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I, Kyle Gundrum, hereby submit this original work as part of the requirements for the degree of Master of Science in Information Technology.

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INTERalliance of Greater Cincinnati: Connecting High School Students with Information Technology Career Pathways

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INTERalliance of Greater Cincinnati: Connecting High School Students with Information Technology Career Pathways

A thesis submitted to the
Graduate School
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by

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Abstract

The United States has a considerable talent gap in Information Technology (IT) as there are not enough qualified candidates to fill open IT jobs. This workforce shortage is addressed locally, regionally, and nationally by non-profit organizations, government initiatives, and educators. One non-profit organization, INTERalliance of Greater Cincinnati, grows the regional IT talent pipeline in Cincinnati by executing experiential programs for local high school students. INTERalliance connects the students with IT career pathways at companies and universities in the region, facilitating early connections with IT managers who can hire them for college internships and full-time jobs. This thesis analyzes data about the college and career decisions of past program participants. Compared to national averages, the results show INTERalliance participants are 12 times more likely to study IT in college and 13 times more likely to work full-time in IT. A regression analysis determined the significance of certain variables like gender and school type towards predicting student decisions. The results demonstrate the value of the organization and suggest opportunities to improve its programs in the future. The INTERalliance model could be deployed in other regions to develop their IT talent pipelines.

Keywords: information technology, talent pipeline, talent gap, regional workforce development, internship programs, non-profit organizations, Greater Cincinnati
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INTERalliance of Greater Cincinnati: Connecting High School Students with Information Technology Career Pathways

The rapidly growing Information Technology (IT) industry creates far more jobs than the market can sustain. In 2015, there were 545,000 open IT jobs in the United States (White House, 2016). The United States must add one million STEM workers by 2022 to mitigate the risks of a talent gap (Olson & Riordan, 2012). Equipping more individuals with the skills necessary for STEM and IT careers via educational programs is a significant component of closing the talent gap. Promoting STEM education has been identified as an important step to maintaining United States global competitiveness (Melguizo & Wolniak, 2012; Ball, Huang, Cotton, & Rikard, 2017). Companies that are unable to fill their open IT jobs with qualified talent face a substantial labor issue, which poses widespread economic problems across the entire market.

IT careers are attractive, offering strong job security and career advancement potential. Per the Bureau of Labor Statistics (2015), the IT job demand is projected to grow 12% between 2014 and 2024, which is a faster rate of growth than the average for all career fields. BLS states the median salary for IT occupations was $81,430 in May 2015, more than double the median salary for all occupations of $36,200. Even though IT jobs are high-paying and widely available, the workforce does not satisfy the talent demand. This leaves companies with open positions that are challenging to fill. In addition to threatening corporate productivity and growth, this talent deficit places the national security of the United States at risk. The United States Department of Defense currently faces a talent shortage in the cybersecurity and intelligence fields. The military anticipates meeting future workforce needs will be problematic as it adapts to emerging technologies (National Academy of Engineering, 2012). Thus, it is important to grow the IT talent pipeline for the stability of the United States economy and even for national defense.
This issue is being addressed nationally, regionally, and locally. This thesis describes a local initiative in the Greater Cincinnati region, which has significant IT talent needs with 4,080 IT job openings (White House, 2016). INTERalliance of Greater Cincinnati is a non-profit organization that executes experiential programs for high school students to connect them with IT career pathways. INTERalliance is funded by regional employers and supported by their IT leaders. Conceptually, the model is as follows: identify potential IT talent in area high schools, nurture and train the students with experiential programs, employ the students in internships and connect them with college co-op opportunities, and retain the students in the region through this combination of programs, facilitated relationships with area employers, and work experience. INTERalliance was founded in 2006 and has executed programs for the last eleven years. This research evaluates the likelihood INTERalliance participants will pursue IT career pathways and examines some of the underlying factors of their decisions. Programs like INTERalliance are important: as developing an IT talent pipeline is a national need, INTERalliance could be replicated in other communities as a model for promoting IT career pathways to more students.

**Regional IT Talent Deficit in Greater Cincinnati**

An annual survey of industrywide IT trends shows 65% of IT leaders reported a technology skills shortage in their organization (Harvey Nash & KPMG, 2016). The report indicates this is the highest technology skills shortage since the Great Recession as the measure has increased since 2011 when it was only 42%. This trend is mirrored in Greater Cincinnati. An estimated 8,000 IT jobs will be created between 2013 and 2020 and there are three times more IT jobs than IT graduates in the region (Cincinnati CIO Roundtable, 2013). Enrollment in undergraduate IT-related programs at local universities had dropped nearly 65 percent in the years leading up to 2006 (Keeney, 2006). These factors all contribute to the lack of qualified IT
talent in the region. There are many challenges in convincing people that IT is an attractive field, as there are misconceptions and stereotypes about IT careers. Toste (2014) claims some of the leading misconceptions preventing people from pursuing IT careers are that IT professionals lack social skills and that “writing code is all they do.” People do not consider IT a viable career option because they do not understand or think they would enjoy IT career opportunities.

Filling these talent needs involves building a more robust IT talent pipeline. The talent pipeline generally refers to the pathway students take from IT interest in grade school and high school, then pursuing IT-related undergraduate and perhaps graduate degrees, and finally entering an IT discipline for full-time employment (Ball, Huang, Cotton, & Rikard, 2017). Many sources discuss the “leaking” that occurs throughout the pipeline, with many students ultimately pursuing other academic programs and career disciplines (Berryman, 1983; Alper & Gibbons, 1993; Cannady, Greenwald, & Harris, 2014). This leaking ultimately results in the industrywide IT talent deficit. INTERalliance of Greater Cincinnati works at the early stage of the talent pipeline, executing experiences for high school students that connect them with attractive IT career opportunities at local employers.

