5-2017

Investigation of influential factors on selecting an engineering major.

Paige A. Miller
University of Louisville

INVESTIGATION OF INFLUENTIAL FACTORS ON SELECTING AN ENGINEERING MAJOR

By

Paige A. Miller
Bachelor of Science in Industrial Engineering, University of Louisville, May 2016

A Thesis
Submitted to the Faculty of the
University of Louisville
J.B Speed School of Engineering
as Partial Fulfillment of the Requirements
for the Professional Degree

MASTER OF ENGINEERING

Department of Industrial Engineering

April 2017

INVESTIGATION OF INFLUENTIAL FACTORS ON SELECTING AN ENGINEERING MAJOR

Submitted by: _____
Paige Miller

A Thesis Approved on

_____
(Date)

By the Following Reading and Examination Committee:

_____
Dr. Jason Saleem, Thesis Co-Director

_____
Dr. Jacqueline McNeil, Thesis Co-Director

_____
Dr. Erin Gerber

ACKNOWLEDGEMENTS

I would like to thank Dr. Jason Saleem of the Industrial Engineering Department at the University of Louisville who served as my thesis advisor. Dr. Saleem was always willing to help whenever I had a question or an idea to run past him. Dr. Saleem always made time to work with me whether that be through email or in-person meetings. I am grateful for the time and effort that Dr. Saleem put forth to be my thesis advisor.

Also, I would like to thank Dr. Jacqueline McNeil of the Engineering Fundamentals Department and Dr. Erin Gerber of the Industrial Engineering Department. Both Dr. McNeil and Dr. Gerber served on my thesis committee and provided me very helpful feedback for the completion of my thesis.

Thank you to the freshman engineering students who participated in the study. Without their willingness to respond, my research would not have been possible. I especially thank the thirteen students who took the time to participate in the interviews I conducted on campus.

Lastly, I am grateful for the support and encouragement provided to me by both my family and friends. They have been there for me throughout my college career, and without their support, this accomplishment would not have been possible.

ABSTRACT

This thesis evaluates the factors that freshman engineering students at the University of Louisville are taking into consideration when deciding on their major within engineering. The outcome of the research is expected to help to shape the syllabus of the ENGR 110 course, which is a mandatory class for all freshman engineering students. ENGR 110 is comprised of course lectures, department presentations, and company presentations. Currently, both the department and company presentations are held outside of course times. The influential factors identified by this research may help shape the course so that these factors are discussed thoroughly about each major as an aid to the decision-making process.

The researcher distributed a survey and conducted interviews to collect both quantitative and qualitative data. The researcher then analyzed the quantitative data using non-parametric tests and the qualitative data using a constant comparative method. Based on this analysis, the researcher concluded that there was a low level of confidence in major selection exemplifying the need for ENGR 110 to discuss the different majors within engineering and spend time discussing the differences between them. The researcher also concluded that the most influential factors in deciding upon a major are job opportunities, potential for societal contributions, and personal interests. From these conclusions, the researcher recommends that the presentations be held during class time, that the presentations continue to be posted on Blackboard to refer back to, and that the course place emphasis on the job opportunities and potential for societal contributions in each major.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

I. INTRODUCTION

Every year, there are many students who are entering their freshman year of college. Some know exactly what path they want to take during their life while others are still trying to make the decision of which major to pursue, or if they want to continue with college. This is a very big life decision that can be influenced by a variety of factors. Decision making is a relevant topic for industrial engineers to study, some professionals look at this in higher education. Everyone has a unique approach to making a decision, but many times the influential factors behind each decision are similar. When choosing a major within engineering, an introductory course is critical so that engineering students can be exposed to all the majors and make an informed decision. This also increases their confidence in their decision (McNeil and Thompson, 2016). This decision will impact their future greatly, and therefore it should not be taken lightly.

Previous research has been performed on this topic; some other universities investigated which factors students find to be influential when deciding upon a major. These studies are described in detail in the literature review. Each university came up with their own conclusions based on the unique contextual factors present at each university, and it is of upmost importance for the University of Louisville to do so as well. By performing this research, students may be provided with an introductory course that contains more information or has different activities in order to prepare them for their futures.

At the University of Louisville, engineering students are required to take Engineering Methods, Tools, and Practice I. This course provides an introduction into essential methods, tools, and skills for success in engineering. Some of the topics discussed in this course are critical thinking, problem solving, design analysis, Excel, graphics, graphical communication, programming, professionalism, and teamwork. The course is also comprised of seminars that

present the different majors within engineering. The seminars consist of presentations by each department at the University of Louisville's J.B. Speed School of Engineering and by employers in the local area that hire future graduates of these programs. The purpose of the seminars is so that the students have an opportunity to learn more about each major and ask questions.

The students at the University of Louisville can enroll in the J.B. Speed School of Engineering as an undecided engineering student or as a Bioengineering, Computer Engineering and Computer Science, Chemical Engineering, Civil and Environmental Engineering, Electrical and Computer Engineering, Industrial Engineering, or Mechanical Engineering major. Regardless of the students' enrollment status, they are required to take the Engineering Methods, Tools, and Practice I (ENGR 110) course. As part of this course, they are required to attend four seminars, which are held outside of the regular course times.

By performing this study, the factors that the students at University of Louisville consider to be important can be identified and they can be used to shape the ENGR 110 course outline. The study is comprised of a survey and interviews. The survey was distributed to all the freshman students in their first semester. Recommendations were derived to provide more understanding so students can make this critical life decision.

The ENGR 110 course is designed at University of Louisville such that the seminars are held outside of regular class time, but there is a minimum requirement for attendance. In total, there are seven department presentations, four employer presentations, and three presentations on student success that presents information about financial management, study skills, and diversity. The students must attend four of the seminars, two of which must be the department presentations. When other Universities have conducted similar research, most of the seminars were in class presentations, which makes this study unique.

Also, some of the other Universities require all freshman to enter their undergraduate career as an undecided major within engineering, but that is not a requirement here at the University of Louisville. By utilizing a qualitative and quantitative approach, a substantial amount of data was collected to make accurate conclusions. Once a thorough analysis of the data had been performed, the researcher believed the main factors that influence the freshman students at University of Louisville will include family influences, job opportunities, and the department presentations.

II. LITERATURE REVIEW

Several other universities offer a version of the ENGR 110 course to prepare freshman engineering students for their coursework, careers, and as a guided course to help them decide on their major within engineering. This course also gives them experience with engineering to see if they really like it. The introductory courses have not always existed, but they have become increasingly popular in the past few years. By having an introductory course, it sets the expectations for the next four years of college for the students and offers insight as to what they could be doing in the future.

Purdue University has a First-Year Engineering (FYE) course which is comparable to ENGR 110. All freshman students begin in the general College of Engineering and do not declare a major until their sophomore year. There was research performed at Purdue University to identify how students make their decision and then how to shape the FYE course around findings from the research. According to Rodriguez-Simmonds et al. (2015) the research conducted at Purdue University identified Self-Led Exploration (SLE) to be the category that was most influential in choosing a major. The research was based upon two surveys and one activity, one survey at the end of the semester, one survey when the student transitioned into their major, and a classroom activity. Some of the other top categories identified included advice from family and friends not at Purdue, advice from other Purdue students, and an "Engineering your Major" session.

Self-Led Exploration (SLE) was not necessarily defined in the beginning of the research and therefore the researchers at Purdue did a qualitative data analysis to gain better insight into what the students were defining as SLE. Some of the responses included online research, discussions with professors, and synthesis of information. Based on this study, the students seek

out most information on their own. This is great information to have because it can help to shape both the introductory engineering courses as well as the University of Louisville website. These facts can be added to the course curriculum and then it is ensured that the students receive the most accurate information.

The survey offered at the end of the semester at Purdue showed that the activity most useful to students was the presentations. Although the article did not mention what the presentation requirements were, it is still useful to know that the students listen to these presentations and genuinely take them into consideration. This helps to justify that the presentations are a worthwhile portion of the course syllabus.

Another study at Purdue was performed by Noonan et al. (2002) with a total of 1256 students completing a survey on their top 3 major preferences. The survey also included their top two influences on their top major choice and it was completed four times throughout their freshman year. The data analysis broke students into four groups: students whose major was the same as their top choice, students in a different engineering major, students in a different STEM major, and students who switched from STEM altogether. Their influences could be 18 different options which included options provided during the introductory course, personal options, and others.

The results show that 1/3 of students were in the same major declared prior to freshman year and ½ by the end of their first semester. When looking solely at the students who stay within engineering, 52% of them decide on their major before the first semester and 26% decide right after their first semester (Noonan et al. 2002). This shows that the students take the first year course seriously and it is helping a quarter of them decide their majors. The students ranked self-exploration and family members as the most influential decision-making factor going into

college and then after the first semester; self-exploration was still the most significant factor but the introductory course was ranked significantly higher.

Binghamton University has a similar setup to Purdue because it also requires students to enroll in a common course load for freshman year. Binghamton also has researched the different factors that students take into consideration when deciding on a major and the top three were personal academic interests, potential for societal contributions, and job prospects (Zahorian et al. 2013). These results come from a survey that was conducted over a time period of four years that was comprised of eleven questions on a Likert scale (Likert, 1932). Some of the factors that contribute the least are the perceived difficulty of the major as well as class lectures.

Binghamton offers departmental presentations as a part of their introductory course in which a general overview of the major is given, the required classes are discussed, and different jobs that you can have within the major are discussed. Out of options, the students ranked these departmental presentations in the middle, meaning they were indifferent. This is very different from Purdue. Students at Purdue valued departmental presentations but this was not the case at Binghamton. The difference in student's response could be due to the material discussed in each presentation since the requirement of the presentations is unknown. Even though the results of these two studies were different, each University was able to conclude which factors students categorized as being important and what they believe is not as helpful in choosing a major.

Another University to perform research on this topic is the University of Colorado Boulder. No introductory course was required at the University prior to the research which is different than the prior two studies mentions. When implementing a new course, it was mostly designed with the undecided students within engineering in mind even though all freshman students were required to partake in the course. The study results show that students have a

higher probability of staying within their first major choice after taking the introductory to engineering course (Argrow et al. 2012). The course requires students to thoroughly examine the majors and take factors into consideration that they probably would not have thought of without the course. One way to interpret this result is to bring into consideration whether or not all students should enter their freshman year as undecided within engineering. This could reduce the amount of major switches and therefore reduce the chance that a student will take longer to graduate than necessary.

