

Building an Academic Pathway for Industrial Engineering Operations Technicians: Year 3 Interim Evaluation Report

Prepared for:

Lee Blyth
Professor and Coordinator for Logistics
Principal Investigator

Columbus State Community College
550 E. Spring Street
Columbus, OH 43215
614-287-5175

Prepared by:

Michael FitzGerald, Ph.D.
Lana J. Rucks, Ph.D.
The Rucks Group, LLC
714 E. Monument Avenue
Dayton, OH 45402

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Executive Summary

Columbus State Community College (CSCC), with funding from the National Science Foundation (NSF), is creating the Logistics Engineering Technician (LET) Pathway¹. By developing career pathways for LET technicians, and meeting the industry need for this skilled workforce, this project aims to: 1) establish an academic model for STEM-intensive programs that can be used to support a variety of technical occupations and sectors, 2) provide access to careers that offer significant earnings potential in the central Ohio area and provide flexible skill sets to meet the needs of many industries, and 3) increase diversity in the workforce through intensified outreach to underserved populations such as women, minorities, and veterans.

During Year 3, the project team implemented project aspects as outlined in the proposal. The project received approval in June of 2017 for the LET curriculum that was developed during Year 1. The approval process took longer than anticipated because of an unexpected requirement to gain approval from two entities that were not originally identified. The new curriculum and two-year degree program will be implemented in the fall of 2017. Additionally, as in Year 2, the project team hosted a pre-college initiative in the form of a two-day summer camp experience in June 2017 solely focused on the logistics engineering technician field. Attitudes towards LET as major and as a potential career showed statistically significant improvement after nearly every activity in 2017. Particularly impactful were the trips to various distribution centers such as Abercrombie and Fitch, learning about the technological components of LET, doing hands-on activities, gaining a more specific sense of LET as a field, and hearing from people currently in LET careers. Industry representative survey responses indicated that companies would be willing to hire students with LET degrees, but some level of industry experience seems to be an important factor in these decisions. Current needs are highest for employees with skills in logistics operations and information technology. Student survey responses indicated an increase in the percentage of students planning to major in a supply chain or logistics-related career. The primary drivers of interest in supply chain or logistics management careers were the perceptions that there are good job opportunities that also pay well. The report concludes with recommendations as the project enters its final year of funding.

¹ The official title of the grant is Industrial Engineering Operations Technicians. Based on industry feedback, the pathway is more appropriately described as Logistics Engineering Technology technician pathway.

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Background

Logistics operation is a key industrial sector in the central Ohio region, as such, it is critical to the growth of the region. The continued economic stability of the region depends on attracting and retaining a competent technical workforce. As the need for a workforce with increasingly sophisticated technological skills increases, there is need for a curriculum that provides individuals with foundational STEM knowledge as well as integrated technical skills in industrial engineering, information technology, and operations.

To help meet this need, Columbus State Community College (CSCC) received funding from the National Science Foundation (NSF) in 2014 to develop an academic pathway for Industrial Engineering Operations Technicians. Based on feedback from industry, this academic pathway has been distilled to specifically develop a Logistics Engineering Technicians (LET) academic pathway. CSCC is collaborating with Eastland-Fairfield Career Center, Franklin University, the Columbus Region Logistics Council, and several other industry partners in this endeavor. The project is developing a multi-disciplinary 2+2+2 career pathway in LET. It also includes a pre-college education initiative to increase the visibility and desirability of a career in LET for high school students. Finally, the curriculum design intends to optimize emerging techniques and technologies in distance education to prepare a technical workforce appropriately educated to support the increasingly complex supply chain operations infrastructure. By developing career pathways for LET, and meeting industry need for this skilled workforce, this project has the following six (6) goals:

1. To conduct an Industry Job Skills Analysis using Compression Planning session focusing on the logistics engineering technician occupation. This session identified the top knowledge, skills, and abilities of logistics engineering technicians as well as the specialized tools required and the desired certifications of new hires.
2. To develop a Logistics Engineering Technology associate degree and certificate curriculum that is aligned. The new curriculum was designed through guidance of an established Industry Advisory Committee and the Jobs Skills Analysis session.
3. To design curriculum that includes virtual simulations that use learning object methodology.
4. Create a hands-on learning experience at a state-of-the-art facility that will provide the real-work experience in designing and using Industrial Engineering Operations Technology-related software and hardware.
5. To launch a Logistics Engineering Technology Pre-College Initiative to increase the number of students matriculating from high school. This was accomplished by educating students, faculty and advisors on career opportunities in the central Ohio region.
6. To establish a Logistics Engineering Technology career education 2+2+2 pathway. This was accomplished by establishing model articulation agreements from high school to community college and then to university level baccalaureate programs.

The purpose of the current document is to provide a summary of formative and summative evaluation information of the project through Year 3.

Purpose and Design of the Evaluation

The Rucks Group, LLC began working with the CSCC project team in 2014 as the external evaluator. The evaluation has a two-fold purpose: 1) to capture information regarding the activities of the project (formative evaluation); and 2) to assess the outcomes of the project (summative evaluation). Key elements of the evaluation are the project logic model, its objectives, and the evaluative questions. The logic model (see Appendix A) provides the frame for the evaluation, while the evaluative questions guide the nature of the data to be collected. The theory of change underlying the project is that if a quality curriculum in LET which aligns with stated industry needs is established - and if high school students, women, and minorities are made aware of the existence of the program and opportunities available in the field - then the number of individuals serving as LET Technicians will increase.

The evaluative questions to be addressed over the life of the project are:

1. How effectively is the project being implemented? What obstacles are being experienced? (Formative)
2. How is the curriculum meeting the needs of industry? What is the quality of the curriculum? (Summative)
3. How are the various modalities affecting student learning (e.g., curriculum, and the summer camp)? (Summative)
4. What difference is the project having on overall student enrollment and retention? What difference is the project having on enrollment and retention for underrepresented groups? (Summative)
5. What difference is the project having on industry/relationships with industry? (Summative)

Findings

Evaluative Question #1: How effectively is the project being implemented? What obstacles are being experienced?

The primary activities for Year 1 revolved around developing the curriculum and implementing the pre-college initiative. In Year 2, these activities continued along with outreach to potential industry and community partners which included hosting the first annual summit on Logistics and Automation and outreach to high school career advisors, and faculty development. In Year 3, the project team completed many major activities including the following:

1. Validated and solicited feedback from industry advisory council.
2. Finalized the Logistics Engineering Technology Associate of Applied Science degree and submitted the new program for approval by the Ohio Department of Higher Education and the Higher Learning Commission.
3. Identified key courses for digitization and simulation efforts: ENGT 1200: Intro to Motors, Controls and PLCs, and SCM 1100 Supply Chain Management Principles, SCM 1501 IT in Logistics.
4. Benchmarked and selected applicable software platforms for use in ENGT 1200: Intro to Motors, Controls and PLCs, SCM 1100 Supply Chain Management Principles, and SCM 1501 IT in Logistics. Solicited donations of logistics engineering technology equipment from area companies.
5. Evaluated the results of a two-day summer 2016 Logistics Engineering Technology summer camp and implemented and expanded three-day model for summer 2017.
6. Piloted a multi-project breakfast briefing for high school counselors and educators.

7. Developed a multi-project, three-day STEM Educator's Summer Institute featuring Logistics Engineering Technology and Cybersecurity. Partner with Abercrombie, Expeditors, and Junior Achievement of Central Ohio to develop a 12-week Logistics internship program for high school seniors.
8. Expanded high school to community college curricula for the Logistics Engineering Technology program through the College Credit Plus dual-enrollment initiative and established articulation pathways to two four-year universities: Franklin University, Ohio University.

Development of the Curriculum and Approval of the Logistics Engineering Technology Associate of Applied Science degree

Curriculum approval took a little longer than expected. The curriculum was finalized at the end of Year 1 (Summer 2015) with the goal of obtaining approval and launch of the LET major by Fall 2016. However, this was based on the shared understanding that that approval was only required from the internal curriculum committee within CSCC and the Ohio Department of Higher Education (formerly known as the Ohio Board of Regents). Through the actual process, however, the project team learned that approval also needed to be obtained from the CSCC's Board of Trustees and the Higher Learning Commission. Approval from the Higher Learning Commission to offer the Associate of Applied Science in Logistics Engineering Technology was finally granted on June 13, 2017. Consequently, the curriculum will be implemented and fully operational for the Autumn 2017 semester. The project team also digitized eight iBooks that cover the fundamentals of supply chain management which can be utilized in a variety of supply chain management courses including those in both the AAS Logistics Engineering Technology and AAS Supply Chain Management programs. These digital textbooks align provide a free textbook alternative that actively engages the reader with learning objects.

Pre-College Initiative (Summer Camp Experience)

The project team again worked with K-12 partners to implement a pre-college summer camp. It is important to note that the structure of the camp in Year 1 was different than the camps in Years 2 and 3. In Year 1, the team partnered with Honda, who has sponsored a pre-college initiative for several years, to implement the summer camp experience. The project team decided to implement its own summer camp in Year 2 because there was not enough time allotted in the schedule to focus on LET with the Honda version of the camp. The summer camp in Year 1 reflected a broad approach to engineering with a 30-minute session on LET. Over two days, the Year 2 iteration of the summer camp allowed for more exposure to the program and facilitated focused recruitment of students interested in LET as a potential career. The additional time also allowed for more hands-on activities and a tour of an industry partner. Given the success of this approach, CSCC again offered their own LET-focused summer camp experience in Year 3 during the month of June 2017. Data regarding participants' evaluative reactions to the summer camp from Year 2 to Year 3 will be discussed under evaluative question #3.