This thesis is organized as follows: after posing the research question and exploring background information about each major program, the method used to conduct this study is explored. The results are then presented, including a logistic regression and descriptive statistics about the data. Trends are identified and the significance of these results is discussed. Finally, additional study is proposed to further determine the effectiveness of INTERalliance.

**Research Question**

The goal of INTERalliance is to promote IT career pathways to high school students in the Greater Cincinnati region. For this thesis, IT career pathways are defined as IT academic
programs in college and then full-time IT employment after college. The objective of this research is to explore the academic and professional decisions of past students and to examine some of the underlying factors that impacted their decisions. This study uses a data set of past program participants and their gender, school type, and INTERalliance program participation history. The high-level research question is: Considering gender, school type, and INTERalliance program participation, what factors impacted whether INTERalliance participants pursued IT career pathways?

INTERalliance’s work to promote regional IT career pathways includes two goals: promoting IT-related academic programs and careers, and connecting students with opportunities at Greater Cincinnati universities and companies. The following questions are explored:

- Considering gender, school type, and INTERalliance program participation, what factors impacted the decision to select an IT-related undergraduate degree?
- Considering gender, school type, and INTERalliance program participation, what factors impacted the decision to study at a Cincinnati undergraduate college?
- Considering gender, school type, and INTERalliance program participation, what factors impacted the decision to pursue an IT-related career after college?
- Considering gender, school type, and INTERalliance program participation, what factors impacted the decision to work in Cincinnati after college?

The experiment method and results are discussed later in this thesis, after examining background information about each INTERalliance program.

**INTERalliance: A Community-Based Model in Greater Cincinnati**

This section of the thesis reviews the programs of INTERalliance of Greater Cincinnati and the best practices utilized to influence student decisions. The pedagogical components of
INTERalliance programs are supported by other research. I am the Executive Director of INTERalliance of Greater Cincinnati, a 501(c)(3) non-profit organization that promotes IT career pathways. I have worked with the organization since 2008, so much of this information comes from my personal knowledge about the mission, operations, and outcomes. The Board of Directors, comprised of IT leaders at regional companies and universities, determines the organization’s strategy and facilitate their organizations’ involvement. Founded in 2006, the organization has impacted nearly 4,000 students.

From a pedagogical standpoint, INTERalliance programs utilize best practices to effectively connect high school students with IT career pathways. Facilitating hands-on IT experiences for high school students increases their interest and knowledge in the field (Doerschuk, Liu, & Mann, 2010). INTERalliance offers high school students these experiential opportunities. Student attitudes about STEM are associated with their likelihood to pursue STEM majors, and experiential curriculum has been demonstrated to improve attitudes (Ball, Huang, Cotton, & Rikard, 2017). Each program aims to immerse students in experiential IT activities so they form an early awareness of opportunities in the field. This awareness increases their likelihood of pursuing IT career pathways. Students with exposure to computer science in high school are much more likely to study it in college (Mattern, Shaw, & Ewing, 2011). This supports INTERalliance’s strategy of growing the IT talent pipeline by planning programs for high school students. Most students who study STEM report their interest initiated from extracurricular experiences (VanMeter-Adams, 2014). INTERalliance successfully promotes IT and STEM majors by demonstrating at its programs real-world uses of IT at local companies. Awareness of how companies implement IT and connections to IT hiring managers at those companies have an impact on future college and full-time work decisions. Additionally, industry
involvement with students before and during college increases their likelihood of completing their degrees and studying STEM (Veenstra, 2014). INTERalliance connects students with employers as early as their freshman year of high school through its portfolio of programs.

**Programs of INTERalliance**

INTERalliance executes several programs to impact high school students and connect them to IT career pathways. Each program plays a different role in the overall strategy.

**IT Careers Camp.** The organization’s first program, IT Careers Camp, is a six-day summer program during which students visit local Fortune 500 corporations to network and to learn how companies use IT to solve business problems. The students network with executive IT leaders and managers, collecting business cards to build long-term relationships. The students collaborate on teams to develop a business plan for a technology company, which is presented on the final day of the program to judges from local corporations. The program is engineered to build connections between the students and local IT leaders. IT Careers Camp is intimate and selective, with five sessions of twenty students enabling 100 students to participate each summer. It is also immersive, as students spend nearly a week staying overnight at a local university, solving IT problems, and learning about IT careers. This program is targeted only for sophomores, as the organization’s strategy is to influence the students’ perspectives early in their high school career, connecting them with more hands-on professional opportunities in their final two years of high school.

**Summer Internship Program.** Every year, INTERalliance arranges over 60 internships with Greater Cincinnati Fortune 500 companies and startups for which high school students apply, interview, and work for 8-10 weeks over the summer. INTERalliance directs participating companies to offer opportunities that deliver tangible value to the company and resemble the
type of work they would assign to a college intern. Students are paid $10 per hour through INTERalliance, which is provided by grants from the sponsor companies. Forming relationships with high school students and companies as early as possible is key to retaining students in the region for college and their careers. This program facilitates an extended touch point between companies and students, with a goal of students having an enjoyable experience so they are more likely to pursue IT. The connections they develop can help with future job opportunities.

Participating in internship experiences has a very positive effect on retention in the field (Jaeger, Eagan, & Wirt, 2008). Companies have an entire summer to impact students for an internship, while the other programs are much shorter. Internship participants can select IT-related majors and full-time opportunities with confidence that they enjoy the field, as they already have relevant professional experience.