The course at University of Colorado Boulder is set up so that each student takes two sections a week. One section covers topics that apply to all engineering majors as well as discussion about each major. After these presentations, the students are assigned to write essays discussing what they like and dislike about the major and comparing them to one another. In the other section the students attend each week, is a module where they choose a combination of three of the majors to explore more closely, including hands-on activities for each.

The introductory course covered a lot about what to expect as a professional in the engineering field so the students could better understand what being an engineer truly means. A downside to the course, was that a lot of the students became more uncertain about engineering as a major and questioned whether to switch out of the major. This could be because students started out uncertain, or because they become more aware about exactly what the major entailed and decided that they would rather opt for another major. Although the introductory course's goal is not to make students switch out of engineering, that can be seen as a benefit to the student because it could help them to realize whether they have made the right choice for their future.

University of New Haven is another college that has performed relevant research. Carnasciali et al. (2013) performed an analysis evaluating 97 students and factors that influenced

their major decision. This study revealed that 56% of students considered other majors besides the one they selected. This is an indicator showing that there is a lot of uncertainty in the students' minds. Also, the survey showed that most students ranked personal interest in subject matter, probability of working in the field after graduation, long term salary prospects, job security, and occupational growth forecasts as very important factors. These results are very similar to Binghamton University.

Ohland and Sill (2002) collected data on students at Clemson University in regards to their major selection prior to the introductory course and after the course. Some of the interesting findings from this research was that of the students that switched out of engineering, about two-thirds of them switched due to failing courses. This shows the importance that students put on their course grades.

Also, the data analysis at Clemson shows that if the course were removed, Industrial Engineering and Ceramic and Materials Engineering would lose a lot of their students. This demonstrated that the course is important to let students learn about the majors that are less commonly heard of. Without any prior knowledge of a major, a student is less likely to pick a less common degree program as their major, which is completely understandable. The course allows students to gain an understanding of all the options and then decide what they want to major in based off of this information.

One study was performed to look at the difference between schools that require an introductory course and those that do not require it (Orr et al. 2013). According to Orr et al. (2013), 60% of Universities require the course. When it was a requirement, many more students are likely to stay in engineering as a major. This is beneficial to the school and therefore it could be one of the reasons the courses are becoming more popular.

Another result of the Orr et al. (2013) study is that if an undecided student is offered an introductory course they will likely choose electrical, civil, chemical, computer, aerospace, and agricultural but if they are not in the introductory course, they are more likely to choose mechanical or industrial and systems. This study demonstrates that the introductory course does play a factor into how the students are deciding upon their majors. By having the course, the students are being exposed to every major offered and not just the ones that they have heard about before coming to the university.

Theiss et al. (2016) performed at study at The Ohio State University on initial choice of major and students that switch throughout their first year of engineering. Their reasoning to perform the study to increase the retention rates in engineering since some students will switch out of engineering altogether if they can't find the right major within engineering. The study included a survey that was performed three times throughout the year that asked questions about their fit in engineering and their specific major. The survey was distributed to all engineering students in the first-year program. The results show that 28% of students change their major within their first year. The majors that the students switched into would be computer science and engineering, and electrical and computer engineering. The researchers believe this was due to the fact that the first-year program was set up so that the students were exposed more to these two majors than what they had previously known.

Course grades are another component to major choice that have been evaluated by Main et al (2015). There were two main research questions in this study. The first was, what are indicators for switching behavior among students who complete an engineering degree? The second was, are students more likely to select a major if they expect to receive higher grades in that major's upper division courses relative to other engineering majors? The study included data

on race, age, gender, citizenship, year of entry, SAT scores, and initial major. Grades were evaluated for introductory and upper division courses and categorized into the proportion of A's and C- 's and below for each major. Nine large public universities participated in the research and the majors included where chemical, civil, industrial, mechanical, and electrical.

Industrial Engineering had the highest percentage of A's awarded and Mechanical Engineering had the lowest. The study found that some of the indicators for switching majors were that if a student had higher SAT math scores, they would be more likely to switch, but if they had higher SAT verbal scores, they would be less likely to switch. If a student had a higher GPA in introductory courses like calculus and physics, they would be less likely to switch. Another finding with the GPA was that if a student had a 3.6 or higher on a 4.0 scale, they would be 19% more likely to stay in their original major (Main et al 2015).

Although this study doesn't pertain to the original decision on major choice, it gives insight into the role that grades play in an engineering student's mind. Engineering students are normally very motivated individuals who strive for success. Something to consider in the study, is the impact that the perceived grades have on the student's decision. If the student has been researching the majors and talking with upper classmen about the difficulty of coursework, that could have a great influence in their minds.

TABLE I

FACTORS RELATED TO ENGINEERING MAJOR SELECTION

Table 1: Factors Related to Engineering Major Selection									
Studies	Purdue (Rodriguez-Simmonds, Ortega-Alvarez, Atiq, Hoffmann, 2015)	Purdue (Noonan, Oakes, Imbrie, 2006)	Binghamton (Zahorian, Elmore, Temkin, 2013)	University of Colorado Boulder (Argrow, Louie, Knight, Canney, Brown, Blanford, Gibson, Kenney, 2012)	University of New Haven (Carnasciali, Thompson, Thomas, 2013)	Clemson (Ohland and Sill, 2002)	Multiple Universities (Orr, Brawner, Ohland, Layton, 2013)	The Ohio State University (Theiss, Robertson, Kajfez, Kecskemetry, Meyers, 2016)	Multiple Universities (Main, Mumford, Ohland, 2015)
Course Where Study was Perfomed	Established First Year Engineering Program	Established First Year Engineering Program	Common Course for Freshman Engineers	Implementing New Introductory Course	No Course: All Undergraduate Students who Were Not Freshman and Had a Major Declared	Common Course for Freshman Engineers	Difference between Schools with Introductory Course and Without	Common Course for Freshman Engineers	Study on Course Grades
Student Entry Type	All Students Enter Undecided	All Students Enter Undecided	All Students Enter Undecided	Students Can Enter with a Declared Major	N/A	Students Can Enter with a Declared Major	N/A	All Students Enter Undecided	N/A
Study Set Up	2 Surveys: End of First Semester and Beginning of Sophomore Year	Survey for Top 3 Major Preferences and Top 2 Influences; Completed 4 Times Throughout Freshman Year	Survey Over 4 years Based on Likert Scale	2 Surveys Distributed at the Beginning of the Semester and at the End of the Semester	Survey Distributed to Students in all Engineering Disciplines	2 Surveys Distributed at the Beginning of the Semester and at the End of the Semester	MIDFIELD Data on Graduation Rates Analyzed for 11 Public Institutions	Survey Distributed 3 Times about Fit in Major and Engineering as a Whole	MIDFIELD Data on Transcript Records Analyzed for 9 Public Institutions
Results	The Top 3 Influences: Self-Led Exploration, Family and Friends, and Deparment Presentations	26% of Students Choose Major after First Semester; Top 2 Influences: Self-Led Exploration and Family Members	The Top 3 Influences: Personal Academic Interests, Potential for Societal Contributions, Job Prospects	More Likely to Stay in Major with Course; Gain Understanding of the Engineering Profession	TheTop 3 Influences: Personal Academic Interests, Job Security, Occupational Growth	More Likely to Choose Less Common Majors; Student Switch Mostly Due to Failing	More Likely to Stay in Major with Course; More Likely to Choose Electrical, Civil, Chemical, Computer, Aerospace or Agricultural Engineering with an Introductory Course Instead of Mechanical or Industrial	Over a Fourth of Students Swith their Majors; Computer and Electrical Receive Most Students Due to Most Exposure	Higher GPA in Calculus and Physics Decreases Switching Majors; Higher Verbal SAT Scores Indicates Lower Chance of Switching Majors

Of all the Universities mentioned, there was a great deal of variability in what each study concluded as factors that were influential for students in selecting a major. There was also a great deal of variability in the benefits found for the introductory course. Table I above shows a summary of each study reviewed in the literature search. Each University sets up their courses differently and therefore different conclusion are to be expected. Due to this fact, it is very important to perform research here at the University of Louisville and reach conclusions based on the ENGR 110 course outline. The benefits of this study are numerous in that it can potentially help a student feel more confident in their choice, help the University to best set up the course, and prepare the students for their future.

III. INSTRUMENTATION AND EQUIPMENT

The study was based on freshman engineering students at the University of Louisville enrolled in Engineering 110. The students were informed that the study was voluntary and they could stop participating at any time. Any student under the age of 18 was excluded from the study. All transfer students and non-traditional students were included. Both a survey and an interview were developed to gain better insight into the factor's influencing the student's decision making. The equipment required for the interviews was an iPad with an audio recorder application. Qualtrics was used to distribute the survey and Minitab was used to analyze the data. The iPad was kept in a locked office and the Qualtrics data was password protected.

IV. PROCEDURE

The main research question being evaluated through this study was to determine which factors students are taking into consideration when deciding their major within engineering. To determine these factors, both a qualitative and quantitative approach was used. The timeline of the study was one academic year which is two semesters starting in the fall of 2016 and going through the spring of 2017. All data was collected during the fall of 2016.

Survey: The survey provides the quantitative data for the study. It was comprised of fifteen questions in which the students responded on a Likert scale and an additional three questions for demographic information. The survey was distributed by two of the ENGR professors and four of the teaching assistants through a link to Qualtrics. All students enrolled in the ENGR 110 course received access to the survey, participation in the survey was voluntary. 407 of the 641 students enrolled in the course responded, resulting in a response rate of about 64%. The survey remained open for a period of three weeks and this included an in-class period in which the students were provided class time to complete course evaluations along with this survey.

The researcher used several nonparametric tests to analyze the survey data. This was performed in Minitab and most of the charts and tables were created in Excel. The researcher analyzed the entirety of the data and compared different groups based on the demographic responses. Responses from the Likert scale questions were treated as rank order data and therefore non-parametric tests were performed.

The first analysis performed used the eight engineering departments as the factor to test for statistical significance of each of the fifteen Likert Scale questions. The analysis method

utilized was a Kruskal-Wallis test, which is a one-way ANOVA test. To be deemed statistically significant, the *p*-value returned in Minitab needed to be less than alpha which was set to 0.05.

