATC-n/a
IAT Technician	BATC-200 DATC- 216 OWATC-200	BATC-9 DATC – 8 ** OWATC-25***	BATC-100 DATC-98 OWATC-98
Associate of Science in Controls Technology	WSU-60 (potential)	New Program No data yet****	New Program No data yet
Bachelor of Science in Electronics Engineering Technology	WSU-10-15 potential added to Electronics Engineering Technology Degree		

\* Many of the BATC Electronics Engineering Technology and Automated Manufacturing and Robotics students are part-time and cannot complete within a one-year time frame. Often students complete enough courses and industry certifications to gain employment before completing a one-year certificate. With about an 80 percent completion rate overall. BATC also broadcasts to 100 high school students (juniors and seniors) in the early morning Automated Manufacturing 900-hour AM STEM program. Approximately 50 percent of these students could

complete the 900-hour certificate soon after graduating from high school. Since this is only the first year, no data exists for certificate completers yet.

## Conclusions

The AAS Controls Technology pathway offers technicians the opportunity to improve their job position and worth by obtaining stackable credentials in a reasonable time without loss of credits earned along the pathway. Students attend a technical college for less than a year to obtain a certification that gives them a career opportunity for advancement. They can choose to exit the pathway permanently or continue/return to the pathway to complete the stackable AAS CT degree for further career advancement. The local industry along the Wasatch Front in Ogden, Utah is being served through a unique collaboration between industry and academia that is providing automation technicians and engineers with desired knowledge, skills, and abilities through stackable credentials.

There are several institutions around the country that are implementing stackable credential programs in various ways. Most of these are programs that articulate credits from one institution to another for mirrored coursework (direct transfer articulation) or they are institutions that offer progress certifications for portions of completed coursework within a program. The Florida State Legislature enacted the Career and Professional Educational Act (CAPE, 2007) that promotes the collaboration between industry and educational institutions that has led to the articulation of nationally recognized manufacturing industry certifications to six to fifteen credit hours toward an associate degree. Georgia has a statewide policy that technical colleges must offer certifications that stack to associate degrees. Each state determines their own policy for stackable credentials and/or state funding that supports stackable credentials, of which, nineteen states have a policy in place for stackable credentials [8]. The AAS Controls Technology pathway articulates a block of credit hours that are awarded upon completion of the Industrial Automation Technician certification from one of three local Applied Technical Colleges and the credit is applied in a vertical stacking toward an associate of applied science degree at Weber State University.

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