Internships are a powerful component of the INTERalliance strategy, as well as any pipeline development initiative. Companies use internships as a key strategy to hire full-time talent. Companies offer full-time jobs to 72.7% of their interns and convert 85.2% of those who received an offer (NACE, 2016). Internship employers anticipate their INTERalliance high school interns will return for college internships and ultimately for full-time opportunities. These interns begin their first college experience with more familiarity than other students. This advantage is mirrored in the transition from college intern to full-time employee as well. Full-time employees who interned with companies are more productive and more likely to stay with the company than hires who did not (NACE). The INTERalliance internship program offers these advantages even earlier, as high school interns should be expected to be more productive as college interns.
**TechOlympics.** In 2010, INTERalliance added a conference, TechOlympics, to its program portfolio. The annual event brings together 500 local high school students and 300 volunteers and speakers to generate excitement and to educate students about local IT internship and career opportunities, trends in the field, and professional development. The objective of TechOlympics is to improve student perceptions about regional IT careers and to form connections between students and companies that the students can leverage when looking for internships and full-time work. Partner companies host breakout sessions on a variety of IT-related topics and set up booths to interact with students throughout the weekend. While IT Careers Camps and internships are more immersive, TechOlympics is more focused on general awareness and excitement about the field, since research shows perceptions of the field are important.

**Leadership Council.** The INTERalliance Leadership Council (ILC) started in 2011 as the student leadership body of the organization. ILC students apply for the opportunity after attending other programs and are selected through an interview process with INTERalliance management. The students are tasked with executing many of the logistics of the other programs. The students attend a weekend leadership retreat at the beginning of the school year, serve as staff at the other programs, and participate in monthly meetings and ongoing work committees. Roughly 45 students are selected each year. INTERalliance has historically selected the students with the most leadership potential and involvement in other extracurriculars, though a shift in this strategy is explained in the Discussion section of this thesis.

**Method**

This section of the thesis describes the method used to conduct the study of past INTERalliance participants and some of the determining factors of their decisions. The first
The objective of this research is to determine how many past INTERalliance participants pursued IT career pathways. INTERalliance maintained records of 3,008 program participants between 2006 and 2017. These records contain basic student information like high school, graduation year, and contact details like cell phone number and email address. The following method was used to gather data about INTERalliance alumni; results are presented and analyzed in subsequent sections.

INTERalliance had never completed a comprehensive survey of all its alumni nor maintained a cohesive database. The first task of this research was to consolidate data sources and create a master student database. I led a group of student interns to create this database and conduct the research. We consolidated over twenty separate spreadsheets of program participants, each of which constituted the records for an individual program in a certain year. The database was cleansed for duplicates and records were merged for students who signed up to several programs with different nicknames. Each student was assigned a unique identifier and a separate data table was maintained to keep track of the programs in which each student participated. Once consolidated, these records were uploaded to Salesforce as a master data repository. INTERalliance made a strategic decision to use Salesforce to support future efforts to maintain communication with alumni.

The resulting master student database contains 3,008 student records for high school students who graduated between 2006 and 2017. The next objective was to collect information about their college and career decisions. I set up a template spreadsheet and added fields to capture this data. The fields are as follows:

- Undergraduate college: college name, major, double major, graduation year
- Graduate school: college name, program
• Full-time: company, city, position/title

I directed the student interns to find LinkedIn profiles for each student in the database and log as many of these fields as possible. The LinkedIn profile URLs were captured as well to expedite future updates. In all, university data was found for 1,825 students, which is a 60.7% sample out of the 3,008 total students. This constitutes the sample population for this research. This method was selected for efficiency as all information is publicly available on LinkedIn.

With the data fully logged, I normalized the data by updating colleges and majors to be represented uniformly. I manually categorized each college as Greater Cincinnati, Ohio, or out of town. I also classified each college by radius from Cincinnati: 50 miles, 100 miles, 250 miles, or beyond. The majors were grouped into IT-related, STEM, and other. Full-time information was located and logged for 352 alumni out of 851 who graduated high school between 2008 and 2012. High school graduates of 2013 and later are excluded as most are still in college and data would not be substantial enough to report. This constitutes a 44.8% sample population for full-time INTERalliance alumni. I categorized the work locations as Cincinnati, Ohio, or out of town, and the positions as IT, STEM, or other.

The classification of academic majors and full-time positions between IT, STEM, and other was performed per the INTERalliance Board of Directors working definition of these fields. IT includes majors like information technology, computer science, computer engineering, and data analytics, while STEM includes majors like biology, mathematics, and mechanical engineering, which are still science programs but not classified as IT. Greater Cincinnati as defined in this research includes fifty miles from downtown Cincinnati, including colleges from Northern Kentucky to Dayton.
The data was analyzed in Microsoft Excel. Each student’s unique identifier was referenced with the program participation records to yield more detailed analytics by program.

A logistic regression was conducted to determine the significance of certain independent variables as potential predictors of future decisions. The independent variables assessed for each student are gender, school type, number of INTERalliance programs attended, and whether the student participated in IT Careers Camp, TechOlympics, internships, and ILC. These variables are included in the master database along with the data collected from LinkedIn. For the regression model, school type was broken into two binary fields: private/public and urban/suburban. Number of programs attended is a continuous variable ranging from 1 to 10. For gender, female is a value of 0 and male is a value of 1. The program attendance variables are binary, set to 0 if the student did not participate in the program and 1 if the student did participate. This data set was generated from the master data set and saved as a CSV. This dataset was imported to IBM SPSS Statistics to conduct a binomial logistic regression analysis. A separate analysis was performed for four separate dependent variable outcomes: studying IT in college, studying at a local college, pursuing a full-time IT career, and working full-time in Cincinnati. A fifth regression model was run to determine the impact of these independent variables on likelihood to select a STEM degree, so the results can be compared with IT degree selection.