Once statistical significance was determined for each question, the research used a post-hoc comparison on factors that showed up as significant to determine between which departments the question was significant. The post-hoc comparison used was a Mann-Whitney test where each of the eight departments were compared against each other for a total of 28 tests. When evaluating statistical significance, the researcher utilized two methods for the post-hoc comparison. The first method is that listed above (Mann-Whitney), where to be deemed statistically significant, the *p*-value needed to be less than alpha of 0.05. The second method takes into consideration an adjustment. An adjustment is considered due to performing a large number of tests which increases the likelihood of significance by change alone. The Bonferroni adjustment takes the alpha value of 0.05 and divides it by 28 so that the new value is set to 0.00179. Interpretations of both are included in the results.

The next analysis performed used a Mann-Whitney test setting gender as the factor. It was performed on each of the fifteen Likert scale questions. This process was repeated once again, but instead setting credit hours as the factor. The Mann-Whitney test was used because both gender and credit hours only had two possible responses unlike the departments which had eight responses, and therefore needed a Kruskal-Wallis test. The test was declared statistically significant if the *p*-value was less than alpha of 0.05.

Finally, in the survey, there are seven potential influential factors including ENGR 110 course lectures, department presentations, company presentations, family, upperclassmen, job opportunities, and potential for societal contributions. The researcher totaled the number of students who ranked each factor as strongly agree or somewhat agree and then performed a

categorical data analysis on the seven factors with their frequencies. The analysis used was a chi-squared test. Statistical significance was determined if the *p*-value was less than alpha of 0.05.

Interviews: The interviews performed provide qualitative data for the case study. The interview was made up of six main questions with sub-questions based on each subject's response. The researcher made an announcement at two of the ENGR 110 seminars to ask for volunteers to be interviewed and then performed thirteen interviews. These interviews were conducted in a private room in Lutz 303 to ensure privacy and confidentiality. To begin, the researcher gave each participant an informed consent form and explained the nature of the interview. Prior to beginning each interview, the participant was asked if they had any questions and they were informed that if they wanted to stop at any time, they could. Once the participant was ready to begin, the researcher began the recording on the iPad and asked each of the six questions with follow-up questions where necessary. The minimum length of an interview was about 7 minutes and the maximum length of an interview was about 26 minutes. On average, the interviews took 20 minutes including the initial discussion and the interview itself.

A constant comparative method was utilized when analyzing the interview responses (Walther et al., 2013). The researcher read over and evaluated the responses identifying any major themes in the responses. Once themes were identified the researcher then listened to the responses again identifying any quotes demonstrating each theme. The researcher went through this process several times.

V. RESULTS AND DISCUSSION

1. Survey Results

Department Analysis of Variance*:* The first analysis completed was the Kruskal-Wallis One-Way ANOVA of each question with the department set as the factor. The possible department options were Bioengineering, Chemical, Civil, Computer Engineering and Computer Science (CECS), Electrical, Industrial, Mechanical, and Undecided. Of the fifteen questions, eight of them were classified as statistically significant as seen in Table II.

The questions that had a *p*-value less than alpha, and therefore classified as significant were, "Prior to ENGR 110, I declared a major within engineering", "ENGR 110 course lectures influenced my decision on my major", "The department presentations influenced my decision on my major", "Potential for contributions to society influenced my decision on my major", "I attended more than the minimum requirement of the department seminars (2) in order to gain more knowledge about each major", "I attended more than the minimum requirement of all the seminars (4) in order to get extra credit", "From all of the resources offered, I feel confident in my major choice within engineering", and "I identify as being talented in math more than physics."

TABLE II

KRUSKAL-WALLIS TEST BY DEPARTMENT FOR SURVEY QUESTIONS

Question	***p*-value**
1. Prior to ENGR 110, I declared a major within engineering.	0.039*
2. Prior to ENGR 110, I felt confident in my choice of major within engineering.	0.091
3. Prior to ENGR 110, I was exposed to most of the different majors within	0.987
4. ENGR 110 course lectures influenced my decision on my major.	0.005*
5. The department presentations influenced my decision on my major.	0.004*
6. The company presentations influenced my decision on my major.	0.491
7. My family, immediate or extended, influenced my decision on my major.	0.352
8. Upperclassmen influenced my decision on my major.	0.373
9. Job opportunities influenced my decision on my major.	0.462
10. Potential for contributions to society influenced my decision on my major.	0.000*
11. I attended more than the minimum requirement of the department seminars (2) in order to gain more knowledge about each major.	0.020*
12. I attended more than the minimum requirement of all the seminars (4) in order to get extra credit.	0.019*
13. From all of the resources offered, I feel confident in my major choice within engineering.	0.004*
14. From all of the resources offered, I feel confident in my choice of engineering as a whole.	0.091
15. I identify as being talented in math more than physics.	0.040*

Note: * indicates statistical significance

Department Question 1: "Prior to ENGR 110, I declared a major within engineering" was determined to be significant from the Kruskal-Wallis test. The researcher then created Table III to perform twenty-eight Mann-Whitney tests as a post-hoc comparison of the departments. Of these twenty-eight tests, eight of them show significance without the adjustment and none of them were significant with it. Industrial and Undecided students both agreed less frequently than the other six departments.

Table III
MANN-WHITNEY TEST FOR QUESTION 1

Departments	***p*-value**
Bioengineering-Chemical	0.778
Bioengineering-Civil	0.2574
Bioengineering-CECS	0.4902
Bioengineering-Electrical	0.4006
Bioengineering-Industrial	0.0254*
Bioengineering-Mechanical	0.447
Bioengineering-Undecided	0.0063*
Chemical-Civil	0.1863
Chemical-CECS	0.3632
Chemical-Electrical	0.2839
Chemical-Industrial	0.0223*
Chemical-Mechanical	0.3149
Chemical-Undecided	0.0046*
Civil-CECS	0.5551
Civil-Electrical	0.7241
Civil-Industrial	0.2731
Civil-Mechanical	0.5123
Civil-Undecided	0.0627
CECS-Electrical	0.8442
CECS-Industrial	0.0671
CECS-Mechanical	1.000
CECS-Undecided	0.0138*
Electrical-Industrial	0.1209
Electrical-Mechanical	0.8148
Electrical-Undecided	0.0289*
Industrial-Mechanical	0.0485*
Industrial-Undecided	0.3042
Mechanical-Undecided	0.0085*

Note: * indicates statistical significance before Bonferroni adjustment (alpha = 0.05). No comparisons were statistically significant after the Bonferroni adjustment (alpha = 0.001786).

Department Question 4: "ENGR 110 course lectures influenced my decision on my major" was evaluated further by performing twenty-eight Mann-Whitney tests as a post-hoc comparison test. Of these twenty-eight tests, nine of them show significance without the adjustment and one remained significant with the Bonferroni adjustment. The Chemical versus Undecided remained significant with the adjustment factor where the Chemical Students agreed at a much lower frequency than the Undecided students.

TABLE IV
MANN-WHITNEY TEST FOR QUESTION 4

Departments	***p*-value**
Bioengineering-Chemical	0.0913
Bioengineering-Civil	0.2008
Bioengineering-CECS	0.685
Bioengineering-Electrical	0.9059
Bioengineering-Industrial	0.7718
Bioengineering-Mechanical	0.6008
Bioengineering-Undecided	0.0058*
Chemical-Civil	0.0028*
Chemical-CECS	0.1605
Chemical-Electrical	0.1314
Chemical-Industrial	0.0855
Chemical-Mechanical	0.0103*
Chemical-Undecided	0.0001**
Civil-CECS	0.0774
Civil-Electrical	0.1697
Civil-Industrial	0.4355
Civil-Mechanical	0.3075
Civil-Undecided	0.0386*
CECS-Electrical	0.774
CECS-Industrial	0.5545
CECS-Mechanical	0.2708
CECS-Undecided	0.002*
Electrical-Industrial	0.6576
Electrical-Mechanical	0.5238
Electrical-Undecided	0.0051*
Industrial-Mechanical	0.9508
Industrial-Undecided	0.0195*
Mechanical-Undecided	0.0055*

Note: * indicates statistical significance before Bonferroni adjustment (alpha = 0.05).
** indicates statistical difference after the Bonferroni adjustment (alpha = 0.001786).

Department Question 5: "The department presentations influenced my decision on my major" was evaluated further by performing twenty-eight Mann-Whitney tests as a post-hoc comparison of the departments. Of these twenty-eight tests, eleven of them show significance without the adjustment and none came up as significant with the Bonferroni adjustment. Many significant results were between Chemical students who agreed less frequently than the remaining seven departments.

TABLE V
MANN-WHITNEY TEST FOR QUESTION 5

Departments	***p*-value**
Bioengineering-Chemical	0.3916
Bioengineering-Civil	0.1062
Bioengineering-CECS	0.6379
Bioengineering-Electrical	0.3356
Bioengineering-Industrial	0.0334*
Bioengineering-Mechanical	0.1196
Bioengineering-Undecided	0.0085*
Chemical-Civil	0.0211*
Chemical-CECS	0.6632
Chemical-Electrical	0.098
Chemical-Industrial	0.0097*
Chemical-Mechanical	0.0144*
Chemical-Undecided	0.0032*
Civil-CECS	0.0327*
Civil-Electrical	0.6472
Civil-Industrial	0.3238
Civil-Mechanical	0.6856
Civil-Undecided	0.0903
CECS-Electrical	0.1841
CECS-Industrial	0.0121*
CECS-Mechanical	0.0228*
CECS-Undecided	0.0037*
Electrical-Industrial	0.3018
Electrical-Mechanical	0.9747
Electrical-Undecided	0.0899
Industrial-Mechanical	0.1558
Industrial-Undecided	0.4523
Mechanical-Undecided	0.0343*

Note: * indicates statistical significance before Bonferroni adjustment (alpha = 0.05). No comparisons were statistically significant after the Bonferroni adjustment (alpha = 0.001786).

Department Question 10: "Potential for contributions to society influenced my decision on my major" was evaluated further by performing twenty-eight Mann-Whitney tests as a post-hoc comparison of the departments. Of these twenty-eight tests, twelve of them show significance without the adjustment and four were significant with the Bonferroni adjustment. The focus here are the four results that stay significant even with the adjustment which are for Bioengineering, Chemical, Civil, and CECS students who agreed at a high percentage.