Industry and Community Partner Outreach

During the current funding year, there were significant efforts by the project team to engage in outreach to industry and community partners. The project team developed relationships with the Mid-Ohio Regional Planning Commission and increased opportunities for students and the K-12 community to learn about SmartColumbus. The Industry Advisory Council provided key feedback regarding skills gaps. Key findings included the increased need for data-based decision-making skills, communication skills, and project management skills. Supply chain management faculty are addressing these by incorporating additional case studies and simulations throughout the curriculum. Columbus State will partner with faculty from Colorado State University to pilot ACTIV82LRN; a novel web-based course enhancement that guides online discussion

boards to increase student critical thinking and engagement which can be applied in a variety of course settings (i.e. in-person, online, and blended courses).

The project team has significantly expanded the reach of the Logistics Engineering Technology pre-college initiative to new districts and institutions. The program reached 11 school districts and career centers in year 2 and expanded to 21 districts and career centers in year 3. The newly added districts and career centers include: Columbus City Schools, Dublin City Schools, Eastland Fairfield Career Academy, Gahanna Lincoln School District, Grandview Heights School District, Groveport Madison School District, Hillard City Schools, West Jefferson School District, Olentangy School District, Pickaway Ross Career Center, South Western City Schools, South Western Career Academy, Upper Arlington City Schools, Westerville City Schools, Metro School District, Delaware Area Career Center, Delaware City School District, Reynoldsburg School District, New Albany School District, Fairfield Christian Academy, Focus Learning Academies. The project team expanded its pre-college initiative efforts to include participation in career days at several middle schools in the region. The team received many hand-written letters with positive comments from students from Genoa Middle School in Westerville, Ohio after their career day. Most comments emphasized how interesting it was to learn about range of things involved with logistics and supply chain management. Several students indicated that the information provided sparked their interest in the field as a potential career.

Faculty Professional Development

Various professional development opportunities were completed during Year 3 by both the project staff and faculty members, including the completion of online training courses, participation in workshops, serving on both industry and technical school advisory boards, and attending professional organization conferences.

Develop an Operations Simulation Laboratory

The project team has benchmarked and will leverage a variety of software platforms (e.g. CMH Constructor and AnyLogic) that will facilitate hands on learning and will be incorporated into several courses within the degree program. The project team also solicited donations of logistics engineering technology equipment from area companies resulting in a donation from one company of a conveyor system. The conveyor system will be incorporated into several courses including ENGT 1300 Intro to Motors, Controls and PLCs and SCM 1501 IT in Logistics and will provide hands-on learning experiences that relate directly to automated logistics distribution centers.

The establishment of a Logistics Engineering Technology career education pathway using a 2+2+2 framework

The project team engaged in outreach initiatives with high schools which resulted in new districts offering to teach college credit plus courses. In addition, formal articulation pathways with both Franklin University and Ohio University have been established. Ohio University's articulation pathway to the Bachelor of Science in Technical Operations Management can be completed online and is specifically designed for students who have completed an Associate of Applied Science Degree. This articulation pathway is a model completion program for students who have completed a two-year technical degree and seek to continue their education.

Evaluative Question #2: How is the curriculum meeting the needs of industry? What is the quality of the curriculum?

Quality is operationalized as the extent to which the program produces qualified job candidates. Because the degree program starts in the Fall of 2017, measuring the "quality" of the program is not yet feasible. However, the curriculum development methodology was designed to tightly align with industry's workforce needs.

The curriculum development methodology can be conceptually divided into *exploratory* and *confirmatory* phases. In the “exploratory” phase, the project team invited comments from a seven (7) person focus group regarding industry’s workforce skills needs through a day-long compression planning session.² As noted earlier in this report, results of the compression planning session indicated that industry partners needed workers with “light” LET skills; the very skills that are core to the LET technician role.

In the “confirmatory” phase, a survey summarizing the components of LET technician skills was administered to a wider audience in 2016 to assess the extent to which those skills are needed as reported by other industry representatives. Another survey was administered to industry representatives in the spring of 2017. As in 2016, the objectives of the survey were to: confirm/disconfirm the knowledge and skills most in need as identified by the initial seven-person focus group; and assess expectations regarding the level of knowledge and skills expected of a new Logistics Engineering Technician graduate. After reviewing the 2016 version through an iterative process, the project team identified some potentially useful question additions and modifications. A description of these modifications, and a full report of the results, will be provided in a separate document but selected updates are presented here to highlight some of the notable differences between the results in 2016 and 2017.

Current LET skills in demand by industry

In the 2016 survey, industry representatives were asked: “To what extent does your company have a current or anticipated need for an operations analyst, systems specialist, or other comparable position?” Thirty percent of the 19 respondents reported a high or medium need while 40% of industry representatives reported a future need (Figure 1).

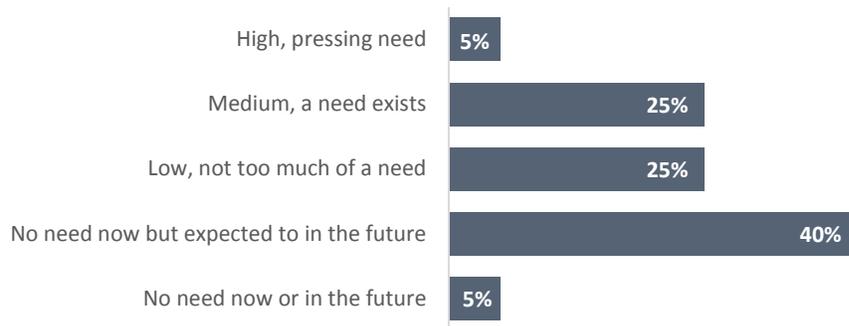


Figure 1. 2016 percent frequency responses by industry representatives to the item “To what extent, does your company have a current or anticipated need for an operations analyst, systems specialist, or other comparable position?” (N=19)

The 2017 industry survey did include a question to assess industry needs for Logistics Engineering Technicians however, instead of describing industry needs broadly in terms of existing roles (e.g., operations analyst), the revised question asked the industry representative to: “rate your company’s current needs for employees with specialized skills in each of the following areas.” These areas included electro-mechanical engineering, logistics operations, data-driven decision making, and information technology/network systems. The need for employees with specialized skills in logistics operations ranked as a “high” need by 5 of 11 (46%) respondents - the highest among the four skill areas. However, 4 of 11 (36%) said that they currently have “no need at all” for employees skilled in logistics operations. Five of 11 (45%) have “no need at all” for employees with specialized skills in electro-mechanical engineering with all but 1 of the remaining ranking it as a “low need.” The majority of respondents (7 of 11 or 64%) indicated that current needs for employees with specialized skills

² The compression planning session was detailed in the Year 1 evaluation report (Rucks & Clasen, 2015).

in data-driven decision making and information technology/network systems was either "moderate" or "high." All percent frequencies are shown in Figure 2.

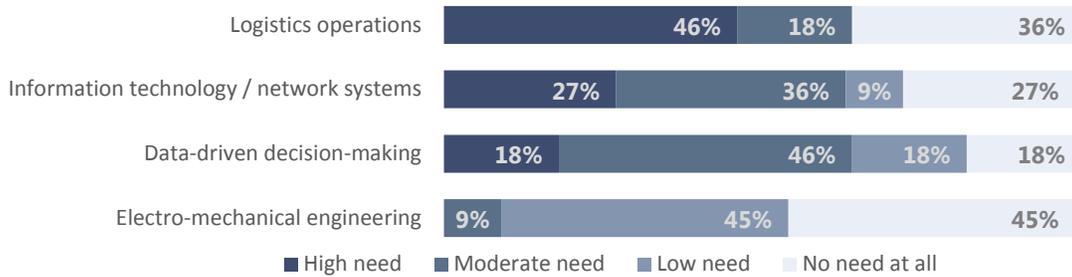


Figure 2. 2017 percent frequency responses by industry representatives to the item "Please rate your company's current needs for employees with specialized skills in each of the following areas." (N=11)

Hiring potential for students with a LET degree

Industry representatives were asked in 2016, "How frequently does your organization hire an operations analyst, systems specialist, or other comparable position with a two-year degree and with experience in logistics?" Seventy-five percent of the respondents said either "infrequently" or "never" (Figure 3).

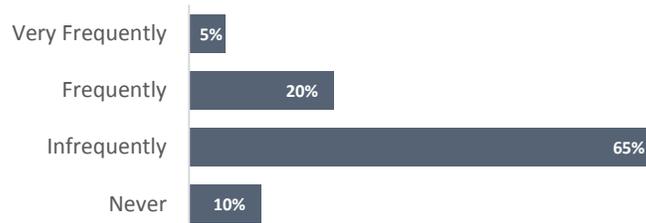


Figure 3. 2016 percent frequency responses by industry representatives to the item "How frequently does your organization hire an operations analyst, systems specialist, or other comparable position, with a two-year degree and with experience in logistics?" (N=19)

This question was modified for the 2017 industry survey to ask industry representatives about the potential demand for students who obtain a LET degree because it is more directly related to the objectives of this project. Industry representatives were first asked how likely their company would be to hire an individual who possesses a LET degree *but has no industry experience* and were then asked how likely they would be to hire someone with a LET degree *and two or more years of experience*. While only 2 of 11 (18%) indicated that they would be "very likely" to hire LET degreed individuals without industry experience, 7 of 11 (64%) said that they would be "very likely" to hire LET degreed individuals if they had two or more years of experience (Figure 4). This underscores the importance of providing opportunities for students to obtain industry experience prior to graduation.

