Development of the Inspire Engineering Mentoring Program

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by
Matt Jackson
Thomas Kostelak
Leah Pervere
Sarah Quatieri

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Report Submitted to:

Elizabeth Poulter
London Transport Museum

Laureen Elgert
Scott Jiusto
Worcester Polytechnic Institute

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ABSTRACT

This project developed the Inspire Engineering Mentoring Program for the London Transport Museum, Transport for London, and Greenwich University Technical College. This program will be implemented using four handbooks that give specific information on detailed lesson plans, orientation, training, matching, evaluations, and several other topics. During this 10-month long program, Transport for London mentors will guide Greenwich University Technical College students towards a deeper understanding of engineering and development in their personal and professional lives.

ACKNOWLEDGEMENTS

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EXECUTIVE SUMMARY

Background

In the United Kingdom there is a growing need for workers in the STEM (science, technology, engineering, and math) fields, as the demand for these employees is much larger than the current supply. Consequently, many efforts are being made to increase UK children's interest in the STEM fields. The London Transport Museum and Transport for London have already begun this process by engaging young students in small, broad programs like LTM's Inspire Engineering days. However, it is especially important to engage with older students as well, particularly year 10-14 students (14-19 year-olds) who are in the process of determining their career paths. Mentoring is one way in which these students can gain insight into what the STEM fields truly are, as well as be encouraged to pursue careers in these fields.

The Inspire Engineering Mentoring Program has been developed for Year 12 (16-17 year-old) students at the Royal Greenwich University Technical College (UTC), an engineering high school that opened in 2013. The school, which is sponsored in part by Transport for London, aims to give students a technical education that will allow them to succeed after graduating from the UTC – whether it be at university, an apprenticeship, or employment in the industry. One way in which the school hopes to ensure this success is by providing students with a mentor from the engineering industry. The Inspire Engineering Mentoring Program will connect Transport for London engineers with Greenwich UTC students who are aspiring towards a career in engineering.

Methodology

The development of this program began with several interviews which allowed the team to determine what the program's stakeholders desired of the program. These interviews, which were conducted with London Transport Museum staff, various Transport for London employees, Greenwich UTC's principal, and several Greenwich UTC students, allowed the team to establish the goals, structure, and lesson plans that were most realistic for this program. While designing and developing the program, the team continued to occasionally consult with these stakeholders so as to ensure the project was on course with their needs and desires.

Program Structure

The Inspire Engineering Mentoring Program was developed as a pilot program for the 2014-2015 academic school year, which will begin with approximately 50 Greenwich UTC A-level

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engineering students. The program will consist of recruitment of mentors, orientation training sessions, and ten monthly meetings between mentors and mentees. Stakeholder input, background research, and safeguarding determined that a 3:1 mentee-to-mentor ratio would be most suitable for the program. Therefore, approximately 16-17 mentors would have to be recruited to mentor the pilot program's 50 students. Stakeholder input determined that TfL graduates would be the optimal mentors for this program, as their young age may allow them to better relate with the students and because they generally have enough time to participate in a program such as this.

Orientation, Training, and Matching

After the mentors and mentees have been identified, they will go through separate orientations. The mentee orientation will introduce the mentees to the program, explain what is expected of them, and have them fill out matching forms. The mentor orientation will cover similar topics, will include a matching form, and will additionally include a communication-based training session so that mentors are prepared to communicate with their mentees. The completed matching forms will allow three mentees to be grouped based on a common interest and then matched to a suitable mentor. Compatible groups of students will be formed by matching them based on the following criteria, in order of priority: engineering interests, career path, and personality.

Program Goals and Lesson Plans

Based on stakeholder input, the mission of the program was determined to be supporting students' personal and professional growth while also giving them a deeper understanding of engineering. This mission shaped the three main themes covered in the program's lesson plans: overview of engineering, professional development, and personal development.

Stakeholder input also determined that mentors and mentees should meet once a month for ten months. Therefore, the three themes of the program were divided over these ten meetings. The initial theme, giving an overview of engineering, will be the subject of the program's first three meetings. Detailed lesson plans have been developed which will allow the students to gain a general knowledge of the different fields of engineering, what engineers do on a day-to-day basis, and how engineering affects their everyday lives. The second theme of the program is professional development, which is the subject of meetings four through seven. The lesson plans developed for these meetings will allow mentees to learn practical professional skills, such as how to interview and how to write a résumé. Finally, the last three meetings will focus on personal development. These

meetings are open-ended, so that mentors may focus on whichever topics will benefit their mentees most. Mentors may develop their own lesson plans or use provided plans that cover topics such as problem solving, communication, and social media. Skills such as these will help mentees personally, while also improving their professional careers.

Evaluations

These lesson plans will be complemented by evaluations throughout the program. After each meeting, mentees will fill out a form explaining how that month's lesson affected them personally and professionally; meanwhile, the mentors will fill out a reflection form noting what did and did not work well with the lesson, as well as what could be improved in the future. Students will also fill out forms at the beginning and end of the program to determine what effect the program as a whole had on their personal and professional development. Mentors will also complete an end-of-program evaluation form, in addition to attending meetings with the program coordinator throughout the program to give feedback and receive support from other mentors.

Handbooks and Documents

The program as described will be implemented using four handbooks: the LTM Guidance Document, Mentor Resource Handbook, Lesson Plan Handbook, and Student Handbook. These documents will communicate how the program should be implemented and will provide the materials to do so. The LTM Guidance Document is the chief document for the program's implementation, as it includes all instructions and materials necessary to begin the program. This includes information on program structure, recruitment, training, matching, and several other topics. A Mentor Resource Handbook has also been developed that will aid the mentors by outlining the program's structure, what is expected of them, and guidelines on how to be a good mentor.

As mentioned previously, lesson plans have been developed for each of the program's ten monthly mentor meetings. These lesson plans are outlined in detail for the mentors and are provided in the Lesson Plan Handbook. These plans, which contain an easy-to-follow table of contents, detailed activities, and any necessary materials, will allow the mentor to lead each meeting with minimal preparation time beforehand. These lesson plans are complemented by the Student Handbook, which contains worksheets and information that will be used to encourage the mentees' thought and to enhance their meetings. These handbooks have been extensively developed so that only minor tailoring will be necessary before the program can be implemented in September 2014.

CHAPTER 1: Introduction

In the United Kingdom there is a large demand for STEM (science, technology, engineering, and math) workers, as it is the world's sixth largest manufacturer and producer of 10% of the world's top scientific research (National STEM Centre, n.d.). However, there are currently fewer students entering the STEM fields than are necessary to fill this demand. In fact, 42% of UK employers already have trouble finding the STEM staff they require (National STEM Centre, n.d.). This demand for STEM employees – and engineers in particular – is especially consistent in London, since it is a major city with constantly-evolving infrastructure. EngineeringUK, an organization aimed at increasing awareness of opportunities in the engineering fields, reports that "over the past seven years participation in the engineering related subjects has declined." The number of students entering vocational schools is rising slowly, but much more needs to be done to spark interest in these crucial fields (Kumar, Randerson, & Kiwana, 2014).

London has begun to shift its educational strategy for its youth away from purely academic work to instead include advanced technical training – leading more students to attend technical schools. These technical schools are aimed at getting students ready for higher education and apprenticeship positions. Students' continuation from technical schools to higher education programs and apprenticeships will help to address the gap employers see in the amount of employees needed at specific qualification levels. By utilizing these technical schools, students are preparing themselves for a wide variety of future job opportunities in high-demand fields.

Programs implemented in the past have shown that mentoring can provide several different benefits to students, including increased interest in the specific field they are studying. Mentoring also provides students with improved self-esteem and confidence (Holloway & Salinitri, 2010), helps them plan for their futures (Younger & Warrington, 2009), and gets them involved in their prospective industry (Gannon & Maher, 2012). Past programs also demonstrate how to best implement a mentoring program. For example, one recurring theme is that mentoring is most successful when done in the context of a minimally-structured program. Such programs give mentors guidance through lists of activities and discussion topics provided by organizations like Teach Engineering ("Teach Engineering Resources for K-12," n.d.) and the National Mentoring Partnership (The National Mentoring Partnership, 2005), and allow students and mentors to decide which of these most interests them. Participants are more likely to commit to a program and engage more if they are allowed ample input into the activities and discussions they partake in (Lumpkin,

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2011). Past programs also show that there are two main mentoring schemes: group and individual ("Mentoring Styles," 2014). Each has its benefits and disadvantages, and each can provide STEM enrichment to students in different ways.

To get students involved in STEM at an early age, the London Transport Museum's Inspire Engineering program aims to help students become more aware of careers in engineering and transport planning ("Inspire Engineering Day," n.d.). One of the main ways they do this is by hosting "Inspire Engineering Day" programs for local schools. Although these programs are very beneficial for the students, a one-day event can only do so much to get students more involved in engineering. The main issue is that one-time visits such as these do not allow ambassadors to build long-term relationships with students, which can be very beneficial in encouraging them to pursue STEM careers. Keen to address this issue, the London Transport Museum and Transport for London are attempting to implement a new mentoring program between Transport for London volunteers and Greenwich University Technical College students with the goal of supporting London's goal of increasing participant numbers in engineering fields.

The project goal is to develop a program for the London Transport Museum, Transport for London, and Greenwich UTC that will increase the number of students pursuing a career in engineering. Although similarly-aimed programs have been implemented by other institutions around the world, such a program has yet to be implemented by these three organizations. Consequently, the exact model for the program had to be developed by the team and the outcomes which will result from it are unknown. Through literature review and case study analysis, along with on-site data collection, the team evaluated the components that make up a successful mentoring program and used them to develop their model. The findings that resulted from this research were adapted to fit the needs of the three involved organizations. Interviews with Transport for London and Greenwich UTC officials and conversations with students, Engineering Ambassadors, and others involved were a driving force in successfully optimizing the program's design to benefit all parties involved. The hope is that this program – once implemented at Greenwich UTC – will be very successful in getting students more excited about and involved in engineering and the STEM fields in general. More specifically, mentoring will hopefully better equip students for a successful career in engineering and inform them of the opportunities available to them in skill-specific jobs.

CHAPTER 2: BACKGROUND

The United Kingdom currently has a lack of students entering the STEM fields – engineering in particular – which can provide many opportunities for students who choose to take advantage of them. The government and industry have tried to move students towards these desired fields through a skills-based approach. Through projects and skills training, students can get real-life experience that will encourage them to enter engineering fields and pursue higher qualifications before entering the workforce. This has motivated a rise in technical colleges throughout the United Kingdom. These university technical colleges (UTCs) give students an in-depth look at their prospective industries and prepare them for life after college. This background chapter will discuss the current state of engineering in London, London's education systems, the team's partner organizations, different mentoring program styles and components, and how it all ultimately helped team to develop a program structure.

The London Transport Museum and Transport for London are working together to bring engineering ambassadors into Greenwich UTC to provide students with a mentoring experience as part of their education. These ambassadors can provide students with first-hand knowledge of the fields they hope to enter. Past programs show that students generally benefit from mentoring programs; these positive experiences will hopefully lead students to further pursue engineering.

Mentoring programs can be adapted to the mentees' desires and the mentors' abilities, and can utilize either individual or group mentoring. These styles lead to different ways of learning for the mentees as they pursue projects, discussions, job exploration, and workshops. Through these experiences, students can gain a deeper understanding of engineering which will allow them to advance in their education, helping to fulfill the United Kingdom's engineering demands.

2.1 Engineering in London

The importance of engineering and the need for skill-specific training is nothing new for the United Kingdom. It is more prominent in London, a city whose infrastructure and economy is constantly changing. In recent years there has been a push for widespread change in education. Under the guidance of government documents and recommendations, the UK has been adopting more specialized work-based education approaches and is turning away from the concept that all students should engage in traditional higher education programs.

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In response to this shift in education and "skills gap," there has been an increase in technical schools and apprenticeship programs available in the UK. It is important to understand why these changes are necessary and how mentoring could be a vital response to them. However, one must first understand the London school system for 14-19 year-olds, as well as analyze the motivating factors behind a system that integrates the needs of government, industry, and students alike.

2.1.1. Motivating Factors: Government, Industry, and Student Viewpoints

Many people in the UK have adopted the same view as the Confederation of British Industry: that "science, engineering, and technology are the foundation for innovation and technological advance, and are traditional strengths of the UK economy. But skills shortages will threaten businesses capacity for growth unless action is taken now" (Confederation of British Industry, 2010). The supply of STEM workers is important in the United Kingdom because it is the world's sixth largest manufacturer, and produces of 10% of the world's top scientific research (National STEM Centre, n.d.). It is concerning that 42% of employers in the UK already have trouble finding the STEM employees they require (National STEM Centre, n.d.). Fortunately, many reforms are being carried out in an attempt to combat problems that exist in the STEM field today.