TABLE VI
MANN-WHITNEY TEST FOR QUESTION 10

Departments	***p*-value**
Bioengineering-Chemical	0.8895
Bioengineering-Civil	0.9962
Bioengineering-CECS	0.0003**
Bioengineering-Electrical	0.0016**
Bioengineering-Industrial	0.0074*
Bioengineering-Mechanical	0.0082*
Bioengineering-Undecided	0.2645
Chemical-Civil	0.8917
Chemical-CECS	0.0011**
Chemical-Electrical	0.0048*
Chemical-Industrial	0.0145*
Chemical-Mechanical	0.0217*
Chemical-Undecided	0.3181
Civil-CECS	0.0017**
Civil-Electrical	0.0065*
Civil-Industrial	0.0168*
Civil-Mechanical	0.0245*
Civil-Undecided	0.3046
CECS-Electrical	0.5133
CECS-Industrial	0.8452
CECS-Mechanical	0.0791
CECS-Undecided	0.3385
Electrical-Industrial	0.5001
Electrical-Mechanical	0.3353
Electrical-Undecided	0.479
Industrial-Mechanical	0.1831
Industrial-Undecided	0.4089
Mechanical-Undecided	0.8462

Note: * indicates statistical significance before Bonferroni adjustment (alpha = 0.05).
** indicates statistical difference after the Bonferroni adjustment (alpha = 0.001786).

Department Question 11: "I attended more than the minimum requirement of the department seminars (2) in order to gain more knowledge about each major" was evaluated further by performing twenty-eight Mann-Whitney tests as a post-hoc comparison of the departments. Of these twenty-eight tests, six of them show significance without the adjustment and one came up as significant with the Bonferroni adjustment. The result that stays significant is between Electrical students who agreed with a high rate and the remaining seven departments.

TABLE VII
MANN-WHITNEY TEST FOR QUESTION 11

Departments	***p*-value**
Bioengineering-Chemical	0.4932
Bioengineering-Civil	0.5188
Bioengineering-CECS	0.3472
Bioengineering-Electrical	0.008*
Bioengineering-Industrial	0.5294
Bioengineering-Mechanical	0.2283
Bioengineering-Undecided	0.2621
Chemical-Civil	0.1819
Chemical-CECS	0.0939
Chemical-Electrical	0.0014**
Chemical-Industrial	0.2333
Chemical-Mechanical	0.0424*
Chemical-Undecided	0.502
Civil-CECS	0.7963
Civil-Electrical	0.0393*
Civil-Industrial	0.9202
Civil-Mechanical	0.6787
Civil-Undecided	0.1116
CECS-Electrical	0.056
CECS-Industrial	0.9425
CECS-Mechanical	0.8966
CECS-Undecided	0.0772
Electrical-Industrial	0.0863
Electrical-Mechanical	0.0363*
Electrical-Undecided	0.0044*
Industrial-Mechanical	0.8509
Industrial-Undecided	0.1343
Mechanical-Undecided	0.0511

Note: * indicates statistical significance before Bonferroni adjustment (alpha = 0.05).
** indicates statistical difference after the Bonferroni adjustment (alpha = 0.001786).

Department Question 12: "I attended more than the minimum requirement of all the seminars (4) in order to get extra credit" was evaluated further by performing Mann-Whitney tests as a post-hoc comparison of the departments. Of these twenty-eight tests, five of them show significance without the adjustment and one was significant with the Bonferroni adjustment. The result that is the main focus is between Chemical and Electrical students, as it remains significant with the adjustment. Chemical students agree less frequently than the Electrical students.

TABLE VIII
MANN-WHITNEY TEST FOR QUESTION 12

Departments	***p*-value**
Bioengineering-Chemical	0.3065
Bioengineering-Civil	0.5848
Bioengineering-CECS	0.1694
Bioengineering-Electrical	0.0125*
Bioengineering-Industrial	0.3125
Bioengineering-Mechanical	0.1053
Bioengineering-Undecided	0.6888
Chemical-Civil	0.1493
Chemical-CECS	0.0185*
Chemical-Electrical	0.0004**
Chemical-Industrial	0.0663
Chemical-Mechanical	0.0046*
Chemical-Undecided	0.8297
Civil-CECS	0.5293
Civil-Electrical	0.097
Civil-Industrial	0.6352
Civil-Mechanical	0.4485
Civil-Undecided	0.3642
CECS-Electrical	0.2826
CECS-Industrial	0.9329
CECS-Mechanical	0.9611
CECS-Undecided	0.1707
Electrical-Industrial	0.3316
Electrical-Mechanical	0.1664
Electrical-Undecided	0.0387*
Industrial-Mechanical	0.9642
Industrial-Undecided	0.2781
Mechanical-Undecided	0.1471

Note: * indicates statistical significance before Bonferroni adjustment (alpha = 0.05).
** indicates statistical difference after the Bonferroni adjustment (alpha = 0.001786).

Department Question 13: "From all of the resources offered, I feel confident in my major choice within engineering" was evaluated further by performing twenty-one Mann-Whitney tests as a post-hoc comparison of the departments. The reason for having twenty-one tests instead of twenty-eight, is that this question is not applicable to the undecided students. Of these twenty-one tests, none of them are significant. This means that the responses from all departments are very similar.

TABLE IX
MANN-WHITNEY TEST FOR QUESTION 13

Departments	***p*-value**
Bioengineering-Chemical	0.4143
Bioengineering-Civil	0.1952
Bioengineering-CECS	0.6487
Bioengineering-Electrical	0.7512
Bioengineering-Industrial	0.2293
Bioengineering-Mechanical	0.6953
Chemical-Civil	0.6157
Chemical-CECS	0.7279
Chemical-Electrical	0.5671
Chemical-Industrial	0.5531
Chemical-Mechanical	0.5308
Civil-CECS	0.3923
Civil-Electrical	0.2804
Civil-Industrial	0.8439
Civil-Mechanical	0.2267
CECS-Electrical	0.8503
CECS-Industrial	0.3904
CECS-Mechanical	0.8373
Electrical-Industrial	0.2985
Electrical-Mechanical	0.9683
Industrial-Mechanical	0.2704

Note: * indicates statistical significance before Bonferroni adjustment (alpha = 0.05).
** indicates statistical difference after the Bonferroni adjustment (alpha = 0.001786).

Department Question 15: "I identify as being talented in math more than physics" was evaluated further by performing twenty-eight Mann-Whitney tests as a post-hoc comparison of the departments. Of these twenty-eight tests, four of them show significance without the adjustment and none came up as significant with the Bonferroni adjustment. The main results to focus on are between Mechanical students who agreed with a lower percentage than the remaining seven departments.

TABLE X
MANN-WHITNEY TEST FOR QUESTION 15

Departments	***p*-value**
Bioengineering-Chemical	0.9121
Bioengineering-Civil	0.1794
Bioengineering-CECS	0.9232
Bioengineering-Electrical	0.1089
Bioengineering-Industrial	0.6214
Bioengineering-Mechanical	0.0389*
Bioengineering-Undecided	0.0563
Chemical-Civil	0.1761
Chemical-CECS	0.9803
Chemical-Electrical	0.1164
Chemical-Industrial	0.6761
Chemical-Mechanical	0.0406*
Chemical-Undecided	0.0699
Civil-CECS	0.1404
Civil-Electrical	0.9016
Civil-Industrial	0.1457
Civil-Mechanical	0.7714
Civil-Undecided	0.2687
CECS-Electrical	0.0802
CECS-Industrial	0.657
CECS-Mechanical	0.0211*
CECS-Undecided	0.0498*
Electrical-Industrial	0.108
Electrical-Mechanical	0.8857
Electrical-Undecided	0.2324
Industrial-Mechanical	0.0529
Industrial-Undecided	0.0586
Mechanical-Undecided	0.27

Note: * indicates statistical significance before Bonferroni adjustment (alpha = 0.05). No comparisons were statistically significant after the Bonferroni adjustment (alpha = 0.001786).

Gender : A Mann-Whitney analysis was completed to determine if there were any statistical differences between the way females and males answered the fifteen Likert Scale questions. The Minitab results can be seen in Table XI below. Two of the questions had a statistical difference and they were, "Prior to ENGR 110, I felt confident in my choice of major within engineering", and "I identify as being talented in math more than physics." For the first question regarding confidence, males agreed more often and for the second question, females responded more often agreeing that they identified with math more than physics.

TABLE XI

MANN-WHITNEY TEST FOR GENDER

Question	***p*-value**
1. Prior to ENGR 110, I declared a major within engineering.	0.2872
2. Prior to ENGR 110, I felt confident in my choice of major within engineering.	0.0369*
3. Prior to ENGR 110, I was exposed to most of the different majors within engineering.	0.07
4. ENGR 110 course lectures influenced my decision on my major.	0.9037
5. The department presentations influenced my decision on my major.	0.4484
6. The company presentations influenced my decision on my major.	0.9372
7. My family, immediate or extended, influenced my decision on my major.	0.4219
8. Upperclassmen influenced my decision on my major.	0.2305
9. Job opportunities influenced my decision on my major.	0.1691
10. Potential for contributions to society influenced my decision on my major.	0.5824
11. I attended more than the minimum requirement of the department seminars (2) in order to gain more knowledge about each major.	0.6144
12. I attended more than the minimum requirement of all the seminars (4) in order to get extra credit.	0.7382
13. From all of the resources offered, I feel confident in my major choice within engineering.	0.555
14. From all of the resources offered, I feel confident in my choice of engineering as a whole.	0.1629
15. I identify as being talented in math more than physics.	0.0141*

Note: * indicates statistical significance (alpha = 0.05)

Credit Hours: A Mann-Whitney analysis was completed to determine if there were any statistical differences between the way students who had over fifteen credit hours and students who had under 15 credit hours answered the fifteen Likert Scale questions. The Minitab results

are in Table XII. Two of the questions had a statistical difference; "I attended more than the minimum requirement of the department seminars (2) in order to gain more knowledge about each major" and "I attended more than the minimum requirement of all the seminars (4) in order to get extra credit." For both questions, the students with over 15 credit hours agreed more often than those with under 15 credit hours.