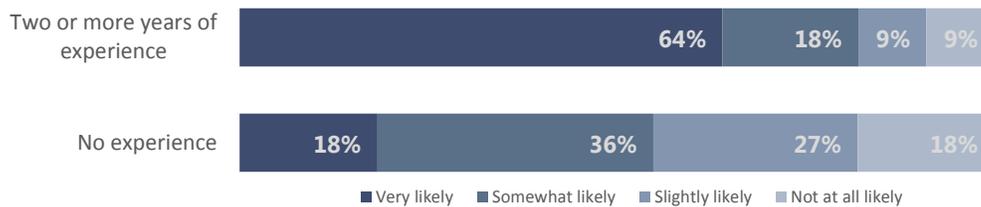


Figure 4. 2017 percent frequency responses by industry representatives to the item “How likely would your company be to hire an individual possesses a LET degree: 1. But has no industry experience or 2. Has two or more years of industry experience?” (N=11)

The LET degree program is intended to prepare students for various positions including those in supply chain management, engineering, and information technology. The 2017 version of the survey was modified to determine if the hypothetical likelihood of hiring varied across these potential positions. Six of 11 (55%) of respondents answered that they would be “very likely” to hire LET degreed individuals for supply chain management positions while only 2 of 11 (18%) answered “very likely” to hire them for engineering or information technology positions (Figure 5).

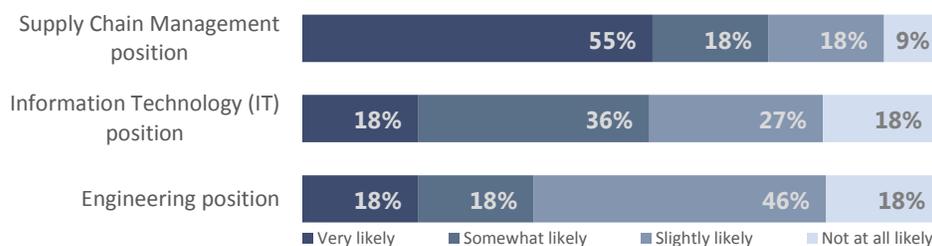


Figure 5. 2017 percent frequency responses by industry representatives to the item “How likely would your company be to hire an individual possessing a LET degree for each of the following positions?” (N=11)

To gain a sense for the relative advantages a LET degreed individual might have in terms of being hired or advancing in their company, industry representatives on the 2017 survey were asked “Would an individual with a Logistics Engineering Technician degree have more opportunities to be hired and/or advance in their company versus an individual with a degree in only one area (e.g., SCM, Engineering, or IT)?” Eight of 11 (73%) responded “yes” to this question and only 1 responded “No”. One of the remaining two respondents selected the option “opportunities would be about the same” and the other selected “can’t rate.”

Given the importance of experience for LET graduates the 2016 and 2017 surveys included the question, “*What level of interest would you have in providing internship opportunities to students in this type of program.*” In 2016, 8 of 19 (40%) reported that they were “very interested” and 30% reported interest in gathering more information. None of the 11 respondents from the 2017 selected “I am very interested” but 7 of 11 (64%) answered that they would like more information (Figure 6). Roughly the same percentage of respondents from 2016 to 2017 indicated that they currently had no interest in providing internship opportunities. These results point to the importance of current efforts in working with industry partners to develop work-study opportunities for students in the LET degree programs.

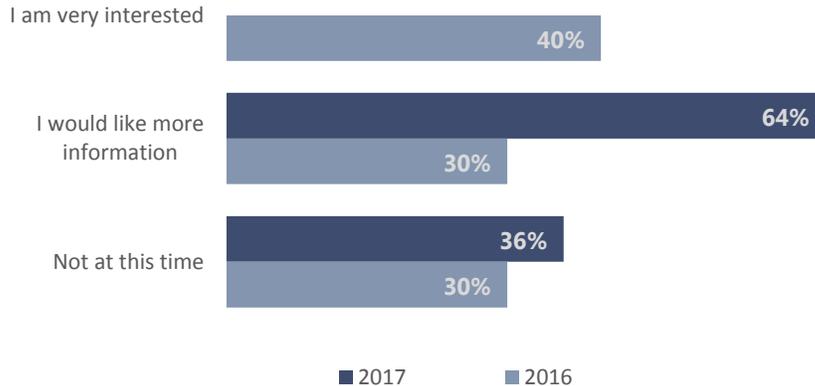


Figure 6. 2016 (N=19) and 2017 (N=11) percent frequency responses by industry representatives to the item “What level of interest would you have in providing internship opportunities to students in this type of program?”

Evaluative Question #3: How are the various modalities affecting student learning (e.g., curriculum and the pre-college initiative)? How are perceptions in learning about LET changing with regard to the project?

Internship program

Two female seniors from Gahanna Lincoln High School participated in the pilot high school supply chain internship program through Abercrombie, Junior Achievement of Central Ohio, and Columbus State. Columbus State provided foundational concepts in supply chain that provided a basis for students’ work in process improvement at an automated distribution center. After the program both students expressed interest in pursuing more logistics or engineering based careers.

Perceptions of Students Participating in the Pre-College Initiative (Summer Camp Experience)

The primary objective of the pre-college summer camp experience is to expose high school students to the field of logistics engineering technology (LET) with the goal of encouraging students to pursue LET as an area of study. As mentioned previously, the summer camp experience offered during Year 1 of the study sponsored by Toyota was designed to broadly cover the field of engineering with only a single 30-minute session focusing on LET. Subsequent summer camp experience programs offered during the summers of 2016 and 2017 were designed as multi-day programs with activities focusing on logistics engineering technology which has allowed for more exposure to the program and facilitated focused recruitment of students interested in LET as a potential career. Given the success of the 2-day program in 2016, the summer camp experience offered in 2017 was expanded to 3 days. The additional time has allowed targeted hands-on activities, facility tours with industry partners, and discussions with people working in LET fields.

Brief counterfactual surveys were disseminated to summer camp attendees at the end of each activity during the summer camp experiences in both 2016 and 2017 to gather feedback regarding students’ perceptions of the camp overall and the various planned activities (e.g., campus tour) as well as their attitudes related to LET as an educational pursuit and career option. Counterfactual survey asks respondents to provide their pre-

intervention attitudes and their current attitudes on the same instrument (Mueller, Gaus, & Rech, 2014) as a measure of impact. In the present context, "before" reflects participants' attitudes regarding each item before the camp – or camp activity -whereas, "after" reflects participants' attitudes after the camp or activity. The counterfactual survey was utilized because research indicates that individuals tend to make overestimations in the absence of a defined standard regarding attitudes and skills (Kruger & Dunning, 1999). Consequently, traditional pre/post-test dissemination methodologies do not fully reflect the impact of an intervention. The items included on the survey were modeled after a nationally sponsored questionnaire designed to assess attitudes towards manufacturing and related careers (Deloitte Development LLC and The Manufacturing Institute, 2014). Responses were captured using a 5-point scale of agreement, with *strongly disagree* rated as "1" and *strongly agree* rated as "5."

Some modifications were made to the surveys between the 2016 and 2017 summer camps including: 1) removal of questions that referred to "comfort level" because it was determined to be ambiguous 2) changing the wording of some questions to make them clearer and 3) asking some of the core questions at least once over the course of the three days to track shifts in attitudes.

LET as major or career

Most of the questions included in the camp surveys were designed to assess interest and intentions regarding logistics engineering technology as an educational path/major or as a career. Figure 7 shows the results of the question "I am interested in LET as a major/career"; a question that was asked after Lab 2 in 2016 and after each rotating lab in 2017. While the agreement ratings for both "before" and "after" were higher overall after the 2016 lab, the increase in agreement ratings from "before" and "after" the labs in 2017 was greater and the changes was statistically significant for both. In addition, there was an increase in the "before" and "after" ratings going from day 2 to day 3. This indicates that the activities in 2017 might have had a stronger impact on attitudes than in 2016. Furthermore, the increase in ratings from day 2 to day 3 might reflect the cumulative positive impact of the activities and experiences between those times.