In 2006, the Leitch Review was published under the guidance of Her Majesty's Treasury demanding change in education for 14-19 year-olds. The review covers topics including the UK skills base, demand-led system, employer involvement, and recommendations for improvement through the year 2020. These skills span basic academic and cultural skills – including literacy and teamwork – but also dive into specific skills and the need for better training programs. In its final report, the review mentions both apprenticeships and vocational education, saying that "for many years apprenticeships have been seen as the best possible route to obtaining practical vocational skills and a good job" (Leitch, 2006). The report stresses the importance of maintaining the high participant satisfaction of these apprenticeships. It also stresses the importance of government involvement and regulation of educational institutions to ensure success (Leitch, 2006). All parties in this debate – government, industry, and students – agree that there has been a skills gap in both academic learning and hands-on education. The way these parties work together is a key factor in fulfilling the goals set forth by the Leitch review.

2.1.2. London's Shift towards Technical Education

University Technical Colleges (UTCs) are independent but state-funded schools where "students study towards GCSEs [general certificates of secondary education] in English, mathematics, science and ICT [information and communication technology], and a technical field related to the particular vocational focus of the UTC they attend" (Fuller & Unwin, 2011). As of January 2014 there are 17 UTCs open in the United Kingdom, with 33 more currently being developed (Department for Education, 2014). There is also government funding available to open 20 more every year ("Frequently Asked Questions and Advice," n.d.). The major advantage seen in this type of education is that it covers not only skill-specific training gaps, but also incorporates a traditional curriculum to cover general knowledge skills – including math, English, and teamwork – which are needed in the workplace. These UTCs will have to answer a question being asked by many: whether or not it is beneficial to shift to demand-led higher education. This means that many people want education to revolve around the job demand rather than jobs revolving around the students available. Mentoring would allow for students to get more involved in the engineering industry, helping fill the gaps that currently exist. Because of this, it seems that the demand for a combined academic and technical environment will be extremely beneficial to all parties.

Greenwich University Technical College is a new school in London geared towards students aged 14 to 19 which promises any student that graduates further placement. On its website, the school has pledged that students will obtain a spot in further education, industry, or an apprenticeship ("University Technical College," 2014). Two of these goals are closely linked to opportunities with businesses around Greenwich, which has led the school to work closely with businesses as sponsors and partners. The school's curriculum focuses primarily on the fields of engineering and construction, with an underlying emphasis on environmentally-friendly construction practices and transportation technologies ("University Technical College," 2014). Like most UTCs, Greenwich UTC is sponsored by companies who specialize in these areas. As a result of this, the school has developed partnerships with Transport for London and with a construction company called the Wates Group. In addition to these two companies, Greenwich UTC is also sponsored by the University of Greenwich and the Borough of Greenwich ("University Technical College," 2014).

One way to get these sponsors more involved in the school is through a mentoring program. Mentoring is one method of getting these businesses and their industry professionals into the school, providing the students with a direct connection to local professionals who are currently

working in the engineering fields. This connection to industry professionals could spark an interest in entering the engineering field, as it would allow the students to get first-hand accounts of what it is like to work in the industry. It could also give students an advantage in their future endeavors, as this exposure to current engineers may provide them with a better understanding of industry jargon, improved interview and résumé-writing skills, and a better idea of the current state of the industry and what it is truly like to work in it.

2.1.3. Apprenticeships: A Work-Based Learning Approach

In addition to technical schools, there has also been an increase in apprenticeships in the UK. In the US apprenticeships are not common; however, in the UK they have been influential for decades. Apprenticeships are a custom in the UK that relate back to historical guilds and span from a long-standing tradition of training certification in skill-specific fields. "In 2013, the Government spent £1.2 billion on the apprenticeship program and in the same year saw 457,000 apprenticeships starts. The Government is also trying to improve the quality of apprenticeships for 16- to 18-year-olds which now must last at least 12 months" (Kumar et al., 2014). These apprenticeships aim to give students who have been demanding more hands-on and work-based learning an opportunity to experience these things without continuing on to higher education. Apprenticeships can last anywhere from one to four years depending on the job. These apprenticeships will fill some gaps and train students for skill-specific openings. While the increase in apprenticeships and UTCs aim to change the way that London's youth look at engineering and career opportunities, many agencies seek to increase interest at an earlier age, so that students will understand the importance of STEM before seeking a UTC, vocational school, apprenticeship, or higher education. Mentoring programs would allow students an opportunity to meet professionals in the industry – some of whom may offer apprenticeships or may have participated in apprenticeship programs themselves.

2.1.4. Partner Organizations

Two organizations attempting to fill the void in London's STEM needs by inspiring youth through STEM-focused programs are Transport for London (TfL) and the London Transport Museum (LTM). Both organizations currently run youth programs in STEM fields – particularly those involving transportation and engineering. These two organization have formed a new partnership with Greenwich UTC, which will likely help students grow in the engineering field. The

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resources and information provided by London Transport Museum and Transport for London will ideally allow the students of Greenwich UTC a better opportunity in engineering.

Transport for London

Transport for London is responsible for overseeing the majority of travel in London, including London's Underground and buses (Transport for London, 2013). Transport for London therefore has a wide reach, which they aspire to use to make a positive impact on the community as a whole. Transport for London has developed several programs to help its community, one of which is the Ambassadorship Program. Through a partnership with the London Engineering Project, this program seeks to spark interest in fields based around civil engineering by having industry professionals speak to children through interactive programming (Transport for London, 2013). The program is able to run through the help of several organizations – including the London Transport Museum, which supplies ambassadors with hands-on materials and presentations for students. Transport for London is also a major sponsor of Greenwich UTC.

London Transport Museum

London Transport Museum is the leading museum on urban development and transportation in London. With over 300,000 visitors per year, it is able to educate people on London's past while encouraging discussion on how best to shape London's future (London Transport Museum, n.d.). The museum does this in a variety of ways, including hands-on programs in the museum and outreach programs.

The London Transport Museum's Inspire Engineering Project is one that encourages students to get involved with the development of their city by getting them thinking about engineering at an early age. The program is closely linked to Transport for London's Engineering Ambassadors, who support Inspire Engineering programs and also host workshops at local schools to introduce students to engineering. The program is run through multiple age levels so that students can be attracted and then educated at different levels. The London Transport Museum began the Inspire Engineering project with the purpose of increasing "awareness of careers in Engineering and Transport Planning." One of the ways the museum accomplishes this is by supporting STEM programs for school children ("Inspire Engineering Day," n.d.).

One of these main programs is the Inspire Engineering Days that LTM hosts for local schools. These programs are aimed at getting students more involved in STEM at an early age, by

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helping them become more aware of careers in engineering and transport planning ("Inspire Engineering Day," n.d.). During this program, students visit the London Transport's Museum depot where they are given a tour of the collection and participate in several engineering activities. Three of these activities are challenges that require the students to work together to accomplish a goal. Another main activity involves them meeting with Engineering Ambassadors from Transport for London. The students ask the Ambassadors several questions about their careers, allowing them to practice asking good questions while also learning more about what it is like to work as an engineer.

2.1.5. Future Outlook: The Impact of Mentoring on Engineering Students

STEM is widely regarded as a fast-growing field – especially in developed nations such as the United States and the United Kingdom. According to the United States Department of Commerce, between 2008 and 2018 STEM occupations in the US are expected to have grown by 17.0% – nearly twice the rate of non-STEM jobs. Their wages are also predicted to be about 26% higher than non-STEM wages (Langdon, McKittrick, Beede, Khan, & Doms, 2011). Despite this, in both the United States and the United Kingdom there is concern over the future supply of STEM workers, as well as concern over retention of students in the STEM field.

In 2006 the Leitch Review set into motion an ambitious plan, set to continue through 2020, to evolve London's school system. It is with the guidance of this, and other reports from organizations like Engineering UK, that STEM field statistics are monitored annually to see where improvements are being made and to track their success. These statistics on engineering program participation show that engineering interests fluctuate from year to year. While STEM subject involvement has increased, it is only in the past year that engineering sector subject areas showed growth in participant numbers (Kumar et al., 2014). Mentoring will become an integral part of not only encouraging students to engage in STEM fields, but also to give a true insight into what they are. Students must understand what engineering and STEM fields are and the range of options they can provide for the future. The government and the STEM industry need high school and undergraduate programs to thrive so that the excess of STEM positions available can be filled, allowing for continued expansion of infrastructure and the economy. The London Transport Museum and Transport for London have already begun this process by engaging young students in small, broad programs like LTM's Inspire Engineering days. The real goal is to inform year 10-14 students (14-19 year olds) who are in the midst of determining their career paths. It is believed that

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mentoring can be used to engage these students, and encourage them to pursue engineering. The development of new UTCs will rely heavily on student demand. Mentoring programs will be integral in not only increasing this demand but also encouraging students and ensuring that those who enter these programs succeed and continue on to jobs, apprenticeships, or higher education in desired fields.

2.2 Styles and Components of a Mentoring Program

The London Transport Museum, Transport for London, and Greenwich UTC all aim to develop such a mentoring program, with the aim of increasing STEM participation. There are a variety of options for developing these programs, and each has advantages and disadvantages that must be analyzed. Mentoring schemes can vary by the type of group setting, types of activities done, or the style and extent to which the program is structured. The benefits of mentoring in general should be analyzed broadly before the specifics of group and individual mentoring are analyzed.

2.2.1. Importance of Mentoring

Mentoring programs vary widely in their implementation, but the premise is consistent for all: members of the program's target audience are paired with a mentor, who is generally older and more experienced. The support they provide varies depending on the purpose of the program. When aimed towards schoolchildren, these programs generally provide psychological support (confidence building, increased self-esteem, etc.) or career support (advising on future plans, industry experience, etc.). At-risk children – those who are from disadvantaged backgrounds or are not expected to succeed academically – generally benefit the most from mentoring programs and the psychological support they provide (DuBois, Holloway, Valentine, & Cooper, 2002). One case study of a Canadian mentoring program that paired at-risk students with teacher candidates demonstrates these benefits. Although there was not a significant change in the students' grades, the students felt empowered and were significantly less likely to engage in potentially harmful behavior like drug and alcohol use or skipping classes. Students reported that they learned from their mentors as role models and saw them as someone in whom they could confide (Holloway & Salinitri, 2010). For many students, a mentoring relationship provides them with more self-esteem and confidence, as well as providing them with someone to challenge and motivate them.

Mentors can also provide their students with significant career support. This can be achieved

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when mentors help secondary school students determine their plans for the future, or give students industry exposure relevant to their planned careers. One case study that demonstrates the former is a mentoring program that was implemented at a secondary school in Northern England (Younger & Warrington, 2009). Participating students were interviewed after they had continued on to further schooling, to gauge their opinions of the program. Almost every student who went on to further education agreed that the mentoring helped them. This included performing better on their GCSEs, psychological support and encouragement mentioned previously, and academic benefits such as determining learning strategies. Some students reported that they had not previously considered further schooling to be a possibility, but the mentoring program helped them to expand their horizons when challenged by their mentors (Younger & Warrington, 2009).

The latter aspect of career support – allows students to receive industry exposure relevant to their planned careers – is well-demonstrated by another mentoring program implemented at a British "hospitality and tourism management school" (Gannon & Maher, 2012). As part of the program, students were assigned to mentors from the hospitality and tourism industry whose main goal was to help the students further their careers. They did this through activities like résumé reviews and interview practice, along with providing the students with networking possibilities and, for some, the opportunity to participate in job shadows. Post-program survey results showed that 91.7% of mentors and 74.3% of mentees believed that the program was a good experience (Gannon & Maher, 2012). When asked about the main benefits of the program, students agreed that career support was quite helpful. 61.3% of participants surveyed thought that the program provided them with more knowledge about their industry, and 54.8% said the program provided them with a "better understanding of industry opportunities." Other benefits included external career support (54.8%), an enhanced professional network (58.1%), and an increased reflection on their own career goals (41.9%) (Gannon & Maher, 2012). These statistics make it clear that matching students with industry mentors can have a significant benefit for the mentees in their career outlook. Although the psychological benefits of mentoring and the encouragement that mentors can provide towards further education are both very valuable, it is this industry career support that would most benefit the students at Greenwich UTC, as they have already chosen to continue beyond their compulsory education.