The dataset was imported into IBM SPSS Statistics and each variable type was established. All independent and dependent variables are nominal except for number of programs attended, which is ordinal. All variables are numeric. A separate binomial logistic regression was conducted for each of the four dependent variables. The results are discussed along with the descriptive statistics of each research question.
Results

These results address the initial research question about the professional and academic decisions of past INTERalliance participants. This section of the thesis explores the regression model of several variables to determine their association with student decisions. The analyses are supported with descriptive statistics related to each research question.

**Considering gender, school type, and INTERalliance program participation, what factors impacted the decision to select an IT-related undergraduate degree?**

The first metric considered is the number of students who studied IT-related majors. Out of the 1,550 students for whom this data was captured, 37% studied IT-related majors, 67% studied IT and STEM, and 33% pursued other programs. A logistic regression was performed to assess the impact of gender, school type, number of programs attended, and participation in IT Careers Camp, TechOlympics, internships, and ILC on their decision to study IT. The regression model is statistically significant with chi-square = 184.041, p-value < 0.0005 with df = 8. The model explains 15.6% of the variance in the dependent variable of IT major selection, per the Nagelkerke R-Square value of 0.156. The model correctly predicts the dependent variable in 66.6% of cases with a cut-off value of 0.5. Additional variables are necessary to create a more accurate predictive model; however, this analysis yields meaningful insights about the relative importance of each independent variable. For each variable, the coefficient, p-value, and odds ratio are in Table 1.
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Table 1: Binomial logistic regression for IT degree selection

The independent variables for number of programs attended, gender, internship participation, ILC participation, public school attendance, and suburban school attendance are statistically significant with \( p < 0.05 \). The \( \text{Exp(B)} \) value indicates that when number of programs increases by one unit (participation in one program), the odds ratio is 1.27 times as large and therefore participants are 1.27 more times likely to study IT. Based on its odds ratio, males are 2.5 times more likely to pursue IT majors than females. Suburban school students are 1.5 times as likely to pursue IT majors than urban school students. Public school students are nearly twice as likely to pursue IT majors than private school students. Participants in the internship program are twice as likely to study IT as students who do not participate in the program, while ILC participants are half as likely. TechOlympics and IT Careers Camp participation did not have a statistically significant impact on this dependent variable. These results add additional insight about the associations between demographic factors and IT major selection.

Descriptive statistics will now be analyzed to explore these associations further. The breakdown by graduation year in Figure 1 reflects a steadily increasing number of INTERalliance students who pursue IT and STEM majors. Out of all degrees conferred in the United States in 2015, only 3.1% were IT-related (NCES, 2017). The 37% of INTERalliance alumni who study IT is much higher than the national average of 3.1%. The trend that INTERalliance alumni are twelve times more likely than average students to pursue IT-related
majors is attractive for partner companies and universities. This demonstrates that INTERalliance selects for its programs the right students who are interested in IT.

Figure 1: Undergraduate Major Selection by High School Graduation Year

The upward trend in students selecting IT majors from the first high school graduating class of 2008 to the latest class of 2017 suggests INTERalliance is becoming more effective at selecting and impacting students. The measures for six of the last eight years are above the all-time 37% average. The all-time measure is pulled down by the first three years, in which INTERalliance selected students primarily for leadership and academic excellence and did not consider IT interest.

Attending more programs made it more likely to study IT, as seen in Figure 2. This suggests intuitively that students who are most interested in IT continue to participate in multiple programs. The trend also suggests INTERalliance participation is associated with selecting an IT-related major. This confirms the logistic regression finding that participating in an additional program makes students 1.27 times more likely to study IT.
INTERalliance implemented a notable strategic shift in 2013 to focus more on IT and less on business in its programs. The classes of 2016 and 2017 pursuing IT at rates of 44% and 42% respectively has promising implications for the effectiveness of INTERalliance’s focal shift.

In terms of promoting IT majors, internships are most effective and the IT Careers Camp is least effective, which is depicted in Figure 3.
The best program for promoting IT majors, internships, successfully yielded 58% of students to IT majors and 84% to STEM majors. Only 16% of students who participated in an internship studied something else in college. For the least effective program, IT Careers Camp, 35% studied IT and 67% studied STEM. This supports the logistic regression finding that IT Careers Camp and TechOlympics did not significantly impact student decisions to study IT, but participation in internships and ILC did have an impact.

Another logistics was run for the impact of the same independent variables on likelihood to study STEM. Effectively, majors like Mechanical Engineering, Biology, and Chemistry are added to the data set of students who chose to study IT majors. The regression model is statistically significant with chi-square = 102.150, p-value < 0.0005 with df = 8. The model explains 9.1% of the variance in the dependent variable of IT major selection, per the Nagelkerke R-Square value of 0.091. The model correctly predicts the dependent variable in 67.9% of cases with a cut-off value of 0.5. The results are in Table 2.

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**Table 2: Binomial logistic regression for STEM degree selection**

As in the regression model for IT majors, internship participation, public school attendance, suburban school attendance, and gender are statistically significant. However, number of programs is not statistically significant like it was in the previous regression model. This suggests attending more programs made students more likely to study IT but did not influence their decision to study STEM. This is a positive indicator for how INTERalliance
focuses its program content and student recruitment efforts. The same trend is true for the
difference that ILC is statistically significant in the previous regression model but not for STEM
majors. While public school attendance has an impact in both models, the impact is higher for
the IT degree model than in the STEM degree model. The impact for suburban school attendance
is nearly the same. Finally, while males are 2.5 times more likely to study IT, they are only 2
times more likely to study STEM. This suggests female participants are more likely to select
STEM degrees after participating in INTERalliance than they are to select IT degrees.