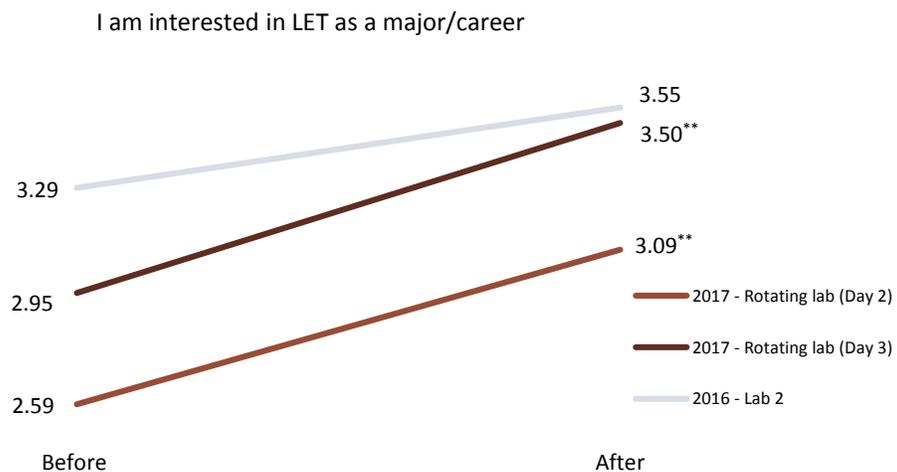


Figure 7. Comparison of mean agreement ratings "before" and "after" each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

A similar trend can be seen in Figures 8 and 9 which show the agreement ratings in response to questions that are directed pointedly at the likelihood of majoring in LET. Initial agreement ratings were higher in 2016 in response to the question "I would like to major in LET" but there was no statistically significant increase in ratings from "before" to "after" as was the case for both labs in 2017. It should be noted that there was no

increase in the “before” attitudes from day 2 to day 3 in 2017, but the “after” agreement rating was higher after the rotating lab on day 3 and very close to the rating from 2016.

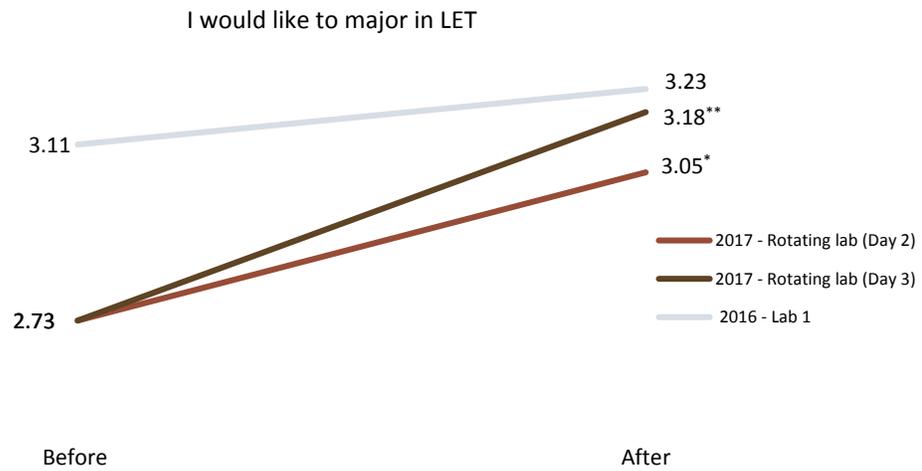


Figure 8. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

A new question was added to the overall camp evaluation administered at the end of the third day in 2017 to directly ask participants about the likelihood that they will major in logistics engineering technology. The mean agreement response when asked to consider the attitude they held prior to the start of the camp was 2.52 (i.e., between “disagree” and “neither agree nor disagree”). The mean agreement rating for their attitude after the conclusion of the camp increased to 3 (i.e., “neither agree nor disagree”); a statistically and – one could argue – practically significant difference. Deciding upon a major is a big decision and the participants at this camp are presumably still weighing various options. One would not expect a movement at this point into the “agreement” ratings. Furthermore, the movement out of the “disagree” rating and into “neither agree nor disagree” puts more students in a good position to be moved by additional recruitment efforts.

I am likely to major in logistics engineering technology -
Camp overall - 2017

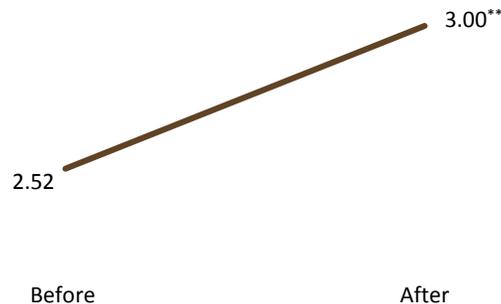


Figure 9. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

The next set of figures (10 through 13) report the results of questions asked in the 2016 and 2017 surveys targeted at attitudes towards logistics engineering technology as a career. These are arranged in order of the degree to which the question might be predictive of a given student pursuing a career in LET but – it should

be mentioned - not necessarily in the order of importance in terms of potential areas for intervention and improvement. Figure 10 presents the mean "before" and "after" agreement ratings to the item "I have a positive image of a career in logistics engineering technology"; an important component of the overall strategy to increase recruitment into the field but not one that necessarily indicates personal interest in it as a career. The mean agreement rating "before" Lab 2 in 2016 was higher than the mean rating given by respondents in 2017 prior to their tour of the Abercrombie and Fitch (A&F) distribution center at the end of day 2. The "after" ratings on this item, however, did not increase in a statistically significant way after Lab 2 in 2016 as they did after the A&F tour in 2017 which increased from a "before" mean rating of 3.11 to an "after" mean rating of 4.05; a movement from a neutral attitude into an attitude just above the rating for "agree." This provides good evidence for the positive impact of the tour which is reinforced by many of the open-ended comments summarized in Table 1 at the end of this section.

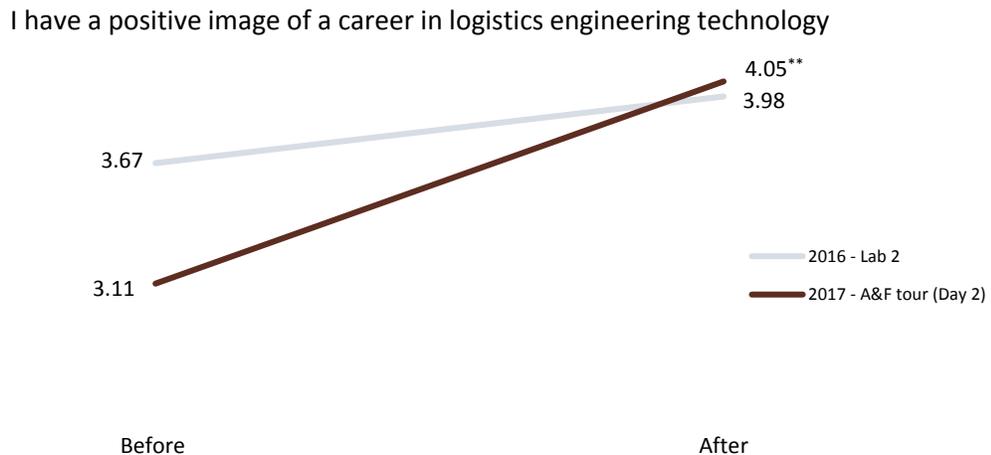


Figure 10. Comparison of mean agreement ratings "before" and "after" each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

Moving more towards attitudes that might predict an individual's likelihood of seeking a career in logistics engineering technology is the item, "I think a job in LET would be both interesting and rewarding." This item was included twice in the surveys administered during the 2016 camp (once after each Lab) and twice in 2017 (once after the 3D print lab and once after the A&F tour). As with responses on prior items, mean attitude ratings did not increase by a statistically significant degree after the Labs in 2016 but did after the activities in 2017.

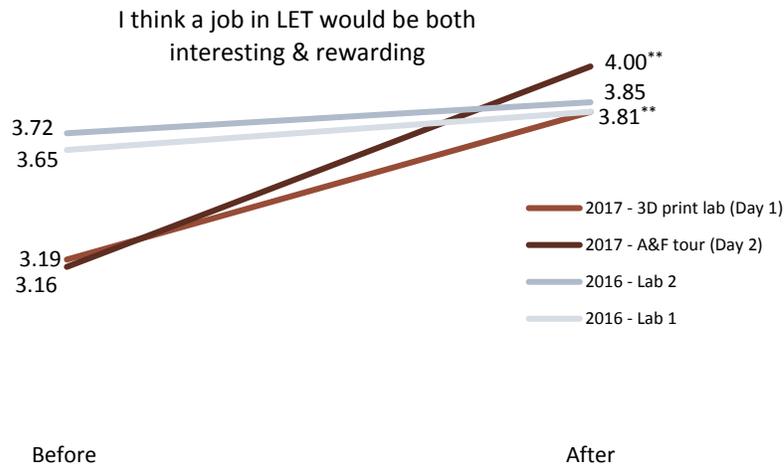


Figure 11. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

The next items asked participants to consider their attitudes about a career in LET. During the camps in 2016 and 2017 students were asked if they could see themselves pursuing a career in LET. The question was only included once in the 2016 survey which showed a statistically insignificant increase in mean. During the 2017 camp this item was included in surveys on each of the three days because it was felt that the attitude regarding this particular question encompasses a number of perceptions about the field along with some possible indications of behavioral intention. Mean agreement ratings showed a statistically significant increase from “before” to “after” the 3D lab on day 1, the A&F tour on day 2, and on the survey administered at the end of day 3. The reported increase on the overall camp evaluation in 2017 was the most dramatic with a mean increase of almost a full point from 2.67 to 3.52.