TABLE XII

MANN-WHITNEY TEST FOR CREDIT HOURS

Question	***p*-value**
1. Prior to ENGR 110, I declared a major within engineering.	0.3385
2. Prior to ENGR 110, I felt confident in my choice of major within engineering.	0.4723
3. Prior to ENGR 110, I was exposed to most of the different majors within engineering.	0.1192
4. ENGR 110 course lectures influenced my decision on my major.	0.093
5. The department presentations influenced my decision on my major.	0.3888
6. The company presentations influenced my decision on my major.	0.895
7. My family, immediate or extended, influenced my decision on my major.	0.8949
8. Upperclassmen influenced my decision on my major.	0.9477
9. Job opportunities influenced my decision on my major.	0.9437
10. Potential for contributions to society influenced my decision on my major.	0.6426
11. I attended more than the minimum requirement of the department seminars (2) in order to gain more knowledge about each major.	0.0043*
12. I attended more than the minimum requirement of all the seminars (4) in order to get extra credit.	0.003*
13. From all of the resources offered, I feel confident in my major choice within engineering.	0.0975
14. From all of the resources offered, I feel confident in my choice of engineering as a whole.	0.065
15. I identify as being talented in math more than physics.	0.8854

Note: * indicates statistical significance (alpha = 0.05)

Influential Factor: A Chi-Squared analysis was completed to determine if there was a statistical difference in responses to the seven influential factors that were in the survey. The first step was to create a frequency count table. Each of the seven factors correspond to questions four through ten on the survey. For each question a frequency count of strongly agree and somewhat

agree was recorded in Table XIII. The test was performed in Minitab and the resulting *p*-value is shown in the table as well.

TABLE XIII

CHI-SQUARED FOR INFLUENTIAL FACTORS

Question	**Factor**	**Frequency**
4	ENGR 110 Course Lectures	125
5	Department Presentations	183
6	Company Presentations	140
7	Family	201
8	Upperclassmen	121
9	Job Opportunities	313
10	Potential for Contributions to	307

The *p*-value is less than 0.001 and therefore the test shows that the frequency counts are not uniform (i.e., there is a statistical difference in the seven influential factors).

2. Survey Discussion

Department Analysis of Variance: The eight questions that were statistically significant need to be further evaluated. The interpretation of these results is not fully revealed until the post-hoc comparison is completed in the next analysis; however, the initial interpretation is that for each of these eight questions, the students answered differently depending upon their major.

Department Question 1: "Prior to ENGR 110 I declared a major within engineering." The eight department interactions that show significance are: Bioengineering-Industrial, Bioengineering-Undecided, Chemical-Industrial, Chemical-Undecided, CECS-Undecided, Electrical-Undecided, Industrial-Mechanical, and Mechanical-Undecided. Of these eight interactions, five of them are between Undecided and another major. This exemplifies that the Undecided students disagreed more than these other five majors. This makes sense due to the question relating to their choice of major, and does not need to be evaluated further. The other three interactions to investigate are all linked to Industrial Engineering with the three other majors as Bioengineering, Chemical, and Mechanical. The responses of each department are in Table XIV.

TABLE XIV

DEPARTMENT: QUESTION 1 RESPONSES

Department	Agree	Neutral	Disagree
Bio	97.92%	0.00%	2.08%
Chemical	93.18%	0.00%	6.82%
Civil	87.50%	2.50%	10.00%
CECS	96.61%	3.39%	0.00%
Electrical	95.74%	0.00%	4.26%
Industrial	80.00%	10.00%	10.00%
Mechanical	94.44%	2.38%	3.17%
Undecided	53.85%	7.69%	38.46%

Due to the fact that many results are significant between Industrial students and the remaining seven departments, the researcher compares the response rates of Industrial Engineering students to some other departments. From Table XIV, it can be seen that 80% of Industrial Engineering students either strongly or somewhat agree that they declared their major prior to starting ENGR 110. In comparison, 97.92% of Bioengineering students, 93.18% of Chemical students, and 94.44% of Mechanical students had declared their major. The researcher concludes from this data that students may not know about Industrial Engineering prior to taking ENGR 110 and therefore the course is beneficial to the students.

Department Question 4: "ENGR 110 course lectures influenced my decision on my major." The nine department interactions that were significant were: Bioengineering-Undecided, Chemical-Civil, Chemical-Mechanical, Chemical-Undecided, Civil-Undecided, CECS-Undecided, Electrical-Undecided, Industrial-Undecided, Mechanical-Undecided. Of the nine interactions, seven of them are between Undecided and the other majors. The other interactions to consider are Chemical with Civil and Chemical with Mechanical. The interaction that was significant even with the Bonferroni adjustment was Chemical-Undecided.

TABLE XV

DEPARTMENT: QUESTION 4 RESPONSES

Department	Agree	Neutral	Disagree
Bio	29.17%	27.08%	43.75%
Chemical	11.36%	27.27%	61.36%
Civil	42.50%	25.00%	32.50%
CECS	27.12%	28.81%	44.07%
Electrical	29.79%	21.28%	48.94%
Industrial	25.00%	30.00%	45.00%
Mechanical	36.00%	24.00%	40.00%
Undecided	61.54%	30.77%	7.69%

From Table XV, it can be seen that 61.54% of Undecided either strongly or somewhat agree that ENGR 110 influenced their decision on major. This percentage is much higher than any other department, which is due to the fact that they are still making their decision. When looking at Chemical, only 11.36% of them say that ENGR 110 influenced their decision. It is the lowest percentage for any department, which could mean that those students who are in Chemical Engineering are confident in their decisions and therefore not influenced by the course.

Department Question 5: "The department presentation influenced my decision on my major." The eleven interactions between departments are: Bioengineering-Industrial, Bioengineering-Undecided, Chemical-Civil, Chemical-Industrial, Chemical-Mechanical, Chemical-Undecided, Civil-CECS, CECS-Industrial, CECS-Mechanical, CECS-Undecided, and Mechanical-Undecided.

TABLE XVI

DEPARTMENT: QUESTION 5 RESPONSES

Department	Agree	Neutral	Disagree
Bio	39.58%	25.00%	35.42%
Chemical	31.82%	29.55%	38.64%
Civil	51.28%	28.21%	20.51%
CECS	31.03%	34.48%	34.48%
Electrical	46.81%	17.02%	36.17%
Industrial	65.00%	20.00%	15.00%
Mechanical	53.17%	22.22%	24.60%
Undecided	69.23%	23.08%	7.69%

Table XVI shows that 65% of Industrial students agree and 69.23% of Undecided students agree that the department presentations influenced their decisions. Only 31.82% Chemical engineers agree therefore supporting the early conclusion that chemical engineering students may be more confident in their choice of major. Although none of the tests remained significant with the Bonferroni example, the researcher compared Industrial and Undecided

students to the Chemical students because these departments had the biggest differences in responses.

Department Question 10: "Societal contributions influenced my decision on my major." The twelve significant interactions between departments are: Bioengineering-CECS, Bioengineering-Electrical, Bioengineering-Industrial, Bioengineering-Mechanical, Chemical-CECS, Chemical-Electrical, Chemical-Industrial, Chemical-Mechanical, Civil-CECS, Civil-Electrical, Civil-Industrial, and Civil-Mechanical.

TABLE XVII

DEPARTMENT: QUESTION 10 RESPONSES

Department	Agree	Neutral	Disagree
Bio	91.67%	4.17%	4.17%
Chemical	88.64%	4.55%	6.82%
Civil	84.62%	10.26%	5.13%
CECS	66.10%	18.64%	15.25%
Electrical	74.47%	17.02%	8.51%
Industrial	60.00%	20.00%	20.00%
Mechanical	75.20%	17.60%	7.20%
Undecided	76.92%	7.69%	15.38%

The main departments to evaluate further are Bioengineering, Chemical, and Civil. 91.67% of Bioengineering, 88.64% Chemical, and 84.62% of Civil Engineering students either strongly or somewhat agreed that they were influenced in their decisions by the potential for societal contributions. These are all very high percentages making these three majors stand out, however when looking at all majors, the lowest percentage is 60% which indicates that over half of students in each major are influenced by this and therefore it is a very important factor.

Department Question 11: "I attended more than the minimum requirement of the seminars in order to gain more knowledge about each major." The six interactions that are

significant between departments are: Bioengineering-Electrical, Chemical-Electrical, Chemical-Mechanical, Civil-Electrical, Electrical-Industrial, and Electrical-Undecided. The one interaction that was significant even with the Bonferroni adjustment was Chemical-Electrical. The main department to evaluate here is Electrical.

TABLE XVIII

DEPARTMENT: QUESTION 11 RESPONSES

Department	Agree	Neutral	Disagree
Bio	47.83%	15.22%	36.96%
Chemical	43.18%	11.36%	45.45%
Civil	55.00%	10.00%	35.00%
CECS	52.54%	13.56%	33.90%
Electrical	73.91%	15.22%	10.87%
Industrial	57.89%	15.79%	26.32%
Mechanical	54.76%	13.49%	31.75%
Undecided	38.46%	15.38%	46.15%

Of the Electrical students 73.91% of them agree that they attended more than two of the departmental presentations as seen in Table XVIII. When comparing this to Chemical students, only 43.18% of them agreed. This once again leads to the conclusion of Chemical students being more confident in their selection of major. Electrical students could be attending more due to a desire to learn more about the other majors.

Department Question 12: "I attended more than the minimum requirement of the seminars in order to get extra credit." The five interactions between departments that were significant were Bioengineering-Electrical, Chemical-CECS, Chemical-Electrical, Chemical-Mechanical, and Electrical-Undecided. The interaction that remained significant with the Bonferroni adjustment was Chemical-Electrical.

TABLE XIX

QUESTION 12 RESPONSES

Department	Agree	Neutral	Disagree
Bio	39.58%	27.08%	33.33%
Chemical	29.55%	27.27%	43.18%
Civil	53.85%	5.13%	41.03%
CECS	60.34%	8.62%	31.03%
Electrical	70.21%	10.64%	19.15%
Industrial	55.00%	20.00%	25.00%
Mechanical	58.40%	12.00%	29.60%
Undecided	46.15%	15.38%	38.46%

Only 29.55% of Chemical students agreed that they went to more than four seminars as shown in Table XIX. Take this in comparison to Electrical which was 70.21%. It is important to note that for both questions in regard to attendance, the test that was significant even with the Bonferroni adjustment remained the same and it was between Chemical and Electrical students. One surprising percentage to notice is that only 46.15% of the undecided students agreed to this.

Department Question 13: "From all of the resources offered, I feel confident in my major choice within engineering." There were no significant results when evaluating the data, however the researcher can make general conclusions based on the data.