The additional qualitative and quantitative variables that could be added to improve these
models are discussed in the Next Steps section. These results demonstrate the association
between INTERalliance participation and IT degree selection. Next, Greater Cincinnati college
attendance is explored.

**Considering gender, school type, and INTERalliance program participation, what factors
impacted the decision to study at a Cincinnati undergraduate college?**

The second metric considered is the number of students who attended a Greater
Cincinnati college. Undergraduate college locations were collected for 1,825 students. Out of
these students, 47% stayed in Cincinnati, 70% stayed in Cincinnati and Ohio, and 30% went
elsewhere. A logistic regression was performed to examine the association between the same
independent variables in the previous models and likelihood to study in Cincinnati. The
regression model is statistically significant with chi-square = 74.585, p-value < 0.0005 with df = 8.
The model explains 5.5% of the variance in the dependent variable of Cincinnati college
selection, per the Nagelkerke R-Square value of 0.055. The model correctly predicts the
dependent variable in 58.4% of cases with a cut-off value of 0.5. As in the previous model,
additional variables are needed to develop a more predictive model, but this logistic regression
reveals some of the determining factors of student decisions about where to attend college. For each variable, the coefficient, p-value, and odds ratio are in Table 3.

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Table 3: Binomial logistic regression for Cincinnati college selection

The independent variables for number of programs attended, IT Careers Camp participation, internship participation, ILC participation, public school attendance, and suburban school attendance are statistically significant with p < 0.05. Gender and TechOlympics participation are not statistically significant. One would not expect gender to make a notable difference for college selection. The coefficients for participation in all four programs are negative, suggesting the programs individually have a negative impact on student likelihood to stay local. However, attending an additional program increases the likelihood of staying in Cincinnati by 1.2 times. This suggests students who attend multiple programs are more likely to be impacted than students who participate in an individual program. Public school students are less likely to stay local than private school students. This result may seem counterintuitive and is examined in the Discussion section. Suburban school students are less likely to stay than urban school students. This result could be expected given the socioeconomic disparity.

The breakdown by graduation year in Figure 4 demonstrates a relatively steady percentage of INTERalliance participants studying in Cincinnati, Ohio, and out of town over time. In an analysis of the distance of each college from Greater Cincinnati, 67% of students stayed within 100 miles and 81% stayed within 250 miles. Only 19% of students went to college
more than 250 miles away from Cincinnati, thus many INTERalliance alumni stay in Cincinnati and Ohio, and those who do leave frequently stay in the Midwest. This suggests an opportunity for INTERalliance partner companies to maintain relationships with alumni, recruiting them for summer internships and co-ops. These active relationships could help encourage them to move back to Cincinnati upon graduating college.

Figure 4: Undergraduate College Location by High School Graduation Year

A survey of national high school graduates indicates 58% of students attend college within 100 miles of their hometown while 72% attend college in their state (Niche, 2014). By comparison, 67% of INTERalliance alumni stay within 100 miles (9% more than the national average) and 70% stay in Ohio (just 2% lower than the national average). This comparison suggests INTERalliance alumni are consistent with national trends in their decisions about where to attend college. INTERalliance can improve by connecting students with scholarships and honors programs at local universities. The organization currently plans many workshops and programs on college campuses and features each university’s unique strengths to the students.
Students who attended fewer programs were more likely to stay in Cincinnati for college. Single-program participants stayed in Cincinnati 48% of the time while only 37% of students who participated in seven programs stayed for college.

![Figure 5: Program Impact on Cincinnati College Attendance](image)

It is perhaps counterintuitive that INTERalliance students are less likely to stay in Cincinnati for college as they participate in more programs. However, 82% of students who attended five or more programs participated in ILC. Students are selected for ILC after an interview process to select top leaders—generally, students with exceptional public speaking skills, high GPAs, and extensive extracurricular involvement are selected. These students become the most involved participants, but they are also the most likely to leave Cincinnati for college, a decision which 70% of them make. The logistic regression variables for each program yielded a negative coefficient, suggesting program participation actually makes students less likely to stay in Cincinnati for college, as also suggested by these descriptive statistics. This result seems to differ with the regression model result of attending more programs increasing the likelihood of staying in Cincinnati by 1.2 times. This suggests it is not actually program participation that
encourages students to leave, but other factors like school type. A hypothesis for this trend is further explored in the Discussion section.

TechOlympics participants are most likely to stay in Cincinnati while ILC members are the least likely, as shown in Figure 6. While 49% of TechOlympics participants stay in Cincinnati and 71% total stay in Ohio, the percentages of 30% of ILC students staying in Cincinnati and 57% staying in Ohio are notably lower. Since TechOlympics did not have a statistically significant impact on the regression model, this suggests TechOlympics is not necessarily influencing students to stay but the other variables, like school type, is really the determinant.

![Figure 6: Undergraduate College Location by Program](image)

Now that the college decisions of past INTERalliance participants have been explored, full-time results are presented.