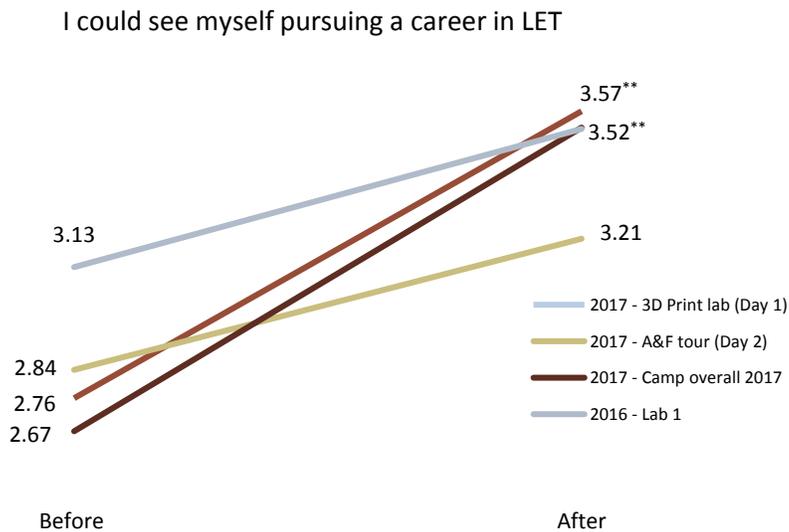


Figure 12. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

The next question to assess students’ attitudes about a LET directly asked them about their personal interest in pursuing it as a career. The question was asked once at the end of the camp in both 2016 and 2017. Both years

showed a statistically significant mean increase in agreement from “before” to “after.” As with a number of these questions, however, the “before” mean was higher for the 2016 students but did not increase as much as it did for the 2017 students. The mean rating for students in 2016 moved almost a half point within the “neither agree nor disagree” to “agreement” range while the mean for the 2017 students moved almost three quarters of a point into that range from the “disagree” to “neither agree nor disagree” range.

I am interested in pursuing logistics engineering technology as a career

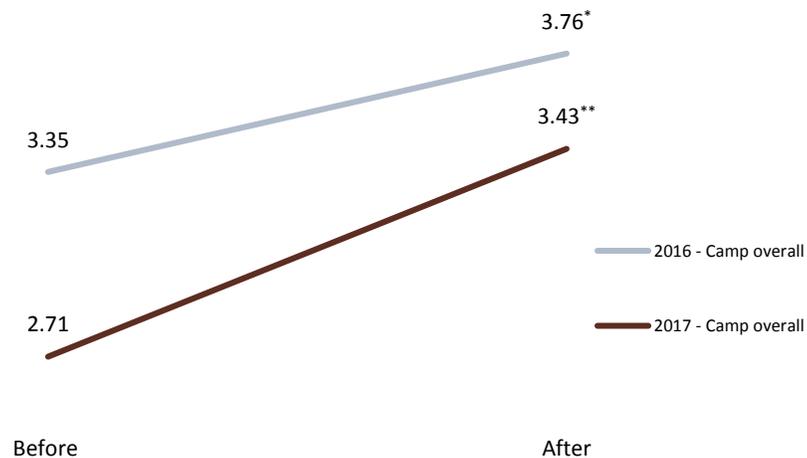


Figure 13. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

While an interest in a career in LET might have some value in predicting the likelihood of a given student pursuing the career, it would also be valuable to know: 1 if the student knows what they would need to do in terms of education to work in the field and 2. if they believe they can succeed in that pursuit. Consequently, participants in both years were asked if they had a “good understanding of the education needed to secure a position and get a job in LET.” Mean agreement “before” and “after” were similar for both years and each showed a statistically significant increase. It should be noted that this question was asked on the first day of both camps. It is possible that the mean “after” agreement ratings would have been even higher if the question had been asked at the end of the camp.

I have a good understanding of the education needed to secure a position and get a job in LET

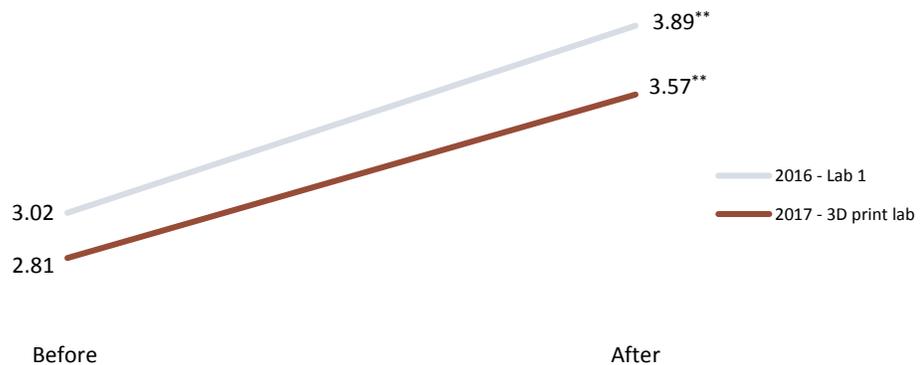


Figure 14. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

Participants in 2017 were also asked to rate their agreement with the statement “*I feel like I have the ability to pursue a career in LET*” during the second and third days of the camp. There was a statistically significant increase in the mean agreement rating after the lab activity on each of these days moving away from “neither agree nor disagree” and towards “agree.”

I feel like I have the ability to pursue a career in LET

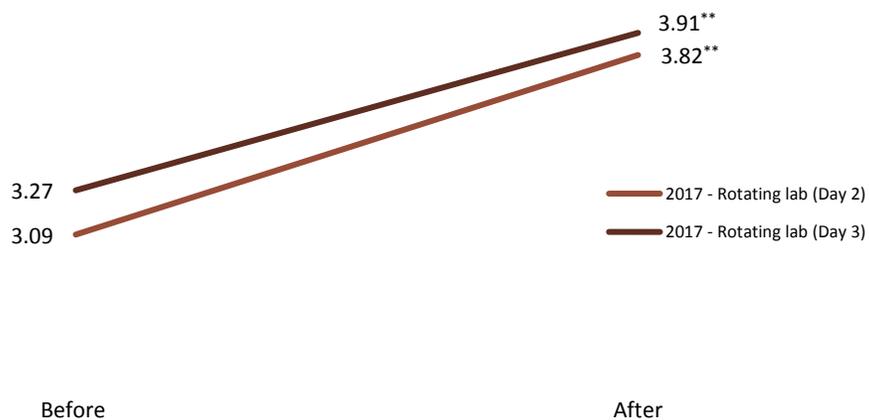


Figure 15. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

The support of parents is also a likely predictor regarding the pursuit of LET as a career. A given student might have a positive image of the field, a strong interest, and a belief in their abilities but – lacking supportive parents – might decide to select a different path. The project teams’ awareness of the importance of parental support led to the addition of a session for parents and families on the final day of the 2017 camp. This session provided an overview of the LET field and career opportunities followed by a discussion with faculty members. Mean agreement ratings in response to the item “I have the support of my parents if I decide to

pursue a career in LET” were in the “agree” to “strongly agree” range both years which is encouraging. The slight increases in the “before” and “after” camp ratings were not statistically significant for either year, but both ratings were higher for the 2017 camp; a difference that might be attributable to the inclusion of the parent/family session. The unknown differences between the participant groups in 2016 and 2017, however, make it difficult conclude with any certainty.

I have the support of my parents if I decide to pursue a career in LET

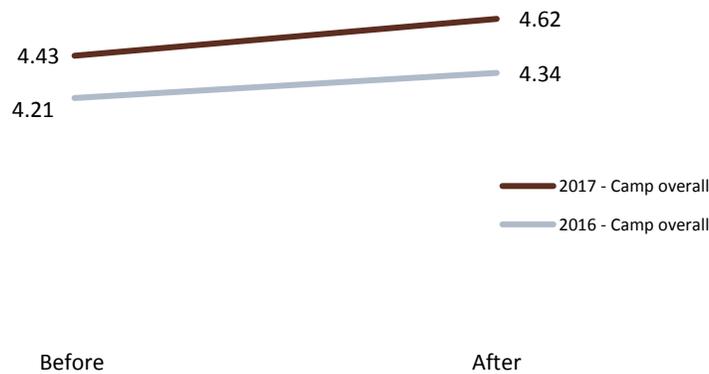


Figure 16. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

While recruitment of students to CSCC is not a primary aim of the summer camp experience, the newly developed two-year LET degree will be the most direct educational pathway into the field for students in this region of the country. Consequently, participants might come away from the camp with an increased interest in attending CSCC particularly because of the LET degree program. A direct question asking about interest in attending CSCC was asked after the campus tours in both 2016 and 2017. This question was also added to the end of the second and third days in 2017 to determine if there was a shift in attitudes over the three days. The mean “before” and “after” agreement ratings showed a statistically significant increase after all activities other than the A&F tour on the second day of 2017. The “after” ratings were similar across each of these measurements with a mean agreement rating just above “neither agree nor disagree.” (Figure 17)

I am interested in attending CSCC



Figure 17. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

Student participants after each camp were also asked to rate their agreement with the statement “*I am interested in attending CSCC because of the LET program.*” The question was asked just after the campus tour in 2016 with mean agreement ratings increasing slightly - but not statistically significantly – from the “neither agree nor disagree” to “agree” range. The question was asked in 2017 at the end of the camp with a statistically significant increase from a “before” agreement mean of 2.5 to an “after” camp mean of 3.09.

As with many of the other questions asked of student participants, it is not surprising that the mean agreement ratings rarely reach into the “agree” to “strongly agree” range since these attitudes are related to big decisions that students are in the process of considering. The statistically significant increases, however, from “before” to “after” are very promising, and point to the positive impact that the summer camps are having on student attitudes towards LET as a major and career.