TABLE XX

DEPARTMENT: QUESTION 13 RESPONSES

Department	Agree	Neutral	Disagree
Bio	81.25%	12.50%	6.25%
Chemical	88.64%	6.82%	4.55%
Civil	90.00%	7.50%	2.50%
CECS	81.36%	10.17%	8.47%
Electrical	89.36%	8.51%	2.13%
Industrial	89.47%	10.53%	0.00%
Mechanical	87.20%	7.20%	5.60%

Table XX above shows that all majors have an 81.25% or higher level of confidence in their major. Civil has the highest with 90%. On the opposing side however, this means that about 20% of students in each major are either neutral or they responded that they are not confident in their major. The goal of ENGR 110 is for students to learn more about engineering and their major and therefore in turn increase the students' confidence.

Department Question 15: "I identify with math more than physics." The four interactions that are significant are: Bioengineering-Mechanical, Chemical-Mechanical, CECS-Mechanical, and CECS-Undecided. None of them are significant with the Bonferroni adjustment.

TABLE XXI

DEPARTMENT: QUESTION 15 RESPONSES

Department	Agree	Neutral	Disagree
Bio	64.58%	27.08%	8.33%
Chemical	65.91%	22.73%	11.36%
Civil	55.00%	27.50%	17.50%
CECS	65.52%	25.86%	8.62%
Electrical	51.06%	31.91%	17.02%
Industrial	65.00%	25.00%	10.00%
Mechanical	55.56%	25.40%	19.05%
Undecided	38.46%	23.08%	38.46%

Of the Mechanical students, 55.56% agree that they identify more with math than physics. When comparing to Bioengineering, Chemical, and CECS that agree 64.58%, 65.91%, and 65.52%. Another significant conclusion is that for Undecided students, there is an equal distribution between identifying with physics more, math more, and neither. Even though there is a difference between departments, overall the lowest percentage excluding undecided students is 55.56% which is still over half. This means that the majority of freshman students here identify

as being more talented in math than physics. Many students from all majors said they neither agreed nor disagreed with this statement.

Gender: The researcher further evaluated the two questions by separating out the responses by male and female and by the response. Table XXII below shows the response percentages for the question, "Prior to ENGR 110, I felt confident in my choice of major within engineering." This shows that 84.75% of males either somewhat or strongly agree that they are confident in their choice in comparison to 76% of females. Conversely 19% of females are uncertain in their choice whereas only 7.80% of males are uncertain.

TABLE XXII

GENDER: QUESTION 2 RESPONSES

Gender	Agree	Neutral	Disagree
Male	84.75%	7.46%	7.80%
Female	76.00%	5.00%	19.00%

For, "I identify as being talented in math more than physics," Table XXIII displays the response percentages. 67% of females either strongly or somewhat agree with this statement meaning they feel they are better at math whereas only 55.93% of males feel this way. At the University of Louisville, certain engineering majors are required to do different levels of both physics and math courses. If females believe they are better at math, they could pick a major that doesn't require as much physics for this reason. Understanding a student's identity can be helpful when researching how students are selecting their major.

TABLE XXIII

GENDER: QUESTION 15 RESPONSES

Gender	Agree	Neutral	Disagree
Male	55.93%	27.12%	16.95%
Female	67.00%	23.00%	10.00%

Credit Hours: The researcher once again further evaluated the two questions by separating out the responses by over fifteen credit hours, under fifteen credit hours, and by the response. Table XXIV below shows the response percentages for the question, "I attended more than the minimum requirement of the department seminars (2) in order to gain more knowledge about each major." 64% of students with over fifteen credit hours attended more than two department presentations while only 49.63% of students with under fifteen credit hours did. The interpretation of these results is that those students who started their freshman year with more credit hours may be more interested in learning about their options and find the seminars more beneficial. It also could be due to the fact that they are more ambitious students, therefore attending more of the seminars.

TABLE XXIV

CREDIT HOURS: QUESTION 11 RESPONSES

Credit Hours	Agree	Neutral	Disagree
Over 15	64.00%	11.20%	24.80%
Under 15	49.63%	14.55%	35.82%

For, "I attended more than the minimum requirement of all the seminars (4) in order to get extra credit," Table XXV displays response percentage values. 62.2% of students with over fifteen credit hours attended more than four seminars whereas only 49.44% of students with under fifteen credit hours did. Like the conclusion above, the students who started with more credits may be more interested in their options or may be more ambitious students.

TABLE XXV

CREDIT HOURS: QUESTION 12 RESPONSES

Credit Hours	Agree	Neutral	Disagree
Over 15	62.20%	14.17%	23.62%
Under 15	49.44%	14.98%	35.58%

Influential Factors: The researcher then looked at Figure 1 below which is created in Minitab and displays the observed and expected values. The figure shows that each of the seven influential factors are expected to have just under 200 in their frequency category. However, for questions nine and ten they have 313 and 307 respectively. These questions correspond with job opportunities and potential for societal contributions, suggesting that the freshman engineering students indicate these two factors are most influential when deciding upon a major.

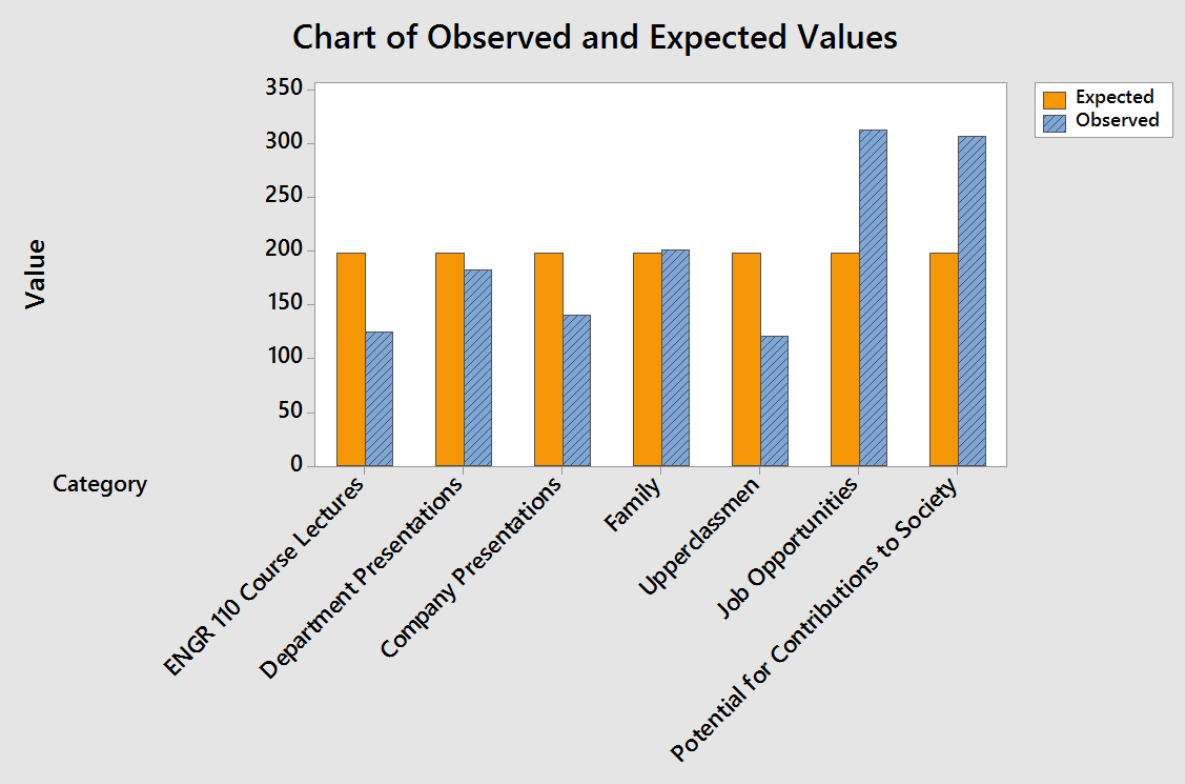

FIGURE 1- Influential Factors Observed and Expected Values

From these results, the researcher believes it is important for the ENGR 110 professors to emphasize the different job opportunities and societal contributions of each major in the course lectures. It is also very important that each of the department presentations includes information on these two factors as well.

3. Interview Results and Discussion

The first question the students were asked was, "Why did you choose engineering?" The results are summarized in Table XXVI below. The most common response was due to the student's interests in math and science, which was mentioned by eight of the thirteen students. One student mentioned math but not science, and another mentioned science and not math. Another common response was due to personal interests. One student has a passion for space and recognized engineering as a field that could help them to become an astronaut, one student has a passion for renewable energy and recognized that civil engineering could help them pursue this interest. There were two students who mentioned that their enjoyment of high school classes such as AP calculus and physics helped them to decide to be engineers. Being able to solve real world problems was mentioned by three of the students and four of them mentioned family influences when deciding upon engineering, whether it be parents or siblings in the field. Lastly, four of the students stated that they knew engineering was a good career field to get into where they can have job opportunities after graduation, and earn a higher income.

TABLE XXVI

INTERVIEW RESPONSES FOR CHOOSING ENGINEERING

Choose Engineering	
Math and Science	8
Personal Interests	6
Family Influence	4
Good Career	4
Real World Problems	3
High School Classes	2
Math	1
Science	1

Of the thirteen students interviewed, twelve of them had a specific major within engineering declared and one student was undecided. When prompted with the question, "Do you feel confident in your major, or do you think you may switch?", six of the thirteen students responded that they have a potential to switch majors. Five of these six students were in-between two majors and one student was deciding between three majors. There was one student who felt confident in their major within engineering, however, stated that they may switch out of engineering into a different major. Lastly, five of the thirteen students felt confident in their major choice and believe that is the degree they will graduate with. These responses can be seen below in Table XXVII. Based on these results, it is critical that the students are presented with the differences between the majors in the ENGR 110 course. This question shows that 61.5% of the interviewed students show uncertainty in their major, thus exhibiting the need for this study to enhance the course so that students can feel confident in their choice by the end of the semester.

TABLE XXVII

INTERVIEW RESPONSES FOR SWITCHING MAJORS

Switching Majors	
Potential to Switch	6
Confident	5
Already Switched	1
Switch out of Engineering	1

The students were also asked, "Do you have family or friends who are engineers?". Of the thirteen students only four of them stated they did not have any family or friends in engineering, meaning knowing someone in the field is an influential factor on selecting engineering as a field. Four of the students have direct family members who are engineers and two of the students have close friends that are engineers who influenced their decisions. Three of

the students had family members who were not degreed engineers, however they were either engineers by trade or worked in a field related to engineering such as mechanical technicians. Four of the students did not have any close family or friends in the engineering field, however one of them mentioned that their dad was a doctor and their sibling was studying to become a doctor and felt the need to hold himself to a similar standard.