2.2.2. Mentor Training Programs

An integral part of any successful mentoring program is the training that the mentors

receive. The training scheme used depends upon the program objectives, age group, mentor experience, program length, and resources available. However, there are many commonalities in any program. Four main objectives that have to be addressed in a model mentoring program according to Lumpkin are as follows:

- Defining a clear purpose, goals, and strategies
- Selecting, matching, and preparing protégés and mentors
- Holding regular meetings and interactions
- Evaluating the effectiveness of mentoring programs
    (Lumpkin, 2011)

These four main goals can be broken down even further, as "developing informational materials is an extension of the purposes" (Lumpkin, 2011). The Teaching Scholars Program at Miami University was an 18-year program that believed mentors were more successful and efficient if they were well-prepared and aware of the objectives for their upcoming mentoring role. Orientation practices and training were instrumental in the program's 18 years of success (Cox, 1997; Lumpkin, 2011). These orientations and informational materials are invaluable for the success of any mentoring program and can be delivered in a variety of ways. The easiest option is program handbooks and mentor resource guides. In Appendix A there is a list of resources needed to develop a mentor resource guide and training program, as well as a mentee/guardian program and handbook. These documents are a compilation of resources collected by the National Mentoring Partnership from a variety of sources that can be adapted to fit any program's individual needs and objectives.

2.2.3. Matching Mentors and Mentees

Another key component of a successful mentoring program is a proper match between mentors and mentees. Matching pairs based on selected characteristics (e.g. shared career interests) can provide more benefits to the mentoring relationship than random assignments. Most importantly, matching based on interests or other criteria provide the pair with more common ground on which to build a relationship. This would make discussions and activity planning much easier for the mentors, if they can base their mentoring activities off of things that they are already passionate or knowledgeable about. Matches can be formed by surveying both the mentors and mentees and pairing them based on selected criteria, which will vary depending on the needs of the program. This can be especially important in group mentoring models, where it would be beneficial

to ensure that all members of the group share a common interest (e.g., a specific type of engineering).

Another way in which matches can be formed is by allowing the mentees to choose their mentors. This has several benefits, as outlined by Milton D. Cox (Cox, 1997). First of all, the mentee will have made the decision themselves – presumably making them more favorable towards the match. The mentor may also feel a special connection to a mentee who has shown favor towards working with them. Additionally, the process of choosing a mentor gives the mentee more exposure to the mentors, which is important for network-building. If an interview process is used, the mentors and mentees will both be able to evaluate the possible mentoring relationship ahead of time, allowing them to determine if it would be a successful match or not. It also places less strain on those responsible for implementing the program (Cox, 1997), as they will not have to sift through surveys in an attempt to form mentoring pairs or groups.

2.2.4. Individual Mentoring

One plausible style that the London Transport Museum, Transport for London, and Greenwich UTC could adopt for their mentoring program is an individual scheme, which involves a one-to-one relationship between a mentor and a mentee. In the case of these three organizations, mentors from Transport for London would work with students from Greenwich UTC for an extended period of time. The mentors would advise their mentees about opportunities provided by engineering and would encourage the Greenwich UTC students to pursue careers in the field.

Mentoring Schemes	Positives	Gaps
Individual Mentoring	• Establishes a strong professional relationship between mentor and mentee • Learning contract • Tailored mentoring program • Easy communication	• Mentor biases • Mentor's possible lack of interest

Table 1: Advantages and Disadvantages of Individual Mentoring

The first pivotal factor for an individual mentoring program to be successful is for the mentor and mentee to establish a strong relationship (DuBois et al., 2002). The mentor must create

a safe environment in which the mentee will feel comfortable (McKimm, Jollie, & Hatter, 2003). This generally causes the mentee to be more cooperative and helps them gain more from the program. Once this environment is created, it may be useful to develop a learning contract to ensure that topics which introduce and inspire the students are addressed (Sayers, 2005). Such a contract could involve a mixture of engineering events, learning seminars, and one-on-one meetings to enhance the pupil's overall performance as a future engineer (Neuman, 2012). One benefit of an individual mentoring program is that these events and the schedule can be specifically tailored to students' interests ("Mentoring Styles," 2014). This would likely keep the mentee absorbed in the engineering topic and increase the probability of the student pursuing a career in engineering. Once the mentoring program is officially over, the mentor and student often have a very strong bond (McKimm et al., 2003). Although there are no more meetings and events, the group can still stay together through social networks and through email. This would allow the mentor to continue guiding the student in becoming a successful engineer.

However, there are some disadvantages to the traditional individual mentoring scheme. The mentor could be biased in their approach to mentoring or to the field of engineering. For example, a mentor could think that a large engineering event is an ineffective method to spark interest in engineering for their mentee because events could be impersonal and uninformative. Also, if the mentor is not interested or lacks knowledge in the field that interests the mentee, they may not connect well with their mentee or the contract will not be optimized towards influencing the student to pursue a career as an engineer. This bias could also affect the amount of material learned, because the mentee would not have an easy way to contact another mentor.

Steps to Individual Mentoring

There are four initial steps to develop a successful mentoring program, as outlined below. First, a successful relationship must be developed in order to develop a positive partnership. A positive relationship will ease the smaller moments and allow for more fruitful returns. Secondly, those involved must define what they will do. Next, goals must be defined so that each person knows what to expect. Finally, the pair must understand that they need to work together in order to get the most out of the experience. In addition, child safeguarding policies must be followed to maintain a successful program.

Key Initial Steps to Individual Mentoring

1. Develop Relationship
2. Define Roles and Responsibilities
3. Set Goals
4. Learn to work together
5. Oversee relationship and ensure child safeguarding policies are being followed

An individual mentor can provide the one-on-one attention and development that allows a mentee to grow academically, professionally, and personally. The key to developing a one-on-one mentorship is establishing a successful relationship. Organizations such as Big Brothers Big Sisters pride themselves on their preparation to match mentors and mentees. Their workers put mentors and mentees through an intricate interview and match process so that relationships are predisposed to success ("About Us," 2014). A safe and successful relationship leads to mentors and mentees getting along better, allowing them to avoid interpersonal problems and focus on the development of the mentee.

Relationships are even more important in individual mentoring than group mentoring due to the safety of the child. Group mentoring provides safety for the child due to the number of people involved, but individual mentoring needs to have a successful relationship so that the child can feel safe in the mentorship. The safety of the child is the top priority in mentoring, which is why the relationship is the first step to a successful mentorship program. A successful relationship requires some similar characteristics such as interests, level of interpersonal interactions, and expectations of the program. Grouping people with similar interests allows for more small talk, which provides a better experience in the smaller moments of the program.

After a relationship of trust is established, it is important to define the roles of the mentor and mentee in the experience, as well as set the goals of the program (Byington, 2010). The mentor and mentee both will have certain expectations of what they should do and what they should get out of the program, even if it is not discussed. Therefore it is important that there is an open discussion of what each person will do and what their goals are. First, each person should explain to the other what they see their role as. This is important for the mentors because they are engineers first. The mentor and mentee need to discuss how actively the mentor will educate them on the field, how much exposure will be given to the industry, and how much contact there should be. The mentee will want to define things such as how actively they plan to use the mentorship and what their time

schedule is. These discussions will ultimately lead to goal-setting for the two. The primary long-term goals will be what the student ultimately wants and how this mentorship will help to achieve that goal. The key for both the mentor and mentee is to listen when goals are being set (Byington, 2010). This listening will prevent miscommunication further down the road and lead to a more successful mentorship.

The last initial step to individual mentoring is to understand how to work together (Byington, 2010). A successful relationship and proper goal-setting is important, but it will not come to fruition if the pair does not work together. These first steps will allow for more positive steps to occur, but only by working together will the pair actually experience a positive relationship, reach their goals, and have a positive experience. If the mentor and mentee work together, they will both get more out of the experience and be able to reach sustained success. An important note is that the group should remember to celebrate success together when they reach it (Byington, 2010). When people work together they can strain a relationship, which is why it is important to build up that relationship after success is found.

There is one final piece to individual mentoring that is needed in order to maintain a successful program, which is oversight from those in charge. Individual mentoring can leave students less protected, which could result in the ultimate failure of the program. Program leaders must check in frequently to evaluate how the mentorship is progressing and how the relationship between the mentor and mentee is developing (The University Technical College of the Royal Borough of Greenwich, 2011). These check-ins will most likely be harmless and not needed for everyone, but they are essential to ensure child safe-guarding policies. These policies and check-ins will serve for the protection of the program and sustained success.

2.2.5. Group Mentoring

The other plausible mentoring style that the London Transport Museum, Transport for London, and Greenwich UTC could adopt is a group scheme. This scheme involves a small group of mentors leading a large group of mentees ("Mentoring Styles," 2014). In this case, Transport for London would provide the mentors to guide the students at Greenwich UTC. These groups would most likely meet together systematically with the goal of encouraging the students to pursue careers in engineering.

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Mentoring Schemes	Positives	Gaps
Group Mentoring	• Common interests increase productivity of the mentee • Enhances social skills • Ability for one-to-one mentoring	• Possibility of students being left out • Inflexible meeting schedules

Table 2: Advantages and Disadvantages of Group Mentoring

The first important aspect of a group mentoring system is to establish a mentoring group in which all of the members share a common interest (DuBois et al., 2002). This is monumental for the growth of the students' interest in engineering. With mentors and mentees sharing the same interest, each group meeting and activity would ideally be focused on this one topic. By doing this, it would help to guarantee that the students remain interested throughout the whole program. Also, an important aspect of a group mentoring scheme is that it is very social (Karcher, Kuperminc, Portwood, Sipe, & Taylor, 2006). With mentors and mentees working together on a similar topic, the students can enhance their social skills through group activities that are important for a successful engineer. Finally, even with multiple mentors the students and mentors can still have the one-on-one experience that is so essential to mentoring (Ritchie & Genoni, 2002). Although this type of one-on-one mentoring is not as personal as the traditional individual mentoring program, this mentoring scheme can still provide the individual meetings that can help students delve further into their selected engineering field.

However, there are disadvantages that coincide with group mentoring. With a large group of mentees, not every student will be properly engaged. This could be due to intimidation or the sheer numbers of mentees in the group. Whatever the case, this could be detrimental towards the student's decision to enter the field of engineering. Also, group mentoring schemes generally have inflexible mentoring scheduling. This could cause students to miss engineering events and group meetings which could later affect the student's professional field.

Activities for a Group Mentoring Scheme

In the case of the mentoring program being designed for the London Transport Museum and Greenwich UTC, the program would aim to form mentoring relationships between engineering students and Transport for London engineers. Therefore the program would mainly be focused on

getting students more involved with the transportation and engineering industries. There are many different activities that could be used to achieve the program's goals. If a group scheme was adopted for Greenwich UTC's program, these activities could include things such as group discussions, job experience activities (workplace visits, "day in the life" presentations, etc.), projects, and workshops. Each activity adds a different dynamic to the program, and the Greenwich UTC program would be most likely to be successful if it employed several of these different methods.

Group Discussions

One method that mentors can use to benefit their group of mentees is the facilitation of a group discussion. The topic of discussion would vary depending on the goal of the program as a whole, the goals of the mentor, and the specific goals of that day's session. An example of this can be seen in the TEAMWORKS mentoring program run by Los Angeles Team Mentoring, Inc. As part of this program, groups of middle school students (8 children or so) meet with two mentors to do activities based around the program's focus of "team building, leadership and community service" (Herrera, Vang, & Gale, 2002). During a day about communication, the mentors facilitated a conversation among the students about experiences they'd had with poor communication. Although the students did most of the talking, the mentors helped to guide the conversation so that everyone was involved (Herrera et al., 2002).

A similar format of group discussions could be implemented as part of the Greenwich UTC mentoring program. Discussions would be particularly beneficial for the students, especially as they are of an older age range of 14 to 19 years old. They are at a point in their life when they starting to make major decisions about their futures. As these students begin to decide what their careers should be and what schooling paths they should pursue, they are likely to benefit more from having serious discussions about engineering rather than doing hands-on activities. Things like building popsicle stick bridges or paper airplane competitions are quite appropriate for younger age groups, as such activities are engaging and generally get the students more interested in engineering. However, Greenwich UTC students have already chosen to attend a school whose curriculum focuses on engineering. Consequently, they would greater benefit from conversations about subjects such as what day-to-day life is like in the engineering industry, what the different fields of engineering entail, and what career paths are available for them.