**Considering gender, school type, and INTERalliance program participation, what factors impacted the decision to pursue an IT-related career after college?**

The next metric to evaluate is the percentage of past INTERalliance participants who accepted full-time IT jobs. Full-time job information was collected for 381 graduates. Out of
those graduates, 29 are still in graduate school, so the full-time employment sample is 352 past program participants. A logistic regression was performed to examine the association between the same independent variables and likelihood to work full-time in IT. The regression model is statistically significant with chi-square = 56.164, p-value < 0.0005 with df = 8. The model explains 18.5% of the variance in the dependent variable of full-time IT career selection, per the Nagelkerke R-Square value of 0.185. The model correctly predicts the dependent variable in 67.2% of cases with a cut-off value of 0.5. Additional variables are necessary to create a more accurate predictive model; however, this analysis yields meaningful insights about the relative importance of each independent variable. For each variable, the coefficient, p-value, and odds ratio are in Table 4.

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Table 4: Binomial logistic regression for full-time IT career selection

The independent variables for gender, public school attendance, and suburban school attendance are statistically significant with p < 0.05. Males are 3 times more likely than females to work in IT. Suburban school students are 3.7 times more likely than urban school students to work in IT, and public school students are 1.8 times more likely than private school students to work in IT. All the other independent variables did not have a statistically significant impact. However, this is likely a result of the limited dataset. This model only includes the professional decisions of 351 alumni while the college models include much more data. A significant number
of the students in this data set did not have the opportunity to even participate in TechOlympics and ILC, as those programs started in 2010 and 2011, respectively.

The results in Figure 7 show 42% of INTERalliance alumni work in IT. These measures are much higher than local averages. Only 3% of the national workforce and 3.1% of Greater Cincinnati’s workforce is in IT as of 2016, per the Bureau of Labor Statistics (2016). INTERalliance alumni work in IT at an exceedingly higher rate than the general population. It is attractive to INTERalliance partner companies that program participants are more than thirteen times more likely to work in IT once they enter the full-time workforce.

![Full-Time Industry By Year](image)

**Figure 7: Full-Time Industry by High School Graduation Year**

Comparing IT major selection and full-time IT work suggests a promising trend. While 37% study IT in college, 42% work full-time in IT. This suggests a fraction of INTERalliance alumni pursue other academic interests in college but then return to IT as they select their full-time jobs. This is also expected given the high level of job availability in IT and the relationships INTERalliance alumni form with sponsor companies. Out of the 352 working full-time in the sample for this study, 38 are working in IT in Cincinnati for INTERalliance sponsor companies. The actual number is expected to be much higher since this is only a 45% sample population.
These results suggest INTERalliance participation is also associated with selecting full-time IT careers. Next, full-time employment location is explored.

**Considering gender, school type, and INTERalliance program participation, what factors impacted the decision to work in Cincinnati after college?**

Finally, we consider the percentage of INTERalliance alumni working full-time in Greater Cincinnati. The percentage of past participants working in Cincinnati is 47%, while 10% work in other Ohio cities and 43% went away to other states. A logistic regression was attempted as with the other dependent variables. However, the regression model is not statistically significant with chi-square = 14.476, p-value > 0.05 with df = 8. The model explains only 4.9% of the variance in the dependent variable of full-time career location, per the Nagelkerke R-Square value of 0.049. The model only correctly predicts the dependent variable in 61.2% of cases with a cut-off value of 0.5. Each variable in the regression is statistically insignificant with p > 0.05. This regression model likely failed due to the small data set of 381 college graduates compared to many more in the models for undergraduate decisions. I hypothesize a successful regression model could be created with more independent variables about the students, which is explored further in the Discussion question, and with more data in general as more past INTERalliance participants enter the workforce. Despite the statistically insignificant regression model, the descriptive statistics about full-time location decisions are now discussed.

The rate at which past INTERalliance participants stay in Cincinnati is lower than Ohio average rates. On average, 62% of Ohio college graduates stay in their hometown while 17% move within the state and 21% move outside the state, per 2015 American Community Survey data (IPUMS USA, 2017). This means 15% more INTERalliance alumni work full-time outside of Cincinnati and 5% more work full-time outside of Ohio. Given the competitiveness of
INTERalliance’s programs, it makes sense that students are more likely to weigh their options nationally and decide to work out of town. Ohio is one of the states that college graduates leave at the highest rate out of all the other states (Bui, 2016). This suggests an opportunity for INTERalliance to form lasting relationships between students and companies to increase their probability of staying in Cincinnati for full-time work.

Figure 8: Full-Time Job Location by High School Graduation Year

Figure 8 demonstrates a moderate increase in Cincinnati full-time retention between 2008 and 2012 graduates. This impact and underlying factors that may have affected the trends are discussed in the next section.

Discussion

This section of the thesis discusses the significance and takeaways of the results presented in the previous section. Next steps are proposed to learn more about the trends observed in these findings. The results presented demonstrate the associations between INTERalliance participation, gender, and school type, with decisions to study IT, attend a local university, work full-time in IT, and work full-time in Cincinnati.
Program impact

The regression models for IT major selection and full-time IT career selection demonstrated attending more programs made it more likely to pursue IT career pathways. The descriptive statistics reinforced this claim, which suggests INTERalliance programs have a positive impact on the likelihood students will go on to pursue IT career pathways.

For promoting IT academic programs, internships are most effective, followed by ILC, TechOlympics, and IT Careers Camp. Internships and ILC are extended experiences for students, with internships lasting ten weeks over the summer and ILC spanning an entire academic year. During this time, students immerse themselves in many IT-related activities, so their impact is apparent. This explains why the variables for participation in internships and ILC had a statistically significant impact on likelihood to study IT. As TechOlympics is a short weekend for a much higher volume of students, there is a shorter opportunity to impact them. However, this number can be expected to improve as more recent TechOlympics attendees graduate high school. At TechOlympics 2017, 81% of students said they were interested in pursuing IT careers and academic programs, per a questionnaire administered to all at the event. INTERalliance focused the TechOlympics curriculum much more aggressively on IT starting in 2014. It will take several years to see the results of this change. IT Careers Camp also started focusing more on IT and less on business and leadership in 2014. This shift is expected to continue improving the statistics as well. In 2017, INTERalliance added questions to the student IT Careers Camp application to gauge their interest and current experience with IT. This was used as an important selection criteria. The same shift will be applied to ILC for the 2017-18 academic year.