I am interested in attending CSCC because of the LET program

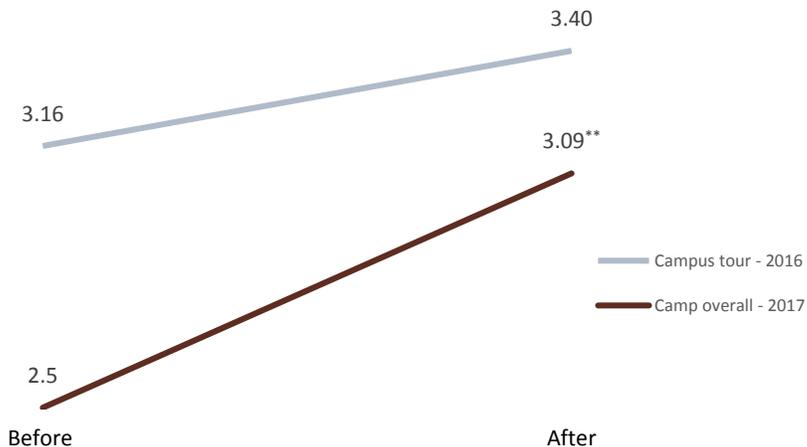


Figure 18. Comparison of mean agreement ratings “before” and “after” each activity based on a 1-5 (Strongly disagree – Strongly agree) response scale. (Note: * before vs. after difference significant at $p < .05$; ** significant at $p < .01$).

A number of open-ended questions were included in the surveys administered during the 2017 summer camp experience to obtain information about perceptions that were not addressed in the closed-ended questions and to gain a better understanding of the activities and components of the camp that are particularly impactful. Responses to these open-ended questions were thematically coded with the most commonly mentioned themes per question reported in Table 1. Based on student responses, it is clear the summer camp experience is valuable and impactful. Particularly appreciated are the trips to various distribution centers such as Abercrombie and Fitch, learning about the technological components of LET, doing hands-on activities, gaining a more specific sense of LET as a field, and hearing from people currently in LET careers.

Table 1. 2017 Summer Camp Survey - Top open-ended response themes

Question	Response theme	Freq.*	Example
What was the most interesting part of the campus tour?	Lounges	5	"The loud lounge"
	Nestor Hall	3	"Nestor hall with 2 types of lounges (quiet and loud)"
	Seeing campus opportunities	3	"Being able to see the campus and the opportunities here"
One thing about the day that made you more interested in LET?	Learning about field	6	"Learning about the new tech in the Logistics field"
	Robots	6	"The robot video"
	Applications	5	"Seeing the automated warehouse and relation to the military"
What would be most difficult for you if you chose LET as a major/career?	Lack of interest/bad fit	7	"I like more hands-on things & building things"
	The engineering aspect	4	"The engineering may be hard to learn but seems fun"
	Unappealing work environment	4	"Working in a warehouse setting"
What had the largest impact on your attitude towards LET as a major/career? (Camp overall)	DC Tours	7	"Going to the DCs and seeing what they do"
	Learning about field	7	"Information on the basics of LET and careers in the field"
	Technology aspect	2	"Technology aspect, robots were most interesting"
What had the largest impact on your attitude towards attending CSCC? (Camp overall)	Campus tour	6	"Being on campus going to classes and seeing a bit of college life"
	Atmosphere/people on campus	2	"The people and work ethic present in the school"
	Availability of LET Program	2	"LET Program"

* The number of participants responding with a statement corresponding to each theme

Perceptions of Students Enrolled in Supply Chain Management Courses

Surveys were disseminated to students enrolled in supply chain management courses during the 2015-16 and 2016-17 academic years to assess attitudes regarding logistics engineering technology as a career and the factors driving those attitudes. Among the 86 student respondents enrolled during the 2015-2016 academic years, 67 (78%) responded "yes" that they were currently planning to major in a supply chain or logistics management related career while 10 of the 11 (91%) student respondents enrolled during the 2016-2017 academic year responded "yes" to this question (Figure 19). The increase is notable, but the relatively low number of responses to the 2016-2017 academic year survey make it difficult to infer a real improvement. This survey will be administered again in the coming 2017-2018 academic year with additional efforts to increase response rates.



Figure 19. Percentage of students responding “yes” to the question, “Are you currently or planning to major in a supply chain or logistics-related career?” during the ‘15-16’ and ‘16-17’ academic years.

Student respondents were also asked to indicate the extent to which they agreed specific statements in relation to their interest in a supply chain or logistics management related career. Results from both academic years indicated that the “good chance to get a job” and the “potential pay of the job” had the highest levels of agreement (Figures 20 and 21). Frequencies for the rest of the questions on the student survey are available in Appendix B.

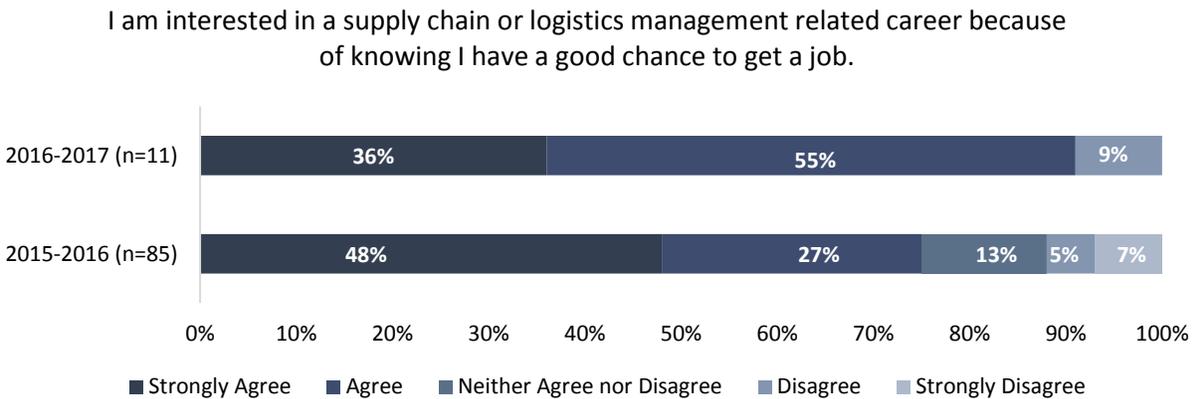


Figure 20. Comparison of percent frequency of agreement with the statement “I am interested in a supply chain or logistics management related career because of knowing I have a good chance to get a job.”

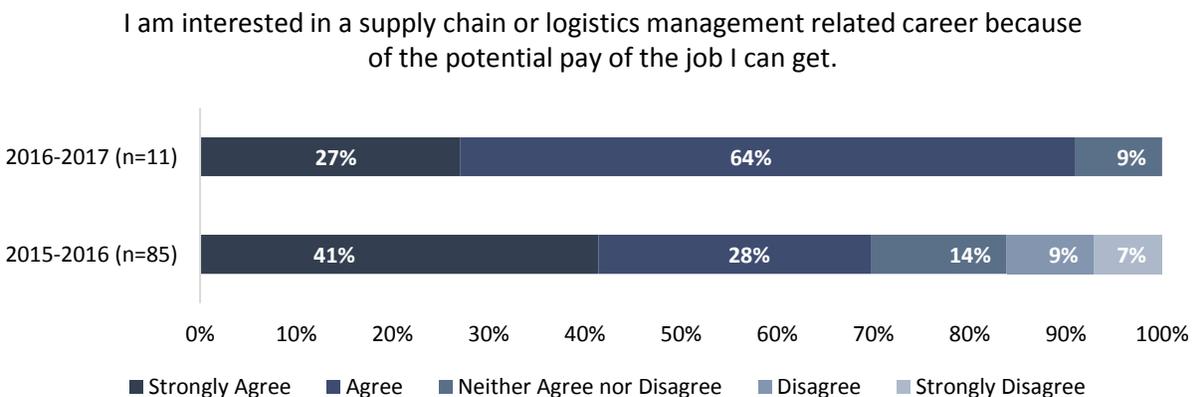


Figure 21. Comparison of percent frequency of agreement with the statement “I am interested in a supply chain or logistics management related career because of the potential pay of the job I can get.”

Evaluative Question #4: What difference is the project having on overall student enrollment and retention? What difference is the project having on enrollment and retention for underrepresented groups?

The evaluative question related to enrollment and retention will be addressed more completely after the implementation of the LET degree program which will enroll its first students in the fall of 2017. However, data that could predict enrollment of underrepresented groups are available. As noted earlier, participation by students in the pre-college initiative is important because it serves as a pipeline for eventual enrollment in the LET program. Therefore, it was encouraging that a relatively large percentage of participants in the pre-college initiative in both 2016 and 2017 were female. Specifically, 27% (6/22) and 57% (12/21) of participants from the 2016 and 2017 summer pre-college initiative respectively were female; a large increase from 2016 to 2017 and both a big improvement over the 2015 pre-college initiative that had no female participants. In addition, the group of participants in 2017 was racially/ethnically diverse as it was comprised of 43% (9/21) African-Americans, 38% (8/21) Caucasians, 10% (2/21) Asian/Pacific Islanders, and one Hispanic individual. Further encouragement regarding progress in this area is the fact – mentioned earlier in the report – that both interns who participated the 2017 pilot high school supply chain internship program were female.

Evaluative Question #5: What difference is the project having on industry/relationships with industry?