Job Exploration and Industry Experience

Another important method that the Greenwich UTC could employ is giving the mentees insight into their prospective industry. This could be done through job shadows, facility tours at the mentor's workplace, or through "a day in the life" style presentations where the mentors explain to their mentees what an average day of working as an engineer is like. By doing this, it would allow students to better understand the engineering and transportation industries and could conceivably make them more interested in or excited about their prospective careers. One example of a program that uses this technique is the Industry Mentoring Program run by the University of Maryland, Baltimore County's Center for Women in Technology. Through this program, undergraduate women in their third year of study are matched with an industry mentor and the pair have monthly contacts. According to the program's information sheet, typical activities include the student doing a job shadow, going to a professional event together, phone check-ins about academic work, or meeting at the university for speakers or events (The Center for Women in Technology, n.d.). These same activities could easily be adapted for use by the Transport for London mentors with their mentees from Greenwich UTC.

Professional Skills

One important thing that mentors should work on with their mentees is developing the students' professional skills. A major aspect of professional development (a main goal of this mentoring program) is preparing students so that they are ready to move forward in the professional world – whether that be through an apprenticeship, attending university, or directly entering the workforce. All of these routes will require the students to be proficient in basic professional skills such as writing résumés and interviewing. Consequently it would be beneficial for mentors to host things like résumé-writing workshops and mock interviews with mentees. Mentors can show students how to write professional résumés by having students work on correcting sample ones or by assisting students in writing their own. The mentors could also work on interview skills by explaining good interview practice, giving the students sample questions, and even hosting mock interviews after which they could give the students feedback.

2.2.6. E-Mentoring as a Supplementary Program

Individual and group schemes are very effective techniques for mentoring. However, these

methods can be enhanced with supplementary mentoring programs. A plausible supplementary program that the London Transport Museum, Transport for London, and Greenwich UTC could use to bolster their mentoring program is e-mentoring. E-mentoring, or Computer Mediated Communication (CMC), is "a computer mediated, mutually beneficial relationship between a mentor and a protégé which provides learning, advising, encouraging, promoting, and modeling, that is often boundary less, egalitarian, and qualitatively different than traditional face-to-face mentoring" (Bierema & Merriam, 2002). The contact between the mentor and mentee can be provided through e-mail, mailing lists, surveys, and chat groups (Bierema & Merriam, 2002). This relatively new mentoring scheme has advanced greatly due to advancements in technology and the resulting ability to connect many mentors and mentees (Karcher et al., 2006). This type of mentoring, when combined with either an individual or group scheme, can greatly enhance a mentoring program.

The first advantage of the addition of e-mentoring is that this extra communication can help to improve the mentor and mentee's relationship (Bierema & Merriam, 2002). The ability to constantly maintain contact between the mentor and the mentee will ideally bring the partnership closer and improve the entire experience. Also, this type of mentoring is informal and allows the schedule to be versatile. This helps to prevent mentees from being left out due to scheduling issues. Finally, a study has shown that this additional mentoring technique is very beneficial to introverts. Introverts responded more frequently than extroverts when the mentor contacted the group through e-mail (Bierema & Merriam, 2002). Introverts generally feel less intimidated contacting their mentor via e-mail than during a group activity. Therefore electronic communication would most likely help introverted mentees to remain absorbed in the mentoring program.

However, there are circumstances in which this technique could be ineffective or even detrimental to a mentee's experience in a mentoring program. E-mentoring would be ineffective if the mentees do not have easy computer access. There is also a disadvantage in that this mentoring scheme does not involve social interaction (Bierema & Merriam, 2002). This could cause the mentee to lose interest in the mentoring program, which could possibly deter them from continuing an education in engineering. Finally, child safety guidelines would have to be strictly followed in order to maintain positive interactions between the students and their mentors. A failure to follow these restrictions could negatively affect the student's education and the mentoring program as a whole.

Overall, e-mentoring can be an extremely effective supplementary mentoring scheme. When combined with an individual or group mentoring program, a student could be guided to succeed as an engineer. However, such a program would have to be implemented properly in order to be

successful. The challenge then remains of determining how to carry out this implementation and how to make e-mentoring fit in with the traditional individual or group components of the mentoring program as a whole.

2.2.7. Flexible Program Concept: The Benefits of a Minimally-Structured Scheme

While pre-prepared activities for group, individual, and supplementary mentoring programs may be a great resource for certain programs, many programs with planned-out activities are aimed towards younger audiences. Information regarding specific mentoring activities aimed at teenage students is difficult to find. Many programs use a flexible open-ended approach that allows students and their mentors to decide what activities they will engage in. After age thirteen, students are encouraged to think about where they want to go in their careers. Many will enter UTCs and higher education that focus on a particular subject. However, many other students may not be certain about what they want to do or – more importantly – may not understand the opportunities available to them.

Many programs for younger kids are extremely structured. There are activities set for each day of the program and few options for deviating from that plan. The idea of a minimally-structured program does not mean that mentors will not be given guidance, but rather that there will be many more flexible options provided to them. This allows students to gain support exactly where they need it, as they are allowed to pick the activities and discussion topics that they are most interested in. In the National Mentoring Partnership's guide for a successful mentoring program (The National Mentoring Partnership, 2005), there are two major goals during planning as follows:

1. Foster a sense of ownership and belonging among volunteers and participants. Be sure to get participants involved in planning program activities.
2. Sponsor a mix of group activities that support program goals and encourage interaction among all participants. Group activities foster a sense of community for both mentors and mentees, providing informal support for the mentors and a strong support system for the mentees (The National Mentoring Partnership, 2005).

Their research has proven that these two factors of involving a mix of activities while also including mentees and mentor in the program process are integral parts of a successful program. Participants are more likely to commit to a program if they are allowed ample input into the activities and discussions they partake in (Lumpkin, 2011). These activities could involve

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interviewing skills, résumé building, discussions on current advances in the mentees' prospective industry, or a general overview of what certain engineering fields involve. In a group setting it could also be beneficial to have students anonymously write down questions they want to discuss and topics they want to learn about, allowing the mentor to better gauge the group's needs. This way the mentor can tailor the program to best fit the students' needs.

CHAPTER 3: METHODOLOGY

This project is intended to help the London Transport Museum increase interest in STEM (science, technology, engineering, and math) careers by developing a mentoring program between Transport for London engineering ambassadors and students at Greenwich University Technical College. The team analyzed model mentoring programs and collaborated with the London Transport Museum and Engineering Ambassadors to establish an ambassador training program and a detailed program schedule that is adapted to Greenwich UTC's curriculum and goals. The graphic below explains the general process overview for the development of the Inspire Engineering Mentoring Program. The first 3 boxes explain the research focuses during the planning and development stage of the program which would be found through interviews, focus groups, and informal meetings. The team then proposed a program model based on these findings and the collaboration of sponsors which was optimized and refined as more input was collected from stakeholders.
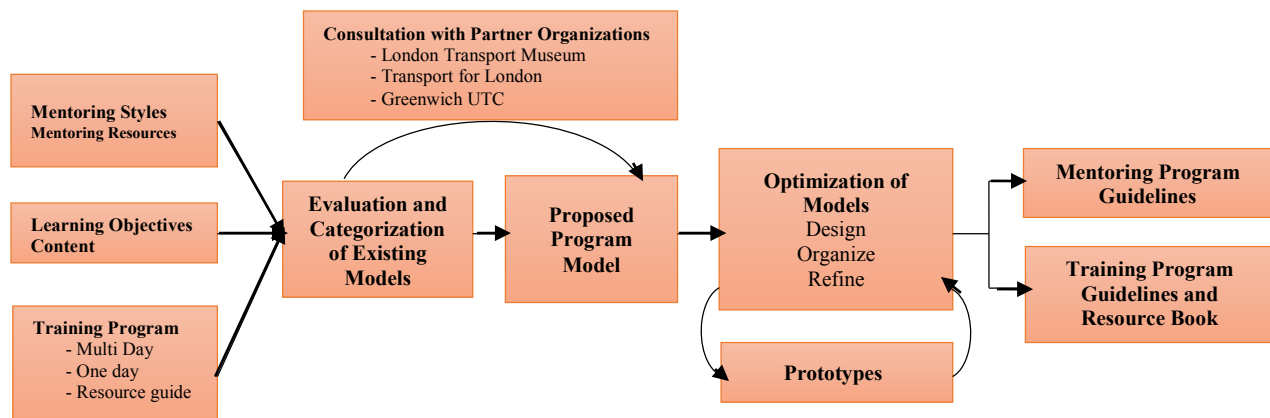
Figure 1: Methodology Flowchart that outlines general project procedure from research to completion.

3.1 Development and Structure

Planning the program included extensive background research and meetings. Research into the needs of the students and the objectives of the program were key factors in this stage. The team approached this research primarily through meetings with key stakeholders in the program. These main meetings included interviews with TfL and Greenwich UTC officials, along with informal conversations with ambassadors and Greenwich UTC students. These meetings were used to obtain a general understanding of the wants and needs of each stakeholder in this program. The team then

used the themes and findings which surfaced during these meetings to organize and develop the mentoring program.

3.1.1 Interviews

The team began their first week in London with interviews with two main stakeholders. The first of these was James Lloyd, a TfL official who serves as the liaison between Transport for London and Greenwich UTC. He has already worked with the UTC on many endeavors, including developing a makeshift curriculum-based mentoring program conducted at the school using Engineering Ambassadors. Mr. Lloyd is very passionate about mentoring and also desires to strengthen the bond between Transport for London and the UTC. Because of this, the team believed his input would be extremely valuable as they began to develop the mentoring program. He was also able to give the team a better understanding of Transport for London and Greenwich UTC's role in the program, along with what each organization expected of it.

The second interview that the team conducted was with Mike Sharp, the principal of Greenwich UTC. The team agreed that meeting with a main staff member at the UTC would be quite valuable, as the program is being designed for the school and its students. Therefore their needs and desires would be key in developing the program model. Also, since the program will be held primarily on the UTC's school grounds, it was helpful to meet with someone who knew what facilities would be available for use as well as the logistics of meeting times.

The final interview that the team conducted was with Ian Rawlings, a Transport for London employee who has been one of the most active members of the Engineering Ambassadors program. He expressed interest in meeting with the team, to give them his input on the mentoring program. By meeting with him, the team was able to learn more about the current ambassadors program and what could be done moving forward with this new program. Mr. Rawlings has also worked with students outside of the Ambassadors program, so he was able to provide the team with information about what techniques work best for working with students in general.

3.1.2 Informal Interviews

During their first week in London, the team was also able to attend an Inspire Engineering Day where they were could meet some ambassadors and watch them interact with students. There were three ambassadors at the event, and the team was able to speak to two of them. Engineering Ambassadors were a very important group of people to get input from while planning this program,

because they are the most likely people to become mentors. The mentors will be Transport for London employees, and ambassadors are simply TfL employees who have already volunteered to be part of a youth outreach program. By talking to some ambassadors at an event, it ensured that the team was talking to ambassadors who were actively participating in the program and whose experiences of working with the children would be fresh in their minds. The conversations that the team had with these two ambassadors were informal but still allowed the team to gain important information about how much time and effort the ambassadors can put into a mentoring program, as well as what training they would need.

One of the ambassadors, named John, was an experienced ambassador who has worked at TfL for many years. He was able to provide the team with the perspective of a busy senior TfL employee who has been a part of company mentoring programs in the past. The second ambassador, named Vivek, was nearly the opposite. He was a TfL graduate who was volunteering as an ambassador for the first time that day. He was able to provide the team with the perspective of a newer graduate who has more availability but less experience. Because it was his first time working with students, he was able to give the team good insight into what training new mentors might want and need.

3.1.3 Focus Groups

The team planned to conduct focus groups with various groups of people. A focus group is a technique to find opinions and beliefs of the panel while gaining vital information from high priority sources (Del Rio-Roberts, 2011). The purpose of focus groups for this project was to explore options for program development and structure.

The first focus group was for the students at Greenwich UTC, as they are the ones who will be mentees in this program. The goal was to allow them to tell the team directly what they wished to gain from a mentoring program, and what their interests in engineering were.

During their interview with Mike Sharp, the team asked if they could meet with some of the students. Six students were allowed to meet with the team for approximately half an hour in an informal meeting. The planned questions changed slightly as the course of the conversation went on and more information was gained. The following are the questions that were asked:

- What projects are you currently working on in your classes?
- What type of career do you hope to have in the future?
- What would you like to learn from people in the engineering industry?
- What would you like to get out of the mentoring program?

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- What type of activities would you like to do with a mentor?

These questions allowed the team to better define the objectives of the program, based on what the students – the mentees themselves – needed to get out of the program. It also allowed the team to better plan the logistics of the program, including what activities should be done.