TABLE XXVIII

INTERVIEW RESPONSES FOR FAMILY

Family or Friends in Engineering	
Family	4
Nobody	4
Tradesmen	3
Friends	2

Table XXIX shows the responses to "Did you research about the different majors within engineering?". Six of the thirteen students said they did not perform any research on their own, one of which mentioned it was on their to-do list. Although six of the students said they did not do any research, almost all of them talked to other people about the different types of engineering, which is the next question to be evaluated. This question was open-ended, and therefore some of the students may have not considered talking with others to be research. The only major conclusion from this question is that five of the thirteen students conducted their own online research about the different majors when making their decisions.

TABLE XXIX

INTERVIEW RESPONSES FOR PERSONAL RESEARCH

Personal Research	
N/A	6
Online	5
Talking with Others	2
Job Shadow	1
Job Outlook	1
Tour	1

As mentioned above, the participants were asked if they discussed the different majors with anyone else to get a better idea about the differences between majors. The frequency of different categories of people is shown in Table XXX. Four students sought advice from their family and from upperclassman which were the two most frequent responses. Two students responded that they had not had any discussions at all and one more student said they had not yet, but planned on talking with professors in the future. The reason being they did not know which professors to seek out. This is an important finding. Students should be provided resources to know professors from each department if they want to ask for advice during any point of their undergraduate career. This could be implemented by having a designated professor in each department for freshman to meet with.

TABLE XXX

INTERVIEW RESPONSES FOR CONVERSATIONS

Conversations	
Family	4
Upperclassmen	4
Faculty	3
Friends	3
N/A	2
Employers	1
Not Yet	1

Another important takeaway from this question is that students are often taking the advice of upperclassmen. There were two students who mentioned shadowing an upperclassman prior to their freshman year and stated this was beneficial to hear their input on the different disciplines.

"How many seminars did you attend?" was asked to each of the students to determine the impact the seminars have on the decision-making process. The requirement for the course is to attend four seminars throughout the semester, two of which must be departmental presentations. A major takeaway from the responses received, is that four of the thirteen students expressed that they did not attend some of the seminars solely based upon scheduling conflicts. ENGR 110 is a course scheduled on Mondays and Wednesdays or on Tuesdays and Thursdays, however the seminars are offered on Fridays at 1:00 and 2:00 pm. One student said that they could only attend the minimum requirement because they work on Fridays and had to ask off ahead of time to attend the seminars. This raises the question of whether the seminars should be held during normal class time, as some other universities do with their departmental presentations.

The majority of the students interviewed had attended all the seminars except a few, mostly due to scheduling conflicts. One student said that although they decided their major already, they enjoyed the seminars and learning about other disciplines to gain an understanding so that they would have the ability to work with the other disciplines effectively in the future. Another student said they liked learning about the profession as a whole and learning about the other disciplines as well. Another result of this question was that five of the thirteen students mentioned that they found the employer seminars very beneficial in seeing what the employers expected as far as GPA and advice given by them.

Some of the information that students desired to know when making their choice on their major was which paths you can take within a degree, the day to day responsibilities of an engineer, and co-op opportunities within each major. Another student mentioned that during the departmental presentations, it would be beneficial if the faculty would discuss the curriculum of each course rather than the course names. They stated that just by hearing the course name, they were unable to fully understand what they would be learning or what the course entails. One other topic that was brought up was that the faculty should stress the opportunities within engineering as opposed to stressing the salaries. Lastly, one student wanted to know more about industrial engineering as a whole due to an inability to attend that specific seminar due to a conflict. The ENGR 110 professors post all the presentations documents on Blackboard so that students can refer back to all the information at any point.

There was one student who mentioned they believed that bioengineering would have an abundance of job opportunities, but learned this was not the case, at least in this part of the country. On the opposing side, they believed that civil would not have as many opportunities but were surprised to learn it was that was not the case. Not every department touched on the job outlook of the field, and this information would be beneficial for the students to hear about during their freshman year.

Regardless of whether the students had decided upon their major, there were eight students who participated in the interviews that expressed interest in two majors. Some of these students were between two of the majors and chose one prior to beginning school, and some of them are still debating switching into the other major. Two of the thirteen students mentioned three majors, and three students only mentioned one major during their interviews. Table XXXI shown below summarizes the number of majors that students expressed interest in. Finding that

ten of the thirteen students were, or still are, deciding between at least two majors reinforces the importance of having freshman engineering courses to talk about the different majors. This course alone can influence their decision and ultimately alter their entire life and career path. When the students are choosing between several options, they should be provided with all the details of each major in order to fully understand what each field is comprised of.

TABLE XXXI

NUMBER OF MAJORS STUDENTS ARE INTERESTED IN

Number of	**Number of**
1	3
2	8
3	2

Another reoccurring theme was that several students mentioned that mechanical engineering was a desirable field due to its broadness. They believed mechanical engineering could be applied to the most industries or could be used as a stepping stone to another career path in the future. When evaluating a student's decision, this should be taken into consideration, because if there is uncertainty, they may be more likely to choose mechanical engineering solely based on this belief.

VI. CONCLUSIONS

Through both the interviews and the survey, the researcher was able to make some important observations about the freshman engineering students at the University of Louisville. One main result of the interviews is that of the thirteen students, eight of them expressed interest in two majors. This indicates that they are not confident in their choice of major and displays the need for the ENGR 110 course to inform the students about each major so the students have the information they need when making their decision. In the survey, the department with the highest confidence was Civil Engineering and the lowest was for Undecided students. Overall in the survey, about 80% of students expressed confidence in their choice. This percentage is much higher than in the interview, and could be due to the fact that the survey took place later in the semester than the interview. Another difference in confidence was displayed between genders. Males responded that they were confident in their major choice with a higher frequency than females.

The analysis of the survey led to some findings between the different majors. For example, the students that found the department presentations and the course lectures the most helpful were the Undecided students and the Industrial Engineering students. Industrial Engineering students also declared their major less frequently than other majors. This could possibly be due to students' lack of knowledge of the major as a whole before being exposed to it in the ENGR 110 course. Chemical engineering students responded that they didn't attend a lot of the seminars and did not find the department presentations and course lectures as helpful. Electrical students, on the other hand, attended more than the required amount of department presentations.

When the students were asked about the factors that influenced their decision in the interview, eight mentioned their interest in math and science, four said job opportunities, six said personal interests, and nine mentioned having either family or friends who were engineers or engineers by trade. Many students responded that they were neutral about the survey question of identifying with math more than physics, which corresponds to the interview responses. The significant portion of that question was that females agreed that they identified with math more than physics with a higher frequency than males. In the survey, the two factors that were influential were job opportunities and potential for societal contributions, which could coordinate with the personal interests expressed in the interview. The three departments that ranked potential for societal contributions the highest were Bioengineering, Chemical Engineering, and Civil Engineering; however, across all departments, over 60% of the students rated this as influential. Converging results from the survey and interviews, it can be strongly suggested that the most influential factors in deciding upon a major are job opportunities, potential for societal contributions, and personal interests.

VII. RECOMMENDATIONS

From the conclusions, the researcher recommends several items in order to enhance the ENGR 110 course at the University of Louisville. During the interviews, four of the thirteen students noted that they were not able to attend as many presentations as they would like due to scheduling conflicts. The researcher therefore recommends that the presentations either be held during class time, or that the students be made aware of the presentation times when enrolling in the class to avoid these conflicts. Secondly, the researcher recommends that all department presentations and company presentations continue to be posted on Blackboard for the students to refer to later. Finally, the department presentations and course lectures should place emphasis on the job opportunities and potential for societal contributions in each major. These two factors were ranked as most influential among the students, so it is of the upmost importance that they are provided with accurate detailed information in both categories.

LIST OF REFERENCES

Argrow, B., Louie, B., Knight, D., Canney, N., Brown, S., Blanford, A., Gibson, C., Kenney, E. (2012). Introduction to engineering: preparing first year students for an informed major choice. *American Society for Engineering Education*. 1-20.

Carnasciali, M., Thompson, A., Thomas, T. (2013). Factors influencing students' choice of engineering major. *120th ASEE Annual Conference & Exposition*. 1-36.

Likert, R. (1932). A Technique for the Measurement of Attitudes. *Archives of Psychology 140*, 1-55.

Main, J., Mumford, K., Ohland, M. (2015). Examining the Influence of Engineering Students' Course Grades on Major Choice and Major Switching Behavior*. *International Journal of Engineering Education Vol. 31*. 1468-1475.9

McNeil, J., Thompson, A. (2016). Enhancing curriculum in a first-year introduction to engineering course to assist students in choice of major. *In Proceedings of 2016 of American Society for Engineering Education.*

Noonan, J., Oakes, W., Imbrie, P. (2006). First-year engineering students' choice of major: when it is made and what influences it. *Illinois-Indiana and North Central Joint Section Conference.* 1-11.

Ohland, M., Sill, B. (2002). Communicating the impact of an introduction to engineering course to engineering departments. *32nd ASEE/IEEE Frontiers in Education Conference*. 1-4.

Orr, M., Brawner, C., Ohland, M., Layton, R. (2013). The effect of required introduction to engineering courses on retention and major selection. *120th ASEE Annual Conference & Exposition.* 1-9.

Rodriguez-Simmonds, H., Ortega-Alvarez, J., Atiq, S., Hoffmann, S. (2015). Identifying sources of information that students use in deciding which engineering major to pursue. *122nd ASEE Annual Conference and Exposition.* 1-17.

Theiss, A., Robertson, J., Kajfez, R., Kecskemety, K., Meyers, K. (2016). Engineering major selection: an examination of initial choice and switching throughout the first year. *ASEE's 123rd Annual Conference & Exposition.* 1-15.

Walther, J., Sochacka, N., Kellam, N. (2013). Quality in interpretive engineering education research: reflections on an example study. *Journal of Engineering Education Vol 102.4*. 626-659.

Zahorian, S., Elmore, M., Temkin, K. (2013). Factors that influence engineering freshman to choose their engineering major. *120th ASEE Annual Conference and Exposition*. 1-13.