The number and depth of industry and community partnerships changed from Year 1 to Year 3. The project team actively reached out to all area schools to increase awareness of the LET program among high school career advisors. As a result of these efforts, 16 of the 58 schools (28%) that the project team has contacted has agreed to in some way support recruitment activities. Similar additional outreach efforts have occurred directly with industry partners and indirectly through professional and business organizations.

In an attempt to quantify these changes in industry and community relationships, an industry relationship partner score was calculated. The score was created by first identifying nine areas related to a pathway development. These are program design, curriculum development, recruitment, training, placement, program management, leveraging resources, and commitment of sustainability. *Program design* involves all the decisions of inclusion or exclusion of the elements involved in the learning process (e.g., the curriculum, whether or not there's an internship, articulation of the pathway etc.); *Curriculum development* relates to the didactic areas of the course; *Recruitment* is the identification of participants for the program; *Training* refers to the professional development targeted to instructors or when involving participants activities that are not course related; *Placement* involves the hiring of interns or providing actual employment; *Program management* involves the day-to-day operations of the program; *Leveraging resources* is the obtainment of cash or in-kind resources; and *Commitment to Program Sustainability* refers to the willingness to transition the program from "grant" status to institutionalization of the training program.

A point is assigned to each area of involvement (see Appendix). The score is calculated by totaling the number of points for each area by industry and community partners. In Year 1, the industry relationship partner score would have been 30, by the end of Year 2 the industry relationship partner score was 48, and by the end of year 3 is was 52 which included the addition of Abercrombie and Fitch as a partner. While admittedly the industry relationship partner score has not been validated, it does provide a useful means to quantifying the changes in the number and depth of partnerships across time.

Industry and community partner relationships also grew and strengthened over in 2017 through the various collaborative efforts described earlier in the report including work with the Mid-Ohio Regional Planning Commission to increase awareness regarding the SmartColumbus initiative among K-12 students, work with

the Industry Advisor Council regarding the identification of skills gaps, and partnering with faculty from Colorado State University to pilot a more engaging web-based discussion platform (i.e., ACTIV82LRN).

Recommendations

The project appears to be on track and moving forward as expected. The LET degree program has been approved and will be operational starting in the 2017 autumn semester. As the project moves into its final year of funding, the following recommendations are provided. These recommendations have been discussed in collaboration with the project team.

2017 recommendations

- It seems clear that students' chances of finding employment after graduating with a LET degree will be significantly improved they leave the program with relevant industry experience. Efforts to ensure this through the establishment of internships should be a high priority. This would also be a good opportunity to capture information regarding the extent to which the education and training being provided through the LET degree program is meeting the needs of industry.
- The impact of the summer camps on student attitudes towards LET as a major and career was particularly strong for the 2017 offering. The challenge for the team here is to identify ways to increase enrollment in the camp so that the positive effects of these efforts are spread more broadly. We recommend that the project team take a closer look at its recruitment strategies for the summer camp and work to identify modifications to improve these efforts. In addition, the distribution center tours were particularly effective in changing attitudes and was most frequently identified by participants as the activity many participants as having the largest impact their attitudes towards LET as a major or career. Consequently, we recommend that the project team continue to identify these opportunities with additional industries and work with them to address any existing barriers preventing high school age students from entering distribution centers.
- The low response rate of students to the survey during the '16-17 academic year made it difficult to draw confident inferences regarding changes and potential trends. The coming academic year of 2017-2018 as the LET degree program is implemented will provide an opportunity to ask questions directly targeting the effectiveness of the program and to assess the attitudes of students who are clearly invested in LET as a major and career.
- In terms of industry perceptions, we recommend that the team continue to capture information regarding their needs and to seek their input on the degree program particularly during this initial year of implementation. The team should also – as mentioned – focus on finding opportunities for students to obtain industry experience and to take the opportunity to assess these experiences from the perspective of both students and their supervisors/managers.

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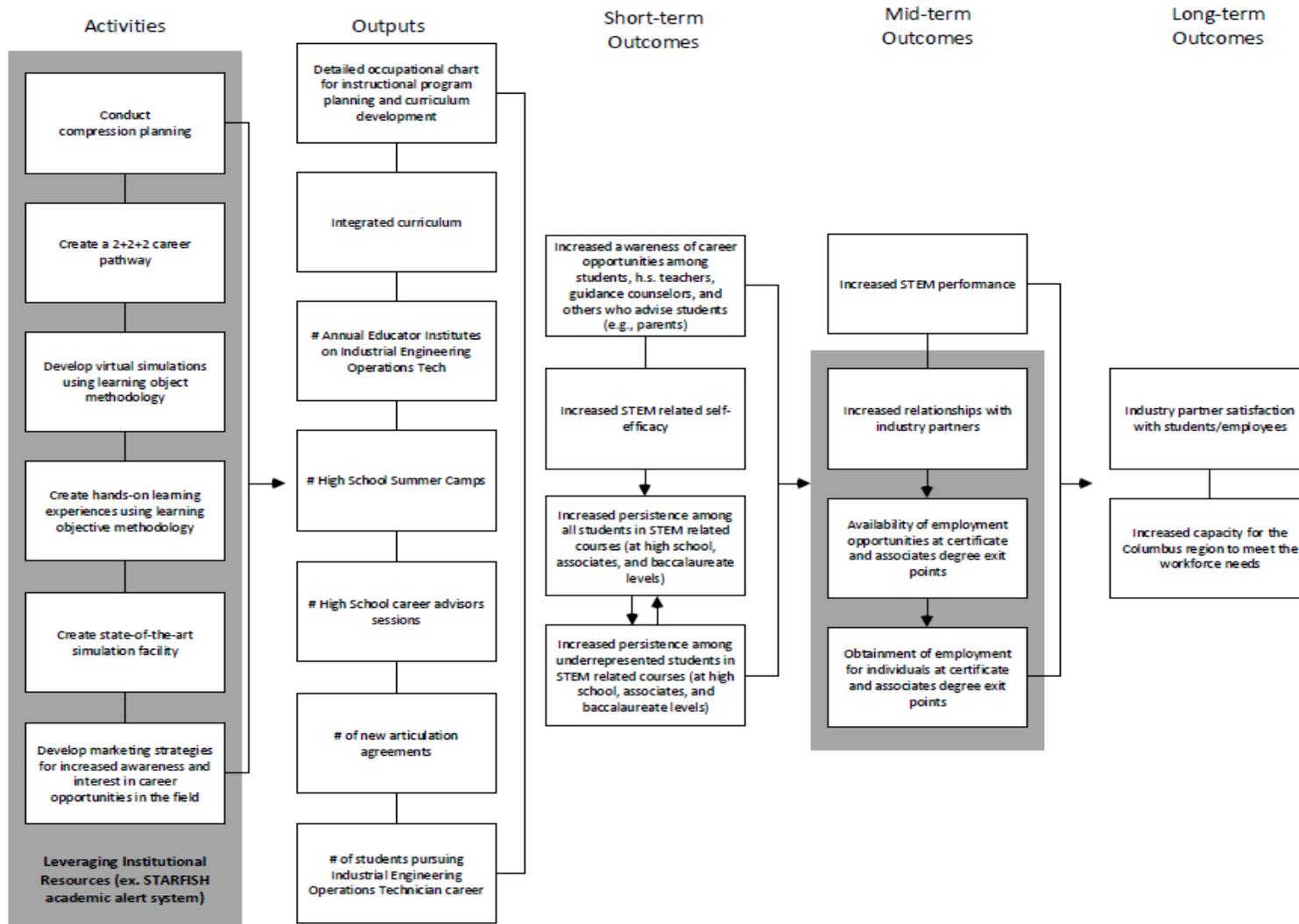
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APPENDICES

Appendix A - Building an Academic Pathway for Industrial Engineering Operations Technicians Logic Model



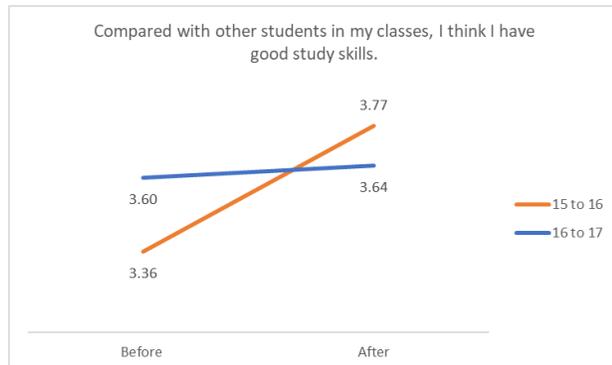
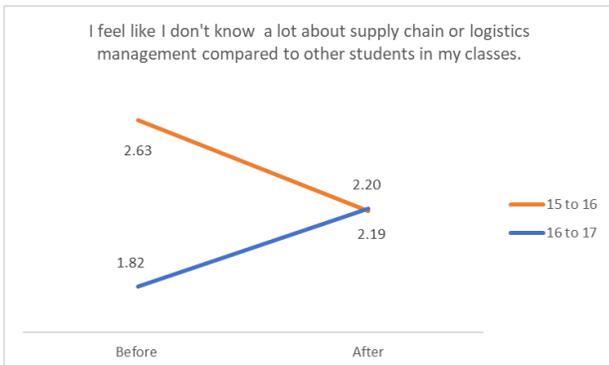
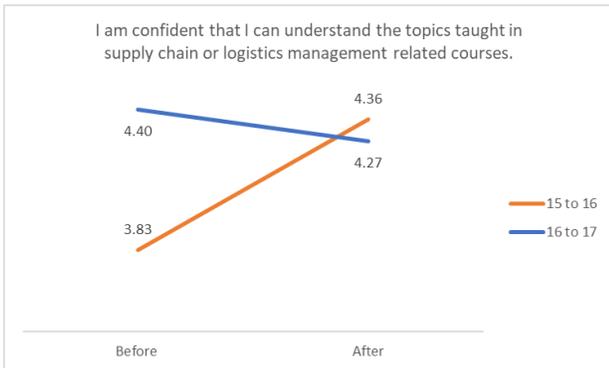
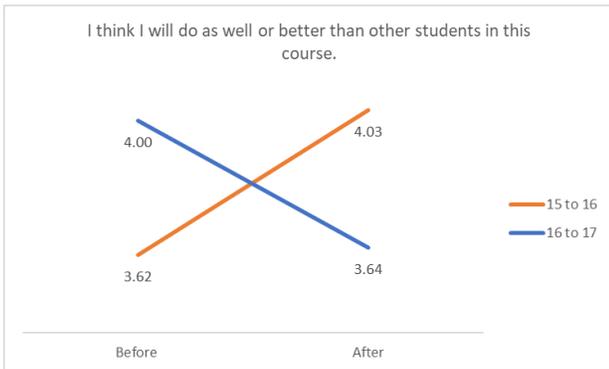
Appendix B –Supply Chain and Logistics Management Student Survey from 2017