The final focus group the team planned to conduct was one with current Engineering Ambassadors. The purpose of this focus group was to analyze the Ambassadors' past mentoring experience and subsequent training needs, discuss activities they found most effective in the past, and gather suggestions on mentoring schemes. A formal focus group was not conducted with ambassadors, as the team was instead given an opportunity to meet with four ambassadors for approximately 15 minutes during a planning meeting they were attending at LTM. The questions (Appendix C) that the team had developed for a focus group were used to help guide the questions asked during this meeting. The focus group questions included:

- Do you have any prior experience with mentoring? If so, how much?
- What type of resources would you like before and during the program?
- What type of activities would you find most effective in a mentoring program?

These questions were changed based on how the team's time in London had changed their plans for the program. By the time this conversation took place, the team had already learned that the ambassadors came from a wide variety of backgrounds. Some were experienced with mentoring, while others were new to the ambassador program and did not have any experience working with children. Consequently it had been decided that an extensive training program was needed, regardless of ambassadors' previous experience. Also, the types of activities needed for the program had already been determined once the program's objectives became more clearly defined. Therefore the team chose to not focus on these topics but instead to ask about the logistics of the program and what reasonable expectations would be for the ambassadors serving as mentors. To begin, the ambassadors were asked to briefly introduce themselves, including what type of engineer they were. This was done so that the team could familiarize themselves with the ambassadors' backgrounds and get a better understanding of what types of engineers are generally involved with the ambassador program. After this, they were asked the following questions:

- How much time would ambassadors be willing to put into a mentoring program? Specifically, would it be feasible to have a 1-hour face-to-face meeting each month with supplemental virtual interactions in between?
- What training resources would you like to have for this program, keeping in mind that it is focused on the 14- to 19-year-old age group?

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These questions were aimed at aiding the team in finalizing the general logistics of the program and in developing training resources for the mentors.

CHAPTER 4: FINDINGS

Valuable findings and conclusions were made throughout the previously discussed interviews, informal meetings and focus groups. The input of the four main stakeholders led to several influential findings, which are summarized in figure 2 below.

- **Greenwich UTC**
- **Students**

Professional development

Relation to real world

Real world experience

Career path exploration

Extensively developed program that can be easily implemented

Ensured safeguarding

Reasonable time commitment

Personal and professional development

Clear objectives and lesson plan materials

- **London Transport Museum**
- **Transport for London**
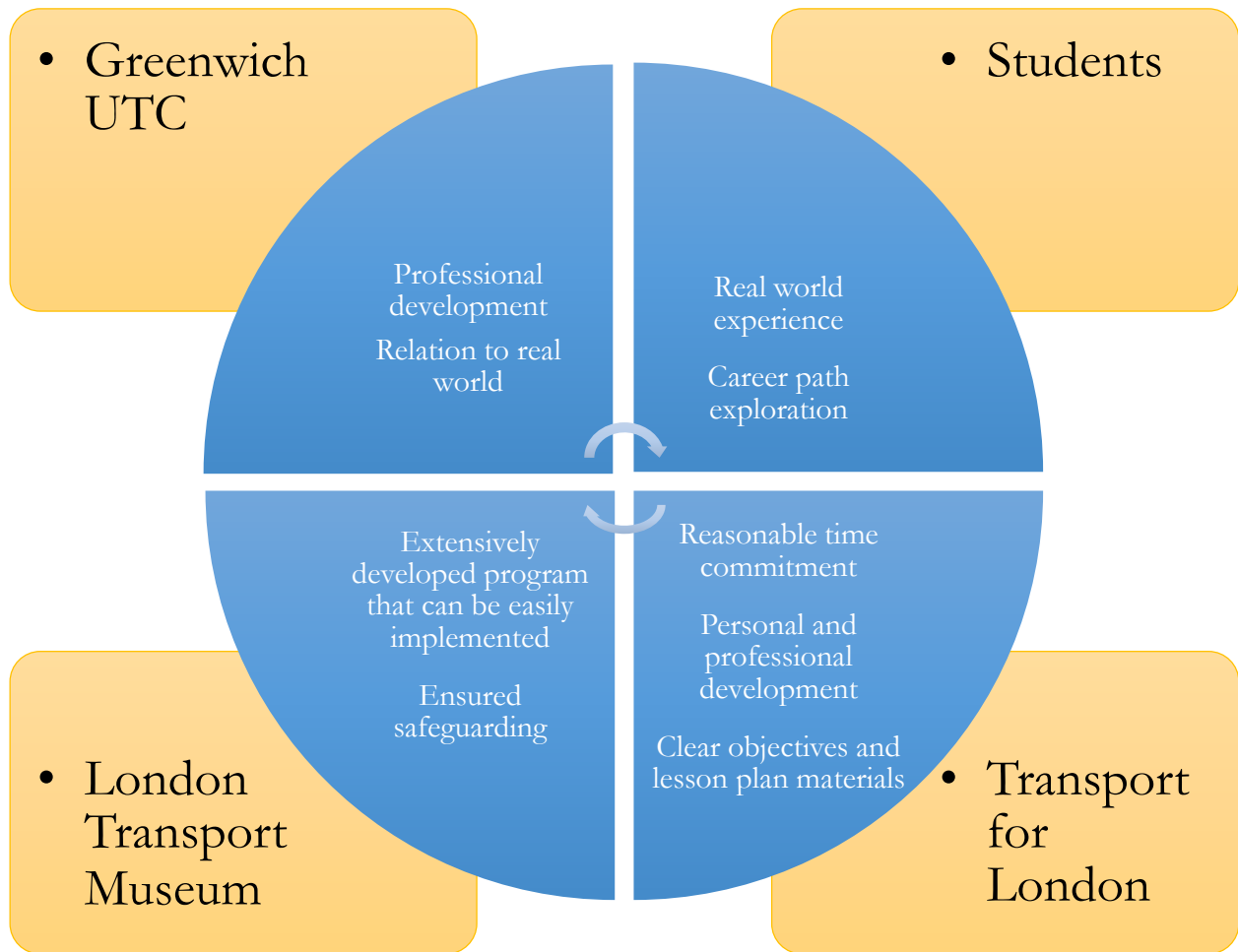
Figure 2: A depiction of the four main stakeholders of the program and a few of the key findings from interviews and informal meetings from each party.

The findings shown in figure 2 fall under three main program categories:

1. Logistics and Structure
2. Content Goals and Objectives
3. Documentation

The logistics of the Inspire Engineering Mentoring Program were shaped directly from input

from the London Transport Museum, Transport for London, and Greenwich UTC. The desires, needs, and limitations of each of these stakeholders laid the foundation for the goals and structure of the Inspire Engineering Mentoring Program. Engineering knowledge, professional development, and personal development were all aspects that stakeholders desired and a ten-meeting program has been designed to best achieve these goals.

The goals and objectives of the program were established first, and these dictated the program's structure and lesson plan content. This allowed the team to develop a program that covered all topics and was as detailed as necessary. Some of the program's logistics, such as dates and exact times of events, will not be able to be established until the program actually begins. However, the team was able to establish the timing of the events and activities as well as how often these would occur. The largest challenge in developing the program's structure was balancing the time demanded of the TfL employees who will serve as mentors with the necessity of regular meetings. The team's findings ultimately led to the goals, objectives, and structure of the program that lay the foundation of the Inspire Engineering Mentoring Program and will give the London Transport Museum the tools necessary to realistically implement the program.

4.1 Logistics and Structure

For logistics and structure, the following conclusions were made:

1. Safeguarding is a top priority when looking at mentor/mentee ratios and types of communication.
2. E-mentoring is preferable for mentors.
3. Meetings should happen frequently for short periods of time.
4. Graduates may make the best mentors.
5. 3:1 Mentee/Mentor ratio
6. Orientation and training are essential.
7. Program lessons should be provided with clear instructions for new mentors.

When developing a mentoring program, logistics and structure are one of the first things that must be taken into account. It was found that the program needed to be extensively planned and easy to implement. This means that the team had to maintain realistic expectations for the program and its design so that it can be easily implemented upon their departure. The museum emphasized that the program needs to ensure child safeguarding. Whenever a program involves students, it must be set up so that it is safe for everyone involved; because of this, safeguarding had to remain a top priority, especially when determining the program's mentor-to-mentee ratio and its modes of

communication.

Many Engineering Ambassadors supported the idea of using e-mentoring, which could be implemented using school-controlled and monitored tablets or the school's online virtual learning environment. However, most programs show that face-to-face contact is preferable because it makes a greater impact on the mentoring relationship and because child safeguarding can be monitored more closely (Johnson & Daire). This taken into consideration, it was found that shorter, more frequent contact with mentees was preferable for most of the program's stakeholders. Vivek, a TfL graduate who was volunteering as an Engineering Ambassador for the first time, explained that an hour once a month would be manageable for many TfL employees. This view was supported by several other ambassadors as well. However, graduates in particular might have more time for a program such as this with monthly meetings. Graduates also have a better understanding of the London schooling system as they have more recently left it and can relate with students who are making future career decisions. If the program met too often, the number of engineers who could participate would be limited; if the program did not meet enough, the mentors and mentees would have inconsistent communication and the relationships would unproductively sputter.

Based on stakeholder input, the program is based on a year-long long structure where the mentors and mentees meet once a month. The program will run during the students' academic year, which is approximately September to July. This commitment is similar to that seen in case studies of previous programs and in recommendations by the US National Mentoring Partnership (The National Mentoring Partnership, 2005). The program's other stakeholders also agreed that this was a reasonable expectation of the mentors. The ten months will allow the mentors' and mentees' relationships to grow and create a productive environment that will be able to cover many important topics while going into the detail necessary to make the program productive.

The monthly meetings will last for one hour. This was again a balance between the mentees' and mentors' time. Greenwich UTC works on a professional schedule, as its school day lasts from 8:30 AM to 5 PM. In addition to this, some students travel as long as two hours to get to the school each day. This led the team to limit the program's meeting times so that they would not interfere with student's classes or travel schedule. This was contrasted with getting the most out of the mentor's time, including their hour-long commute to the UTC. The engineers themselves were also concerned with getting the most out of their time during the mentoring program. Their time is valuable, and they will most likely be missing part of their work day for this program; therefore the team wanted to ensure that the program was a good use of the engineers' time. Taking these factors

into account, the team determined that the most reasonable design would be a program that meets once a month for an hour.

The other major aspect of the program's structure was the mentee-to-mentor ratio. The team conducted extensive background research on individual versus group mentoring, which was used in conjunction with stakeholder input to determine the proper mentee-to-mentor ratio. This background research demonstrated that individual attention is important for mentoring, but group work and safeguarding are also very important for successful mentoring. Another factor to consider was the logistics of the program. As a pilot mentoring program, it will be starting small in the first year to establish the program and then will seek to expand in future years. The program will begin with Year 12 A-level engineering students at Greenwich UTC, of which there are approximately 50. Interviews revealed that the recruitment of 10-20 mentors would be a reasonable expectation of TfL. This led the team to choose a mentee-to-mentor ratio of three to one, which would require 16 or 17 mentors to accommodate the 50 students. This allows the mentor to affect the most students while also providing proper safeguarding and allowing the mentees to get individual attention throughout the program. This will result in the most successful program and mentorship for the pilot program.

James Lloyd and other stakeholders were in favor of thorough training for the mentors. After attending a peer-mentor training session run by Maria Peters, the team found that communication techniques learned would be extremely beneficial for new mentors in learning how to effectively communicate with students. "Mentoring relationships are, in fact, interpersonal relationships in which individuals must communicate, respond to one another, and share information about oneself" (Scielzo, Patel, & Smith-Jentsch, 2011). As a trial program, the Inspire Engineering Mentoring Program will be new to all participants involved and as proved by many research articles, "proper training in the development of a mentoring program is key to maximizing the success of the mentoring relationship" (Dziczkowski, 2013; Ehrich & Hansford, 1999; Hopkins-Thompson, 2000). Orientation and training will help ease the minds of mentors and students alike by introducing them to the program and explaining the benefits that will come out of it. Our informal meetings showed that almost all stakeholders favored at least some training to help mentors adjust to their new role as a mentor before the start of the program. During an Inspire Engineering Day, a first-time volunteer's interactions with students suggested that he was nervous. The team noticed in particular that he followed program leaders' directions very closely. This emphasized the need for thorough training and guidance for mentors who may be new to working

with students, but also brought up the question of how the lesson plan content and documentation, explained in the following sections, should be set up in terms of extensive instructions for LTM and mentors for implementation of the program.