In terms of promoting Cincinnati colleges, TechOlympics participants most often go on to study in Cincinnati, followed by IT Careers Camp, Internships, and ILC with the smallest
number of students. This trend mirrors the competitiveness to be selected for each program.

TechOlympics is open to all students, who need only to register online to attend. Students complete an application for IT Careers Camp, which 100 attend each summer. Companies interview applicants for internships, in which 60 participate each summer. And a small group of 45 students is selected each year for ILC as a result of a highly competitive interview process.

This trend suggests a tendency for more competitive students with higher GPAs and stronger extracurricular experience to go out of town for college. As a takeaway from this study, INTERalliance can add elements to its programs to connect top talent to scholarships and honors programs at local universities. As an important note, while TechOlympics participants most often go on to study in Cincinnati, the independent variable was statistically insignificant. This implies TechOlympics participation is not impacting the student decision to study in Cincinnati, but the other variables like school type are having an impact. Students also often participate in multiple programs, so the logistic regression results are more detailed than the cursory descriptive statistics.

**School type**

School type had a statistically significant impact on every dependent variable. The examination of school type was separated into two binary flags: public/private and urban/suburban school attendance. Public school students were 1.9 times more likely than private school students to study IT and 1.8 times more likely to work full-time in IT. However, public school students were only 1.6 times more likely to study STEM, suggesting selection of STEM majors explains part of the gap between public and private schools. Suburban school students were 1.6 times more likely to study IT and 3.7 times more likely to work full-time in IT than urban school students. This result is unfortunately expected. There are many challenges to STEM
education in urban public schools (Eisenhart et al, 2015). Per Eisenhart, even urban public
schools dedicated to STEM struggle to impact the students. This result suggests the suburban
schools are better equipped to prepare students for IT and STEM career pathways than urban
schools. From an INTERalliance perspective, this result indicates the organization should be
prepared to augment the education and take extra steps in its efforts to impact urban school
students.

The results of the regression model show public school students are less likely to stay in
Cincinnati than private school students, which seems counterintuitive. However, when simply
comparing public schools to private schools, the urban public schools are included in the same
data with elite suburban public schools like Mason High School, one of the biggest
INTERalliance participant schools. The regression pointed out students from urban schools are
more likely to stay, which is the expected a result. A further examination should be conducted of
the schools that participate in INTERalliance and their average socioeconomic status. The
percentage of students who receive free and reduced lunch would be a good start as a variable to
compare the schools. Students of lower socioeconomic status can be expected to be more likely
to stay local given the higher costs involved with moving away for college.

**Women in IT**

A descriptive analysis indicates 45.7% of males pursue IT majors while only 23.7% of
females pursue the same. This supports gender as a statistically significant independent variable
in the regression models for IT major selection and full-time IT careers. For full-time IT careers,
the odds ratio of 2.996 for gender indicates males are 3 times more likely to pursue IT careers
than females. The tendency mirrors industrywide trends with low female participation in IT
career pathways. Nationally, females only represent 18% of students pursuing IT degrees
(NCWIT, 2014). The tendency in the regression models for some of the program participation variables to be statistically insignificant while gender was statistically significant for IT degree, STEM degree, and full-time IT work selection, shows gender and other variables are the underlying result of student decisions rather than program participation. While INTERalliance female participants pursue IT degrees at a slightly higher rate than the national average, this highlights an opportunity to better promote IT to females in the programs.

**STEM majors**

For several years between 2010 and 2014, the INTERalliance Board decided to focus on STEM in addition to IT. As such, STEM results were presented along with IT. The region needs more STEM talent as well, with IT representing just one component of STEM. Higher ratios of students pursuing STEM in college between 2014 and 2017 are seen in Figure 1. Since 2014, the Board is now focusing more narrowly on IT. Any program curricular changes take several years to be reflected in the statistics, since INTERalliance programs are available to students in every high school grade level. The management team is working to focus more on IT and less on STEM and business in program content. However, students who study and work in STEM are not considered completely negative statistics. While INTERalliance is generally supported by the IT departments at local companies, all the companies employ other STEM professionals as well, like engineers and mathematicians. As discussed in the Results section, attending more programs had an impact on likelihood to study IT but a statistically insignificant impact on likelihood to study STEM. This suggests INTERalliance’s relationship with students over the course of participating in multiple programs is successfully promoting IT but not STEM. As a takeaway from this research, the INTERalliance Board is being asked to consider the balance of IT, STEM, and other fields, and how this should direct program content and selection criteria.
The most effective program: internships

With 58% of internship participants studying IT in college, internships are the most effective program for promoting IT majors. The results from the regression model indicated the same finding, with internship participants twice as likely to study IT as students who did not participate in the program. This mirrors a trend suggested by other research, which is reviewed in the “Programs of INTERalliance” section of the thesis. This is a substantial finding for INTERalliance. The organization is working to expand the internship program and offer as many positions as possible to students in the future, given its high conversion percentage. Other communities can learn from this finding as well, making internship programs the cornerstone of any talent development initiatives.

Pipeline Development Initiatives in Other Regions

Other regions and organizations have implemented similar initiatives. Some of these initiatives consulted with INTERalliance as they designed their programs. These serve as examples of the INTERalliance model in practice in other communities.