I am interested in a supply chain or logistics management related career because of...

	Year	N	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Mean
A parent(s)/friend(s)/significant other's encouragement	'15/'16	86	15%	26%	27%	21%	12%	2.88
	'16/'17	11	27%	9%	9%	27%	27%	3.18
A teacher(s) or guidance counselor(s) encouragement	'15/'16	85	15%	22%	35%	17%	11%	2.85
	'16/'17	11	36%	27%	27%	-	9%	2.18
Hearing about the program from someone else	'15/'16	84	18%	20%	27%	24%	11%	2.89
	'16/'17	10	20%	40%	10%	20%	10%	2.60
Attending a CSCC sponsored event	'15/'16	85	19%	27%	39%	12%	3%	2.54
	'16/'17	10	30%	50%	10%	10%	-	2.00
Attending a workforce sponsored event	'15/'16	85	21%	28%	40%	5%	6%	2.46
	'16/'17	10	30%	50%	20%	-	-	1.90
Visiting a company that uses workers with a related degree	'15/'16	85	14%	19%	28%	25%	14%	3.06
	'16/'17	11	27%	36%	18%	9%	9%	2.36
Working with related equipment or activity	'15/'16	87	13%	8%	18%	25%	36%	3.63
	'16/'17	11	9%	9%	27%	27%	27%	3.55
Information directly from CSCC	'15/'16	85	15%	15%	29%	25%	15%	3.09
	'16/'17	10	30%	40%	10%	20%	-	2.20
Information from television or radio	'15/'16	84	24%	31%	27%	13%	5%	2.44
	'16/'17	10	30%	40%	30%	-	-	2.00
Information from social media	'15/'16	85	27%	27%	29%	13%	4%	2.39
	'16/'17	10	30%	50%	10%	10%	-	2.00
Knowing I have a good chance to get a job	'15/'16	85	7%	5%	13%	27%	48%	4.05
	'16/'17	11	-	9%	-	55%	36%	4.18
The potential pay of the job	'15/'16	85	7%	9%	14%	28%	41%	3.87
	'16/'17	11	-	-	9%	64%	27%	4.18

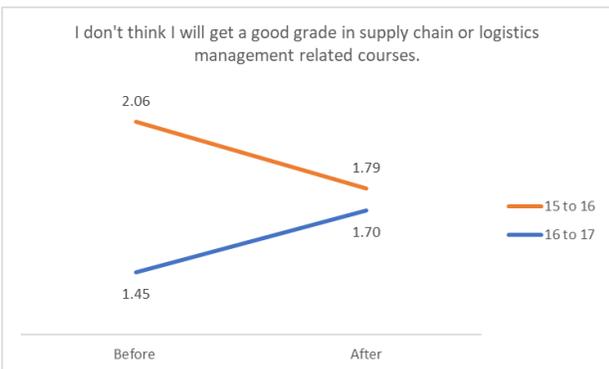
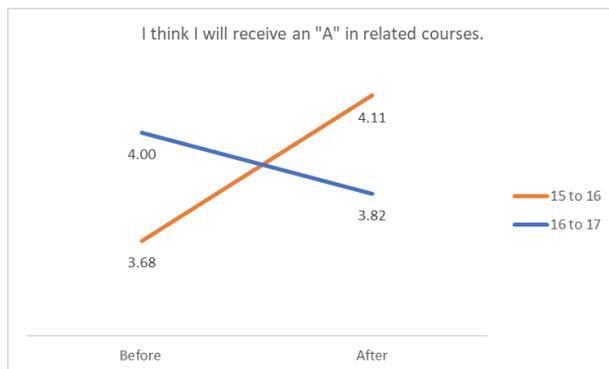
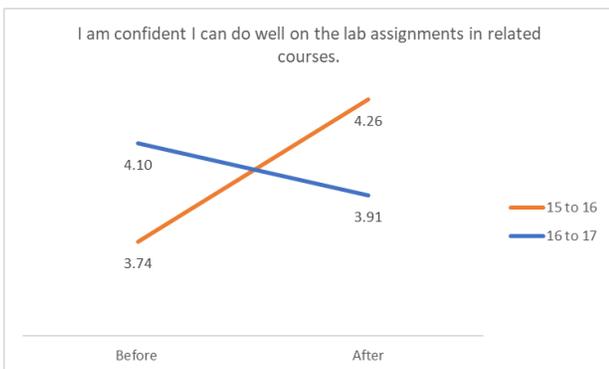
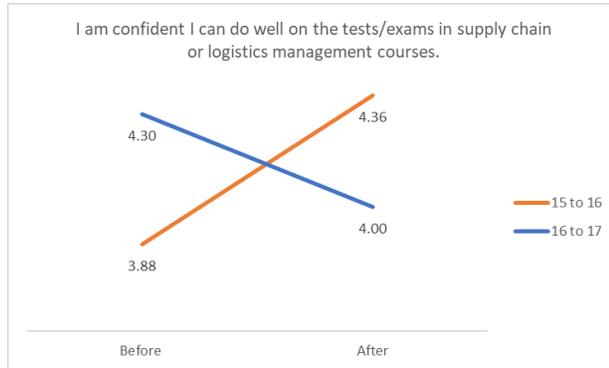
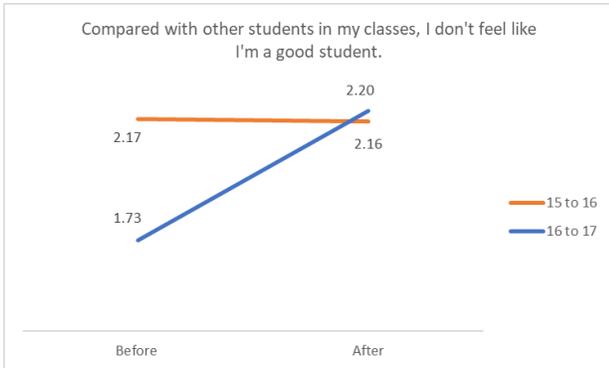
Appendix B –Supply Chain and Logistics Management Student Survey from 2017 (cont.)

Comparison of mean agreement ratings “before” and “after” the course based on a 1-5 (Strongly disagree – Strongly agree) response scale.



Appendix B –Supply Chain and Logistics Management Student Survey from 2017 (cont.)

Comparison of mean agreement ratings “before” and “after” the course based on a 1-5 (Strongly disagree – Strongly agree) response scale.



Appendix C – Overview of Partnership Involvement as of July 2017

(Greyed areas indicate involvement as of July 2017)

Program Development Areas								
Partner	Program Design	Curriculum Development	Recruitment	Training	Placement	Program Management	Leveraging Resources	Commitment to Program Sustainability
Employer								
Abercrombie & Fitch								
Ashland								
Boars Head								
Cardinal Health								
Columbus Region Logistics Council								
Dole								
Honda								
Intelligrated								
MAST								
ODW Logistics, Inc.								
Thirty-One Gifts								
Workforce System								
Columbus Downtown Career Center								
Eastland-Fairfield Career Center								
High Point Career Center								
Training and Educational Institutions								
Columbus Downtown H.S.								
Dublin Coffman H.S.								
Dublin Jerome H.S.								
Dublin Scioto H.S.								
Eastland Fairfield Career Center								
Focus Learning Academy								

Program Development Areas								
Partner	Program Design	Curriculum Development	Recruitment	Training	Placement	Program Management	Leveraging Resources	Commitment to Program Sustainability
Franklin University								
Gahanna Lincoln H.S.								
Hi-Point Career Center								
Lancaster-Stanberry								
National Center for Supply Chain Technology Education								
New Albany								
Northland High School								
Tolles Career Center								
West Jefferson Middle School								
Westerville City Schools								

Industry Partner Score: 52



Evaluation
Plans



Program
Evaluation



Report
Writing



Data Collection
& Analysis

The Rucks Group is a research and evaluation firm that gathers, analyzes, and interprets data to enable our clients to measure the impact of their work.

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