4.2 Content Goals and Objectives

The Inspire Engineering Mentoring Programing at Greenwich UTC is a program primarily for Year 12 engineering students, although in the future it may be expanded to include Year 13 students as well. Input from the program's stakeholders made it evident that the content in the program needed to revolve around 3 major themes:

1. Professional Development
2. Personal Development
3. General Engineering Knowledge and Engineering as it Relates to the Real World

The program has been designed with the collaboration of the London Transport Museum, Transport for London, Greenwich UTC, and Worcester Polytechnic Institute. The backbone of any program is its goals and objectives. The goals and objectives of this mentoring program were reached through input from the various stakeholders, evaluation of what each party desired, and the combination of these to implement a realistic program at Greenwich UTC. The goal of this mentoring program is to support students' personal and professional growth while also developing and expanding the students' understanding of engineering. A detailed explanation of the program's goals and objectives can be found in table 3 below.

Inspire Engineering Mentoring Program: Goals and Objectives			
Overall	**Knowledge of Engineering**	**Professional Development**	**Personal Development**
Our Mission: To support students' growth personally and professionally **Our Vision:** To encourage students' personal and professional development by matching them with a mentor who can encourage them in their daily lives and encourage them to continue on in engineering.	**Priority:** To develop the students' understanding of engineering	**Priority:** To encourage students' professional development	**Priority:** To encourage students' personal development
	Objectives ○ Give the students an overview of many engineering fields ○ Provide an understanding of daily life in the engineering industry ○ Allow the students to gain a deeper understanding of engineering by relating it to everyday items	**Objectives** ○ Explore possible career paths for engineering and the opportunities that each present ○ Build job skills (e.g., CV writing, interview skills)	**Objectives** ○ Building students' self-confidence through their accomplishments ○ Help find and build the students' ambition and enthusiasm. Use real-world activities to bring life to the programme and explore the students' ambitions ○ Improve students' communication skills by learning how engineers communicate

Table 3: Program Goals and Objectives

4.2.1. Professional Development

Professional development was a recurring theme in the team's meetings, in particular those with TfL employee James Lloyd and Greenwich UTC Principal Mike Sharp. TfL is constantly looking for new passionate engineers, and they hope this program will help to provide a source when looking for tomorrow's engineers. Mr. Lloyd and Mr. Sharp's desire is to help students succeed professionally in their future careers. Examples of professional development include CV writing, networking skills, and interview skills. It is important that students be able to explore jobs, apprenticeship opportunities, and higher education (university) while also gaining the skills necessary to get them to that phase in their professional lives. The team's discussion with Greenwich UTC students revealed that the students wanted help with practical subjects such as résumé writing and

interview preparation. They also were unsure of what they should do to advance their careers while still at the UTC and after graduation.

Professional development will take place throughout the program as mentors help their mentees explore different career paths and the skills needed to work professionally. Resources will be provided so that mentors can work with mentees to provide a broad overview of engineering fields, which will complement the specific firsthand knowledge that mentors can provide to their mentees. Mentors' discussions about their personal experiences as an engineer will provide the mentee with insight into what to expect from the professional world and how they can fit into it. These discussions will run parallel to discussions about professional skills such as interviewing and developing a résumé. These skills will support the mentee's professional development and prepare them for life after the UTC.

4.2.2. Personal Development

The second element that stakeholders would like to see in the program is personal development. James Lloyd explained that by "personal development" he meant that mentors should help build students' confidence, help them adapt to the new and more business-like environment of the UTC, and encourage them to take advantage of opportunities given to them. While students are developing professionally, it is important to also further their personal development. A mentoring program is great for this, as mentees can see their confidence grow and improve their communication skills along the way.

Personal development will complement the mentee's professional development, and will allow them to grow into a well-rounded individual. The main way in which the mentor can aid the students' personal growth is by working with them on their communication skills. Communication is a very important skill for engineers, both personally and professionally. Through interacting with the mentor, the mentee will learn what it takes to communicate as an engineer. The mentee will learn how to speak professionally while also learning engineering-specific terms. This is a skill that can be applied professionally, but can also be translated to the students' day-to-day personal lives. Improved communication skills and other skill improvement will lead to more self-confidence for the mentee. The third area is to improve and guide their passion and enthusiasm. This mentoring program will aim to explore the mentees' passions and show them how exciting engineering can be. TfL engineer Ian Rawlings discussed how it can be difficult to find people with a true passion for engineering. This program hopes to "light the flame" in the mentee and instill them with a passion

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for engineering that will guide them both personally and professionally.

4.2.3. General Engineering Knowledge and Real-World Engineering

The third, and possibly the most important, element of the program is general engineering knowledge and its relation to the working world. All stakeholders believed that tying in real-world experience and knowledge would improve the program for the students. During a discussion with Greenwich UTC students, it became apparent to the team that the students lacked an understanding of what engineering is. This observation was supported by conversations with Transport for London and London Transport Museum officials about their experience with youth. The students also expressed interest in learning more about real-world engineering experiences and their options after Greenwich UTC. Their principal, Mike Sharp wanted them to learn more about real-world experience so they would be better prepared for future endeavors. He believed that real-world knowledge would benefit the students down the road in areas such as job interviews. His hope is to produce students who are in the top 10% of whatever field they choose to enter, and he wants them to be enthusiastic about said field. TfL employees also expressed their desire to explain to students the relationship between engineering and its application to the world around them. It is an area that they are comfortable with and would like to share with students. The students can learn a lot in the Greenwich UTC classrooms, but this mentoring program provides a great opportunity for the students to grow professionally as they learn about engineering, what engineers do, and the potential of how this may fit into their life. As the mentee learns more about their mentor, they will also learn which skills are necessary for them to succeed in their own careers.

One thing that became very clear was that, schooling-wise, students were not sure about their futures. It became clear that there was a wide mix of students in this group; some wanted to be engineers while others wanted to be physicists or biologists, and some had a basic understanding of engineering fields while others showed confusion about the subject. They also had questions about what classes to sign up for, what exams to take, and what university and apprenticeships entailed. These are questions they will likely want to ask a mentor, so mentors must be directed as to how or if they should address topics such as these. However, overall the students seemed excited about the prospect of getting to learn more from people who work in the industries they plan to enter and gaining an understanding about the opportunities and day-to-day work that engineers encounter.

4.3 Documentation

A key piece of the team's initial findings was the need to develop documents and lesson plans for the Inspire Engineering Mentoring Program. The program's stakeholders wanted documents that will allow the program to be easily implemented upon the team's departure from London. The ideas and structure that the team created for the program needed to be organized and documented so that the program could begin during the upcoming school year.

The London Transport Museum, the team's sponsor, explained that clear instructions on the timeline of the program's implementation were needed, including extensive materials and instructions for recruitment, orientation, training, matching, and evaluations. This led to the development of an LTM Guidance Document and supporting documentation for mentors and mentees.

The stakeholders also indicated that the program's lesson plans needed to be as detailed as possible for the mentors. These engineers would be unable to put in additional time to develop lessons before each meeting; therefore, the plans need to be pre-prepared, well-organized, and easily understandable. This led the team to the conclusion that extensive documents and lesson plans needed to be developed to best complete the program.

CHAPTER 5: INSPIRE ENGINEERING MENTORING PROGRAM DESIGN

The findings give great insight into the development of program logistics and structure, content, and necessary documentation. These findings have been incorporated into the overall design components for the Inspire Engineering mentoring Program. Given this, the success of the program as a whole is dependent upon these design components as follows:

1. Orientation and Training
2. Matching
3. Lesson Plans
4. Evaluations
5. Handbooks and Deliverables

These components are contained in the project's final deliverables: four guidance documents and handbooks that were developed to make implementation of the program possible. Each book contains material that help to supplement the integration of orientation and training, matching, lesson plans, and evaluations as noted above. All the materials necessary to implement the program are contained in these documents, including recommendations and instructions. The overarching handbook is the LTM Guidance Document, which explains the main components of the program and gives specific instructions on how to implement it. The secondary handbook is the Mentor Resource Handbook, which will be used by the mentors to guide them in their mentoring process and help them to become a better mentor. The third handbook is the Lesson Plan Handbook, which covers all materials of how to run each mentoring lesson and is complemented by the fourth handbook, the Student Handbook. An outline of each document is shown below.

LTM Guidance Document:
1. Program Overview and Structure
2. Implementation Timeline
3. Goals and Objectives
4. Recruitment
5. Safeguarding
6. Handling Difficult Questions
7. Lesson Plan Overview
8. Mentee Orientation
9. Matching

> 10. Mentor Orientation and Training
> 11. Evaluations

Mentor Resource Handbook:

1. Program Overview and Structure
2. Goals and Objectives
3. Expectations
4. Mentor/Mentee Relationship
5. Safeguarding
6. Training
7. Evaluations
8. Contact Information

Lesson Plans:

1. Lesson Plan Objectives
2. Activity Instructions for Meetings 1-10
3. Mentor Reflection Evaluation Sheets

Student Handbook:

1. Program Overview and Structure
2. Parent Guidelines
3. Parent/Guardian Permission Form
4. Mentee Roles and Responsibilities
5. Evaluation Forms
6. Lesson Plan Worksheets and Information

These handbooks cover the major components of the program's design. The program is designed as a pilot program that can be realistically implemented in 2014 but also expanded in the years to come. Each of the main components that appear in these handbooks will be explained in-depth below.

5.1 Orientation and Training

Orientations are very important for this program as it is an original program that will be new to everyone involved. To prepare the mentors and mentees for the program, separate orientation sessions have been developed for both parties. These orientations will cover similar topics and both aim to ease the mentors' and mentees' entry into the program. The orientations, due to content findings (see section 4.2), aim to answer participants' questions and excite both groups by identifying the logistics of the program and also the future benefits for all participants.

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Since this mentoring program is a pilot program, mentors and mentees may have questions, concerns, or anxious feelings about the project. In order to minimize these feelings, the orientations will explain the logistics of the program. This will include structure of the program, goals and objectives, roles and responsibilities, and the mentee and mentor relationship. After this, answers can be given to any questions that were not answered in this explanation. By addressing all of the logistics of the program, the mentors and mentees will feel more comfortable and safe in the program, which is an essential factor for a mentor and mentee group.

The orientations also aim to get the mentors and mentees excited and motivated to begin the mentoring program, in part by identifying benefits that the program will provide to both mentors and mentees. For the mentees, it will be explained that the program will teach them about many different engineering fields and that the program will prepare them for future schooling and/or careers. For mentors, it will be explained that mentoring is a fulfilling experience and that the program could also help them to advance their own career. These explanations will hopefully motivate both parties and make them more dedicated to the program. This motivation, combined with explanations of the program's logistics, should successfully prepare both mentors and mentees to begin the program.

After their orientation session, mentors will also partake in an extensive training session. This 5-hour session will serve as the majority of the mentors' day-long orientation. Training is an integral part of any mentoring program, as "proper training in the development of a mentoring program is key to maximizing the success of the mentoring relationship" (Dziczkowski, 2013; Ehrich & Hansford, 1999; Hopkins-Thompson, 2000).

The team believes that a professional training program, such as the one run by Maria Peters, would be beneficial; however, the LTM Guidance document contains extensive activities and instructions so that any person can run the mentor training program. The program covers all pertinent communication techniques for implementation of the program. Training provides mentors with not only background program information but also communication techniques and the technical know-how necessary to deal with the new mentor/mentee relationship. The training session for this program was adapted from activities used by Maria Peters in a peer-mentoring training session, which two members of the team were able to attend. The focus for the program is communication techniques. "Mentoring relationships are, in fact, interpersonal relationships in which individuals must communicate, respond to one another, and share information about oneself" (Scielzo et al., 2011).

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After extensive research, it was found that it can be beneficial to train only the mentors. "By training one individual to communicate a certain way, the other individuals will likely follow that individual's lead thus possibly limiting the need to train both mentors and protégés" (Scielzo et al., 2011). Mentors can be trained through activities like *Attention on the Intention*, an activity outlined in the LTM Guidance Document, to provide positive encouragement. Students look up to their mentor, and if a mentor knows how to effectively communicate in their personal and professional lives they are more likely to make a positive impact throughout the mentoring process. "Mentors model the skills they wish their mentees to acquire and help them apply and develop the skills on their own, bringing attention to success and shortcomings along the way to mastery" (Georgia Department of Technical & Adult Education, n.d.; Kouzes & Posner, 2002). By focusing on the mentor, skills are provided to the mentors that will positively impact mentees no matter what personality or group dynamic issues may exist. The activities and lesson plans designed for this program also complement the idea that engineers need to learn to work with diverse groups of people. Throughout the program, mentors will often be asked to provide the mentees with challenges that will allow them to develop their problem solving and teamwork skills. During these times, mentors can use the lessons they learned from their training program to help the students through these situations and teach them personal and professional development skills.