Northeast Ohio RITE. In Cleveland, an initiative called RITE (Regional Information Technology Engagement) started in 2009 to “champion IT career development by proactively attracting, preparing, and placing IT talent” (RITE Board, 2016). RITE’s management team has consulted with INTERalliance to help determine their strategy, including making several visits to Cincinnati to observe INTERalliance’s programs. Like INTERalliance, RITE facilitates hands-on IT opportunities for students and introduces them to local companies, facilitating site visits, guest speakers, and training workshops. RITE lists no success metrics on its website but mentions impacting more than 1,000 high school students and offering 41 IT internships at
partner companies (RITE Board). This organization serves as a model of INTERalliance being deployed in another city.

Northeast Indiana Tech Coalition. Another initiative inspired by INTERalliance is the Northeast Indiana Tech Coalition (NEITC), formed in 2010 (Northeast Indiana Tech Coalition, 2016). NEITC plans TechFest, a one-day conference modeled after TechOlympics, and TechCamp, a summer opportunity for high school sophomores, modeled after the IT Careers Camp. NEITC hosted INTERalliance student leaders on-site for their first TechFest, asking the student leaders to help facilitate and observe the conference in its pilot year. The NEITC website also does not list success metrics, but it is a community collaboration of employers, colleges, and high schools, just like INTERalliance.

Maine Workforce Innovations Program. The state government of Maine runs a Workforce Innovation Program to build the IT talent pipeline in Maine. A report about the initiative states 24% of Maine’s IT workforce will be eligible to retire in 2018 (Samson-Rickert, 2016). Per the director of the initiative, “recruitment efforts of the past don’t reach the IT workers of the future” (Samson-Rickert). The report describes the Workforce Innovation Program’s efforts to offer IT internships to traditional millennial students, adult learners, students with disabilities, and veterans. This program is successful with 75% of interns being recruited for full-time careers, per the report. This success corroborates the efficacy of internship programs in attracting and retaining IT talent.

Virginia High Tech Partnership Program. This initiative started as the high-tech industry in Virginia was already booming: per Dennis (1998), Virginia had experienced a 63% growth in its economy due to high-tech fields. Dennis reported “the shortage of skilled technology workers threatens our economy.” This program specifically targeted African-
American students with an internship program, job placement program, and partnerships between universities and companies. The results of this program were also evident, as Dennis indicates two of the interns were offered full-time roles with starting salaries of $45,000 or more. Again, this Virginia effort confirms an internship program is an effective model of engaging and retaining IT talent.

These programs are examples of similar models being utilized in other communities in the United States, validating the attractiveness of the model and the urgency of the issue. While these other programs lack robust statistics to quantify their success, this thesis evaluates INTERalliance’s past program participants for the first time.

Next Steps

Many of these metrics are expected to change over time as more past participants attend college and enter the workforce. The organization has gradually impacted more students each year of its existence and refined its curriculum. The full-time statistics in particular are expected to evolve. The impact of TechOlympics, the largest INTERalliance program by far, is yet to be quantified. The first TechOlympics was in 2010 and the latest graduates in the full-time data set finished high school in 2012. As the next two years of data emerge, INTERalliance can learn more about ultimate conversion of students into IT careers.

This study establishes an annual data gathering cycle for INTERalliance. The results of this study will serve as benchmark data. Each year, the new high school graduating class and individuals entering the full-time workforce can be added and compared to previous results. Additionally, even though information was found for 61% of past participants, INTERalliance is seeking data for 100%. Tracking updated information ensures accurate measures and helps the organization stay in touch with alumni as they enter college and the workforce. This contributes
to other efforts to start INTERalliance programming for college students, as the current program portfolio is completely targeted at high school students. The organization plans to work with student interns to use other methods like calling and emailing to reach additional alumni.

While a significant amount of data is reviewed in this thesis, much more analysis can be done. The internship experiences students have in college can be compared to their high school program participation. A qualitative analysis should be conducted to evaluate the aspects of each program and INTERalliance in general students found impactful. For instance, determining which components of each program students identified as most impactful can help to optimize the programs for future students. This research effort will determine the role INTERalliance played in influencing student decisions.

A survey will be developed to assess student intent to pursue IT career pathways and student perceptions of the field. This survey will be administered to students before and after participating in each program. These results will be stored and associated with the student Salesforce profile. Intent can be compared before and after programs to assess the impact, as well as over time. Ultimately, student intent can be added to the regression models to strengthen their predictive accuracy. Other variables like GPA, socioeconomic status, participation in other IT extracurriculars, and number of IT courses taken could be predictive as well. Another effort could be undertaken to seek a control group of students similar to those who participate in INTERalliance programs (but did not actually participate). The results in this thesis yield rich insights, but they could be strengthened with additional study. These results convey associations between INTERalliance participation, demographic factors, and decisions to pursue IT career pathways. A study with a control group and more variables in the regression models would much more completely assess the actual impact and influence INTERalliance had on student decisions.
Finally, the INTERalliance Board of Directors is holding a strategy session to establish a new strategic path for the organization. The data from this thesis is being used to reflect on the organization’s impact so far and implement changes to the programs to have an even greater impact in the future.

**Conclusion**

As the IT talent deficit is a national problem, a proven model for growing the IT talent pipeline is a significant contribution. This paper builds a compelling case that regions nationwide could benefit from the INTERalliance model, as they could implement similar initiatives in their communities to improve their IT labor deficits. Comparing the results of this study to national averages demonstrates INTERalliance’s success, with students twelve times more likely than average to study IT in college and thirteen times more likely to work full-time in IT after college. Additional research will be performed to further quantify and qualify INTERalliance’s impact and improve the programs for future students.
References