APPENDIX I

Interview Questions

1. Why did you choose engineering?
2. Do you have family or friends who are engineers?
3. Were you undecided or did you have a major declared when the semester started?
4. Do you feel confident in your major or do you think you will switch?
5. If undecided do you feel rushed to make a decision? When did your advisor tell you to declare a major?
6. If undecided in the beginning and declared now, why did you choose that major?
7. Did you research about the different majors within engineering?
8. Did you talk to others about the different majors within engineering?
9. Professors, family, friends, other students, professionals
10. Was there any source of information you wish you were provided with in order to make an informed decision on your choice of major?
11. How many seminars did you attend?

APPENDIX II

Survey Questions

Rank the following on the Likert Scale as shown below

1=Strongly Disagree; 2=Disagree; 3=Neutral; 4=Agree; 5=Strongly Agree

1. Prior to ENGR 110 I declared a major within engineering.
2. 2.Prior to ENGR 110 I felt confident in my major choice within engineering.
3. Prior to ENGR 110 I have been exposed to the different majors within engineering.
4. ENGR 110 course lectures influenced my decision on my major.
5. The department presentation influenced my decision on my major.
6. The company presentations influenced my decision on my major.
7. My family influenced my decision on my major.
8. Upperclassmen influenced my decision on my major.
9. Job prospects influenced my decision on my major.
10. Societal contributions influenced my decision on my major.
11. I attended more than the minimum requirement of the seminars in order to gain more knowledge about each major.
12. I attended more than the minimum requirement of the seminars in order to get extra credit.
13. From all of the resources offered, I feel confident in my major choice within engineering.
14. From all of the resources offered, I feel confident in my choice of engineering as a whole.
15. I identify with math more than physics.

General

1. What is your gender?
    a. Male
    b. Female
2. What is your major?
    a. Bioengineering
    b. Chemical Engineering
    c. Civil Engineering
    d. Computer Engineering and Computer Science
    e. Electrical Engineering
    f. Industrial Engineering
    g. Mechanical Engineering
    h. Undecided

APPENDIX III

Analysis 1: Frequency Count Tables

DEPARTMENT: FREQUENCY COUNT OF QUESTION 1

	Bio	Chemical	Industrial	Mechanical
Strongly Disagree	0	0	1	2
Somewhat Disagree	1	3	1	2
Neither	0	0	2	3
Somewhat Agree	7	3	4	20
Strongly Agree	40	38	12	99
Total	48	44	20	126

DEPARTMENT: FREQUENCY COUNT OF QUESTION 4

	Bioengineering	Chemical	Civil	CECS	Electrical	Industrial	Mechanical	Undecided
Strongly Disagree	11	11	6	16	10	2	27	1
Somewhat Disagree	10	16	7	10	13	7	23	0
Neither	13	12	10	17	10	6	30	4
Somewhat Agree	9	4	12	13	9	2	34	2
Strongly Agree	5	1	5	3	5	3	11	6
Total	48	44	40	59	47	20	125	13

DEPARTMENT: FREQUENCY COUNT OF QUESTION 5

	Bioengineering	Chemical	Civil	CECS	Electrical	Industrial	Mechanical	Undecided
Strongly Disagree	7	11	3	10	7	3	18	1
Somewhat Disagree	10	6	5	10	10	0	13	0
Neither	12	13	11	20	8	4	28	3
Somewhat Agree	15	11	13	13	9	7	50	3
Strongly Agree	4	3	7	5	13	6	17	6
Total	48	44	39	58	47	20	126	13

DEPARTMENT: FREQUENCY COUNT OF QUESTION 10

	Bioengineering	**Chemical**	**Civil**	**CECS**	**Electrical**	**Industrial**	**Mechanical**	**Undecided**
Strongly Disagree	1	1	2	4	2	1	3	2
Somewhat Disagree	1	2	0	5	2	3	6	0
Neither	2	2	4	11	8	4	22	1
Somewhat Agree	20	17	12	26	25	7	54	5
Strongly Agree	24	22	21	13	10	5	40	5
Total	48	44	39	59	47	20	125	13

DEPARTMENT: FREQUENCY COUNT OF QUESTION 11

	Bioengineering	**Chemical**	**Civil**	**CECS**	**Electrical**	**Industrial**	**Mechanical**	**Undecided**
Strongly Disagree	12	15	6	9	3	2	18	6
Somewhat Disagree	5	5	8	11	2	3	22	0
Neither	7	5	4	8	7	3	17	2
Somewhat Agree	8	7	9	8	12	6	21	3
Strongly Agree	14	12	13	23	22	5	48	2
Total	46	44	40	59	46	19	126	13

DEPARTMENT: FREQUENCY COUNT OF QUESTION 12

	Bioengineering	**Chemical**	**Civil**	**CECS**	**Electrical**	**Industrial**	**Mechanical**	**Undecided**
Strongly Disagree	12	12	8	12	5	3	19	5
Somewhat Disagree	4	7	8	6	4	2	18	0
Neither	13	12	2	5	5	4	15	2
Somewhat Agree	4	4	6	9	9	3	21	3
Strongly Agree	15	9	15	26	24	8	52	3
Total	48	44	39	58	47	20	125	13

DEPARTMENT: FREQUENCY COUNT OF QUESTION 13

	Bioengineering	Chemical	Civil	CECS	Electrical	Industrial	Mechanical	Undecided
Strongly Disagree	1	1	0	2	1	0	3	5
Somewhat Disagree	2	1	1	3	0	0	4	1
Neither	6	3	3	6	4	2	9	3
Somewhat Agree	16	15	12	16	20	5	48	2
Strongly Agree	23	24	24	32	22	12	61	2
Total	48	44	40	59	47	19	125	13

DEPARTMENT: FREQUENCY COUNT OF QUESTION 15

	Bioengineering	Chemical	Civil	CECS	Electrical	Industrial	Mechanical	Undecided
Strongly Disagree	1	3	3	2	0	0	9	3
Somewhat Disagree	3	2	4	3	8	2	15	2
Neither	13	10	11	15	15	5	32	3
Somewhat Agree	15	13	13	18	14	4	48	2
Strongly Agree	16	16	9	20	10	9	22	3
Total	48	44	40	58	47	20	126	13

Analysis 2: Frequency Count Tables

GENDER: FREQUENCY COUNT OF QUESTION 2

	Male	Female	%Male	%Female
Strongly Disagree	6	4	2.03%	4.00%
Somewhat Disagree	17	15	5.76%	15.00%
Neither	22	5	7.46%	5.00%
Somewhat Agree	84	29	28.47%	29.00%
Strongly Agree	166	47	56.27%	47.00%
Total	295	100	100.00%	100.00%

GENDER: FREQUENCY COUNT OF QUESTION 15

	Male	Female	%Male	%Female
Strongly Disagree	17	4	5.76%	4.00%
Somewhat Disagree	33	6	11.19%	6.00%
Neither	80	23	27.12%	23.00%
Somewhat Agree	95	32	32.20%	32.00%
Strongly Agree	70	35	23.73%	35.00%
Total	295	100	100.00%	100.00%

Analysis 3: Frequency Count Tables

CREDIT HOUR: FREQUENCY COUNT OF QUESTION 11

	Over 15	Under 15	% Over	% Under
Strongly Disagree	17	54	13.60%	20.15%
Somewhat Disagree	14	42	11.20%	15.67%
Neither	14	39	11.20%	14.55%
Somewhat Agree	24	50	19.20%	18.66%
Strongly Agree	56	83	44.80%	30.97%
Total	125	268	100.00%	100.00%

CREDIT HOUR: FREQUENCY COUNT OF QUESTION 12

	Over 15	Under 15	% Over	% Under
Strongly Disagree	19	57	14.96%	21.35%
Somewhat Disagree	11	38	8.66%	14.23%
Neither	18	40	14.17%	14.98%
Somewhat Agree	16	43	12.60%	16.10%
Strongly Agree	63	89	49.61%	33.33%
Total	127	267	100.00%	100.00%

VITA

EDUCATION

University of Louisville, Louisville KY **GPA: 3.95**
B.S. in Industrial Engineering Graduation Date: May 2016
M. Eng. in Industrial Engineering Graduation Date: May 2017

WORK EXPERIENCE

The Boeing Company April 2016-July 2016
Everett Delivery Center Stall Team Industrial Engineering Intern, Seattle, WA

- Created barchart schedules for baseline work on each airplane; updated and communicated with managers on daily basis regarding the status of each airplane
- Completed analysis on each airplane after delivery to provide post-delivery metrics
- Co-lead safety project for improving emergency placards in the conference rooms; gathered data and performed analysis on current state of emergency placards

The Boeing Company May 2015-August 2015
Supplier Management Industrial Engineering Intern, Seattle, WA

- Analyzed cost reduction opportunity for 787-9 program; determined based on utilizing near net shapes
- Determined standard cut sizes for aluminum master plate to increase material utilization
- Collected pricing data of raw materials for engineers to have visual design implications

Walt Disney World August 2014-December 2014
Engineering Services Professional Intern, Orlando, FL

- Performed labor hour analysis on 109 jobs for the attractions to optimize the labor and verify standard work instructions; recommended net hour change of over 10,000 hours
- Conducted time studies at Hollywood Studios to determine optimal labor requirements for Tower of Terror; involved third shift work

General Cable January 2014-May 2014
Industrial Engineering Intern, Malvern, AR

- Collected over 250 samples of copper wire as data for a cost reduction effort
- Performed process capability data analysis on multiple wire products to ensure they met required tolerances at the lowest cost

ADDITIONAL SKILLS

Project Management	Statistical Analysis in Minitab	Time Management
Work Design	Ergonomics	Lingo
Experimental Design	Microsoft Office	Access

ACHIEVEMENTS and ACTIVITIES

- Recipient, Thomas L. Ward Scholarship Award, 2016
- Recipient, University of Louisville Henry Vogt Scholarship, 2012-present
- Dean's Scholar, University of Louisville, 4 semesters
- Dean's List, University of Louisville, 4 semesters
- Member, Alpha Phi Mu: Industrial Engineering Honor Society, 2015-present
- Secretary, Institute of Industrial and Systems Engineers, 2015-2016
- Member, Phi Eta Sigma National Honor Society, 2013-present
- Triathlete, Louisville Race the Bridge Olympic Distance, 2014
- Certification, PADI Scuba Diving, 2010
- Hobbies include: hiking, baking, skiing, traveling