Training is not over when the mentor finishes this one-day session. Evaluations and check-ins will also be crucial during this trial program. Mentors will continue to learn from each other and re-evaluate their communication and mentoring techniques throughout the process during quarterly check-in meetings and also through communication on the school's virtual learning environment. Evaluations will be discussed in more detail at the end of this chapter.

5.2 Matching

Matching is one of the most important components of a successful mentoring program ("Mentor and Mentee Pairing," n.d.). Because of this, the team developed matching forms for both the mentees and mentors. These should ensure that mentees are matched to a mentor based on criteria that is proven to create beneficial mentoring groups.

The criteria for the mentees' matching form are: engineering interests, career paths, and personality. The team chose only three criteria for matching because research has shown that "matching on too many criteria is at best time-consuming and at worst unfeasible" and that three to

five criteria are an optimal amount (Insala, n.d.). Students will primarily be matched based on the types of engineering they are most interested in. Secondary to this, students will also be matched based on their intended career paths and their personalities. The mentee matching form will be given to the students before the mentors receive their matching form. This will allow the program coordinator to first organize students into compatible group. The group aspect of a 3:1 mentor-to-mentee ratio program adds a level of complexity to matching. With a one-to-one group, mentors and mentees can be directly matched based on the previously described criteria. In the case of this program, students' group interactions and how they will affect the mentoring relationship must also be taken into consideration. This is why matching will first focus on creating compatible mentee groups, as it will allow the program coordinator to more easily match a mentor to a group of students.

The mentor matching form will be given to the mentors once mentee groups are established. The criteria for the mentor matching forms are: what field of engineering the mentor currently works in, the career path they followed before employment, and how much experience they have with mentoring. When possible, groups of students will be matched to a mentor who is currently employed in one of the engineering fields that interests them. Career paths will be a secondary criterion for matching, so that students – when possible – may be matched with mentors who took the same career path that they intend to take (e.g. going to university or doing an apprenticeship). This form will effectively match the mentor with a group of mentees similar to each other, which research has shown to establish better relationships and more effective mentoring (Allen, Eby, & Lentz, 2006). Mismatching of mentees and mentors has shown to create barriers that impede the effectiveness of the program (Allen et al., 2006). By using these forms and establishing groups in this way, the team hopes to avoid many of the barriers faced during group dynamic development.

As previously stated, the first criterion used to match the mentees and mentors will be shared engineering interest. Matching based on interest will be the highest priority matching criterion for this mentoring program. This criterion has been identified as very important in establishing a positive mentoring group(Rhodes, 2013). In this program, it is necessary for the mentor to have extensive knowledge, experience, and interest in their field of engineering in order to educate and motivate their mentees. From interviews conducted with students from Greenwich UTC and ambassadors from Transport for London, it was found that both groups were adamant about working with a mentor or mentee that shares a common interest with them. Both parties will be more likely to remain interested throughout the ten-month mentoring schedule if they share a

common bond. The students will be allowed to rank multiple engineering fields, so that the program coordinator can get a general idea of the fields they are interested in and what they would want to learn about. However, the team understands that TfL engineers do not encompass all engineering fields that students may be interested in. Consequently the program is not focused on any narrow fields of engineering, but rather on providing students with a better understanding of engineering as a whole. Therefore students can have a positive experience in personal and professional development regardless of which field they hope to enter. This way, the students will benefit from the program even if they cannot be matched with a mentor from their field. To minimize misunderstandings of what each field entails, students will be given descriptions of what engineers from each field do before they attempt to rank the fields that interest them most.

The next criterion that will be evaluated through the matching forms is the career path that each mentee wishes to pursue, as well as which path each mentor has already completed. This matching criterion is important because there are three main career tracks that could lead a student into the engineering industry in the UK: university education, an apprenticeship, or receiving a BTEC or other qualification. These paths all involve very different steps that must be taken. Therefore, when possible it would be most beneficial for a mentor to be matched with mentees who are on a track in which they have first-hand experience. Most TfL ambassadors interviewed by the team had gone to university, so career resources have been provided to mentors for when this matching criterion cannot be met. This way mentors, regardless of which career path they personally took, will be able to help students understand their options.

The third criterion, which is unique to the mentees, is to match the students based on their personalities. Due to the group format of this program, it will be essential that groups are formed of mentees with compatible personalities. The matching form with ask each mentee three different questions with two possible answers. These questions, which are listed below, will allow for compatible groups to be formed. This will create better group interactions for the students and will limit interruptions of the mentoring program that could result from group dynamics problems. The questions asked of the mentees are as follows:

Question: *"If you were asked to complete a group project, what task would you be most comfortable in completing?"*
Possible answers: "*Assigning roles to the members of the group*" or "*Completing any task that needs to be done*"

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This first question will categorize each student as a leader or a follower. In this program, a group with only leaders may not be able to recognize the importance of a follower and there may be competition for control. This would hamper learning progress for the entire group. However, if the group is only comprised of followers, activities may be less organized and possibly not completed. This would affect the overall educational impact of the activity. "The connection of group and leader is a reciprocal one: the way the leader organizes, directs, coordinates, supports, and motivates others in the pursuit of shared goals influences the group and its dynamics, but the leader's own actions and reactions are shaped by the group as well" (Forsyth, n.d.). Therefore, a diverse group of leaders and followers will lead to the best results.

Question: *"When given an option to work in a group or alone, I will choose to:"*
Possible answers: "*Work in a group*" or "*Work alone*"

This question will help to identify whether the mentee is outspoken or reserved. A group with a mix of outspoken and reserved students is effective because the outspoken mentee will make the group atmosphere more comfortable, encouraging more discussion from the reserved mentees (Peters, 2014). However, if a group is composed of three outspoken students, the students will want to dominate the conversations and possibly cause conflicts within the group. In the opposite case, a group with three reserved students will struggle in discussion situations because they will feel uncomfortable in that social environment (Peters, 2014).

Question: *"If your mentor gives you an optional assignment, how likely are you to complete the assignment?"*
Possible answers: "*Very likely*" or "*Not likely*"

This final question will determine whether the individual in motivated or unmotivated. In matching the mentees, it is very important to avoid a group with three unmotivated mentees. This type of group will be much less successful because they are less invested in the program. By having at least one motivated member in the group, this student can encourage the less motivated students and make the program beneficial to the group by encouraging active participation.

Optimally, the mentoring groups will be composed of a diverse mixture of the personalities identified from each of these three questions. A mixed group will benefit from the different characteristics embodied by each member. Therefore, these personality-based questions will enable

the program coordinators to create compatible student groups. However, it is important to keep in mind that there is no such thing as a perfect group. Groups ultimately develop and change over time, and their success will ultimately be dependent not on how they are originally formed but how the groups develop over time.

5.3 Program Evaluations

A key component of the Inspire Engineering Mentoring Program's pilot run is its evaluation process. As previously described in chapter 4, this program is a pilot program that the stakeholders hope to expand in the future. This program is meant to establish and sustain a successful mentoring program at Greenwich UTC, but it should also be able to eventually be implemented at other schools. As this is a trial program, the team aimed to ensure that positive changes can be made as the program moves forward. The best way to do this is through critical evaluation of the pilot program. Therefore, a series of evaluations has been designed for the mentors and mentees to complete throughout the program so that the program coordinator can receive accurate feedback throughout the program of what could be improved. In addition to these evaluations, mentors will meet with the program coordinator at LTM three times over the course of the program to evaluate progress, see what can be improved, and do any necessary training. Evaluation forms will also be collected at these check-in meetings. These evaluations and check-ins will allow the program to improve as it moves forward and will also enhance the mentoring experience for both mentors and mentees. Successful evaluation and improvement upon the initial pilot program will be vital for expanding the program in the future.

Evaluations provide many benefits for mentoring programs; some of these benefits include providing feedback as to whether a program is fulfilling its objectives, identifying the strengths and weaknesses of a program, and assuring stakeholders in the program that the program is being responsibly managed (Partnership, n.d.). There are two main types of evaluations: formative and summative evaluation. Formative evaluation is information that is collected while the program is taking place, while summative evaluation is information that is collected after the program has terminated (National Center for Women & Information Technology, 2011). Formative evaluations can be used to monitor the program as it progresses, and make any appropriate minor changes to the program. Summative evaluations can be used to determine if any large changes need to be made to the program if it is to be held more than once. In the context of this mentoring

program, formative evaluations throughout the program will help to determine which activities the mentors should focus on in the open-ended portion of the program (meetings 8-10). Summative evaluations at the end of the year-long program will determine if the program's training programs, matching procedures, logistical structure, etc. need to be changed before the program enters a second year. It is also important that these evaluations are conducted for both the mentees and mentors. By doing this, the program coordinator can best attempt to satisfy both parties, making the program more appealing to new participants and more successful in the long run.

5.3.1. Mentor Evaluations

After each meeting, the mentors will be required to fill out a reflection sheet that is included at the end of each lesson in their lesson plan handbook. This sheet asks the mentor questions that are meant to make them think about what went well with that specific lesson, as well as what could be improved if the lesson were to be used the following year. These reflection sheets will make the mentors write down feedback while the lesson is still fresh in their mind, which will allow them to better discuss the lesson at their next check-in meeting.

Mentor Check-In Meetings

Part of the evaluation process will involve regular meetings between the mentors and the program coordinator. These "check-in" meetings, which will happen after every three mentoring sessions, should be held at the same time each month, on a day and time decided by the program coordinator. These meetings should be held at a location in central London (most likely at LTM or a TfL building) so that mentors do not have to travel too far for them. These meetings will serve two purposes: 1) to allow the program coordinator to receive feedback about how the program is going, and 2) to provide the mentors with support. The first part of this 1-2 hour-long check-in meeting will focus on receiving feedback. The program coordinator will guide the mentors through a discussion of the previous three meetings, to see what went well and what could be improved. The second part of the meeting will focus on providing support to the mentors. During this time, the mentors will be given the chance to discuss any difficulties they are having with their group and to ask any questions they may have. By doing this, the mentors can receive advice from their fellow mentors and the program coordinator can intervene with any problems before they become a significant hindrance for the students participating in the program.

Final Evaluation Form

At the end of the program – during the final check-in meeting – the mentors will be asked to fill out a final evaluation form. This form consists of six open-ended questions, which ask the mentors about various aspects of the program. The feedback gained from these forms, like all of the evaluation methods used for this program, will be used to improve the program in future years. From this form, the program coordinator will learn if lesson plans, training programs, or the logistics of the program need to be changed for future years. They will also learn how the program benefited the mentors, which will help in making the program more appealing to new mentors in future years.

5.3.2. Mentee Evaluations

In order to properly evaluate this mentoring program, the mentees will be required to complete three evaluation forms. Evaluations from mentees in the program are very important for advancing the mentoring program and identifying whether the program was beneficial for the students. This is especially important for the Inspire Engineering Mentoring Program since it is a pilot program. Therefore, three evaluation forms have been developed to moderate how beneficial the program was for the mentees. These forms will be completed throughout the program and will allow the program coordinator to properly evaluate how effective the program was for the students.

The first evaluation form that the mentees will complete is the intended learning outcomes form, which will be filled out at the end of their orientation session. This form will ask the mentees how they wish to grow personally, professionally, and in any broader areas form the program. This evaluation will be effective in understanding what the students wish to gain from the program. Then when the program is finished, the program coordinator can check to see whether the program successfully fulfilled the mentee's intended learning goals by comparing their intended learning outcomes forms to their later evaluation forms.

The next evaluation form that the mentees will complete is the nutshell evaluation form. At the end of each mentoring session, the students will fill out two sections of this form. In one section they will explain how that month's lesson affected them personally, and in the second section they will explain how it affected them professionally. There are two of these forms – one for the first five meetings and one for the last five. At the end of each form (after meeting 5 and meeting 10), the students will create an action plan based on their documented growth. This action plan will identify how they will use what they learned from each meeting to aid them in their future career plans. The mentees will keep this nutshell evaluation as a reference once they complete the program to evaluate

how they grew personally and professionally. The mentors will photocopy the completed nutshell forms and pass them into the program coordinator. This will be essential in recognizing how each lesson affected the mentee, and will allow lesson plans to be optimized in the future so that mentees grow personally and professionally from each meeting as intended.

The last evaluation form that the mentees will complete is a personal and professional impact form. This form will be completed by the mentees at the end of their final mentoring meeting. This form will evaluate how the mentoring program impacted them in five categories: knowledge, skill, motivation, confidence, and communication. These five categories are areas in which the team intends mentees to grow personally and professionally by the end of the program. Therefore from this evaluation, the project coordinator can identify if the program was effective in achieving these goals. Also, if there is an impact area that is not recognized by the students, the program can be modified to emphasize the specific area. These three evaluation forms will all aid in making improvements like this to the program in future years.

5.4 Lesson Plans

There are many different types of mentoring models. After receiving input from the program's stakeholders, the team decided that the program would focus on personal and professional development in the form of a school-to-career model. As outlined in *How to Build a Successful Mentoring Model,* a school-to-career model which "incorporates a more intentional effort to help young people explore a career direction, is most frequently used at the middle school and high school levels" (The National Mentoring Partnership, 2005). In this model mentees participate in career exploration, job/life skills, and postsecondary education/internships (The National Mentoring Partnership, 2005). The program was developed with each of these ideas in mind as well as additional personal and professional skill development objectives specific to the students' needs.

To accommodate the varying levels of mentors' experience discussed in our findings, lesson plans with activities and supplementary materials have been developed for meetings one to seven. Optional supplementary lesson plans were written as recommended models for the remaining three lessons of the program. Each lesson plan outlines main learning objectives and the instructions on how to carry out the lesson so as to fulfill these objectives. Each lesson plan is formatted with the same main subsections and, for the sake of simplicity and practicality, is no more than two pages. Every lesson plan clearly outlines the below subsections, as relevant to the activity:

- Title
- Meeting Agenda
- Materials (as needed)
- Objectives
- Activity Directions and Explanations
- Guidance questions (as needed)
- Discussion

These subsections were picked based on models of current London Transport Museum activities and lesson plan examples from FranklinCovey's *The 7 Habits of Highly Effective Teenagers* (FranklinCovey, n.d.). The lesson plans include detailed directions and time tables for carrying out reasonable and effective mentoring sessions, all of which involve guided participation. "The purpose of guided participation is skill transfer from the assistant to the learner. This is accomplished in three phases:

(a) Choosing activities that interest the learner and contain the desired skills to be learned,

(b) providing support as learners participate in activities, and

(c) adjusting the level of support as learners begin to complete activities and acquire the skills to complete tasks on their own" (Dziczkowski, 2013; Meece, 1997).

The 10 planned meetings have three core objectives taking directly from findings in chapter four: an overview of engineering for meetings 1-3, professional development for meetings 4-7, and personal development for 8-10, as described in the following sections. All lesson plans are found in the Lesson Plan Handbook.

5.4.1. Meetings 1-3: Overview of Engineering

The initial three meetings of the Inspire Engineering Mentoring Program will introduce mentees and mentors to the program, its goals, and structure as well as explore what engineering is. As any relationship begins, it is important to move through the sometimes uncomfortable first stage by utilizing activities that will help to build the relationship. In addition to this relationship building, this portion of the program seeks to expose students to the field of engineering since this subject is a main content goal from our findings and background research.

The mentor and mentee orientations both attempt to prepare the program's participants for the successful building of relationships within the group; however, the program's lesson plans also address this through introductions, icebreakers, and structured program content. The first meeting is centered on the participants getting to know each other and growing more comfortable with one

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another. This will allow the relationship to begin to grow, which will increase productivity later on in the program.

The material covered in the first three meetings of the program aims to develop the mentees' knowledge of engineering, what engineers do on a day-to-day basis, and how it affects their lives. Many students don't understand the difference between the types of engineering and the vast job opportunities available in each separate engineering field. An important aspect of this portion of the program is to relate the material to what the mentees already know and understand, so that the abstract idea of engineering is easier for them to understand. This is accomplished by having the mentees learn about the engineering behind items they use on an everyday basis, such as chocolate and music. The mentors have also been instructed to speak about their personal experiences, but to simplify them and relate them to what the mentees can understand. The hope is that these first three meetings will guide the mentors and mentees through the initial awkward stage of their new mentoring relationship while also giving the mentees a deeper understanding of what engineering is and the different engineering fields in order to prepare them for the next phase of their life.

5.4.2. Meetings 4-7: Professional Development

Meetings 4-7 of this program will focus on helping the mentees to grow professionally. Based on the team's discussion with students from Greenwich UTC (see section 4.2.1.), this portion of the program will consist of lessons that focus on career paths into engineering, résumé writing, and interviews. During lesson 4, mentors will discuss the main career routes available to the students: university, apprenticeships, and vocational qualifications. They will also discuss the professional registrations available to engineers in the UK that the students may one day aspire to achieve, as well as performing an activity aimed at breaking down stereotypes that the students may associate with these career paths. This lesson should help students gain a better understanding of what routes are available to them and which would be best for their individual career goals.

Lesson 5 focuses on writing CVs, the two-page version of American résumés that are used in the UK. The mentors will discuss what makes a good CV and will have the students work on writing their own. Lessons 6 and 7 focus on interviews. Lesson 6 will focus on the preparation required for an interview and developing an "elevator pitch" that can be used to answer the typical interview prompt, "Tell me about yourself." After this, the mentor will spend lesson 7 conducting mock interviews with their mentees. These lessons will ensure that the students have a good CV and interview experience by the end of the program, which will benefit them as they seek admission

from a university or employment from companies in the engineering industry.

5.4.3. Meetings 8-10: Open-Ended/Personal Development

The final three meetings of the program will touch on the mentee's personal development and wrap up the program. Personal development focuses on developing the students' personal skills, which will benefit them both in their personal and professional lives. The lessons designed for this portion of the program have been deemed optional because the first seven meetings should give the mentor a good understanding of what their mentors are missing and what they want or need to gain from the program. If the mentor feels it is worth revisiting something from earlier lessons, they can do so during these meetings. The mentees will have picked up personal development skills throughout the program and will have varying needs as far as personal skills are concerned. This is why several optional lesson plans have been provided for this portion of the program. These options include goal setting, communication, problem solving, and a current events activity aimed at relating engineering to the mentees' community. These first three options are focused on basic skills that in the team's experience are necessary for students and young professionals. These skills are also ones that the program's stakeholders deemed important, so mentors have been given different activities that will help mentees learn, practice, and develop those skills.

A final lesson plan has been developed for meeting 10 which it is highly recommended that the mentors follow. This lesson serves as a conclusion to the program and will allow mentees to practice some of the skills they've learned while reflecting on the program and discussing what they've gained from it. The students are asked to give a final presentation, which will allow them to internalize and think critically about the progress they've made. This was based on team's experience with one of LTM's Inspire Engineering Days, where the students were asked to give a brief (3-minute) presentation at the end of the day. The students were split into groups and asked to explain to the class what skills they learned (teamwork, etc.), what they learned about TfL, and what surprised them about the day. The students in the Inspire Engineering Mentoring Program would give a similar presentation, which would also serve as an opportunity for the mentees to display their improved communication skills. If possible, it is recommended that multiple mentoring groups meet together for this meeting. This way the students could work together on a group presentation that they would use to teach other groups about what they've learned. Either way this lesson would serve as a way for the students and the mentors to reflect on the progress that the students have made in the three content categories that needed to be addressed from the findings for the program.

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5.5 Program Implementation Documents and Handbooks

The components described above are located in three handbooks, LTM Guidance Document, Mentor Resource Handbook, and Student Resource Handbook, which will all be integral in the implementation of the Inspire Engineering Mentoring Program. Each component was made for a different participant in the program, LTM, the mentors and the mentees consecutively. These components, as outlined at the beginning of chapter 5, will be used before the first meeting between the mentors and their mentees to explain the purpose and goals of the program and what steps need to be taken to reach the objectives previously mentioned.

5.5.1 LTM Guidance Document

The London Transport Museum (LTM) Guidance Handbook is the main handbook that LTM can use to implement and execute the program. This handbook contains information that is vital to running the program, including the 10 sections mentioned previously:

1. Program Overview and Structure
2. Implementation Timeline
3. Goals and Objectives
4. Recruitment
5. Safeguarding
6. Handling Difficult Questions
7. Lesson Plan Overview
8. Mentee Orientation
9. Matching
10. Mentor Orientation and Training
11. Evaluations

Each of these sections addresses information specific to implementation of the program, including all necessary orientation instructions, timetables, and materials necessary for the Inspire Engineering Mentoring Program to begin during the 2014-2015 school year.

Overview and Structure, Implementation, Goals and Objectives

The initial part of the handbook, sections 1-3, sets the scene for the remainder of the document as it contains the Program Overview, Structures, and Goals and Objectives (refer to LTM handbook and report sections 4.1-4.2).

Recruitment

      This section of the LTM Guidance Document briefly explains who ideal mentors for the Inspire Engineering Mentoring Program would be, what would be expected of these mentors, and the benefits that the mentors would receive from the program. Ideal mentors for this program would be TfL graduates, as conversations with TfL Engineering Ambassadors revealed that graduates would have more time to dedicate to the program (see "Informal Interviews" in section 3.1.1). As graduate schemes are 2 or 3 years long and begin in September, first year graduates would not be ideal for the program as they would still be getting accustomed to their graduate scheme when the mentoring program begins that same month. Therefore, second or third year graduates would be ideal mentors. Graduates who have just finished the scheme may be ideal as well, as they should still have enough time to dedicate to the program. This section of the document also explains when recruitment should begin and includes a frequently asked questions document that can be distributed to TfL engineers targeted for recruitment (see LTM Guidance Document).

Safeguarding

      The team was unable to complete the Safeguarding section, something that was extremely important in our findings, and it therefore begins with a special note that this section needs to be revisited by LTM. This is because the London Transport Museum is currently re-developing their entire safeguarding policy, led by Head of Live Programmes Liz Power. LTM has been instructed that this section should be revisited and completed once the new policy is developed, to ensure that the program's safeguarding policy reflects the safeguarding policy at LTM. For the time being, three sections have been included for Safeguarding: CRB, Safety, and Confidentiality. LTM has dictated that all mentors must be CRB checked. This is the equivalent of a background check in the United States as it looks at their criminal history to be sure they can work with younger mentees.

      The Safety section explains the safeguarding built into the program by keeping the groups to three mentees with one mentor and also outlines the policy for communication outside of the program. In the 21st century there are many ways for mentors and mentees to communicate and this program wants to ensure that it is happening in the safest and most constructive manners. The mentors and mentees can communicate face-to-face during their mentor meetings, through the mentor's professional email, and through the e-mentoring platform the program develops. There should be no other communication outside of these avenues as it cannot be moderated and opens those involved up to dangerous situations. The mentor's professional email is monitored through

their company and requires login information to use, which is why it is safe to communicate in this manner. The team was not able to include details about the program's e-mentoring platform as many of these details will need to be managed by Greenwich UTC. The school already utilizes a virtual learning environment for their academic purposes that could be adapted to accommodate the needs of this program. This platform would require login information to access and would only utilize public message boards; no private conversations would be possible. The team believes that utilizing this platform will be beneficial to the program as long it is only set up in this manner.

The third section of Safeguarding is Confidentiality. This information is adapted from materials from the National Mentorship Partnership (The National Mentoring Partnership, 2005). A mentee's confidentiality is an important part of the success of any mentoring program. Although the program will not focus on the mentor filling a role model character for the mentees, it is still important that the information the mentees share with the mentor is kept confidential. This confidentiality allows the mentees to feel more comfortable with the mentor, and will allow for a more trusted relationship and thus a more productive experience. The exceptions to this confidentiality are if the mentee is in any danger or if the mentor needs help from the program coordinator in working through a situation with the mentee. Safety itself is a top priority, which is why the mentor will go to the program coordinator if there are any signs of danger. Another aspect of confidentiality is that mentors should not speak negatively about their mentees, even when problems may present themselves throughout the program. This is why the program coordinator can assist to work through these problems, which should allow the safest environment for the mentors and mentees.

Handling of Difficult Questions

The section on Handling Difficult Questions was adapted from the National Mentorship Partnership (The National Mentoring Partnership, 2005) from "How to Handle a Variety of Situations." This dealt with many behavioral issues which were not relevant to this program. Hence these situations have been limited to students asking difficult questions. The handbook's approach to difficult questions was based off LTM's current approach to the subject, which the team witnessed at an Inspire Engineering Day where TFL engineering ambassadors spoke with London students. The directions given on not answering inappropriate questions or how to handle questions you do not know the answer to were based off what the mentors were told that day and what the team witnessed.

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Lesson Plan Overview

The LTM Guidance Document contains an overview of the lesson plans for the program which have been described in section 5.4. LTM will have access to the complete lesson plan, but the team felt it was important to provide them with an overview to refer back to. This section lists the objectives and activities for each meeting for a quick view, then has a quick description of the activities so that information about them can be obtained quickly. If more information is necessary, it can be found by viewing the complete plan in the Lesson Plan Handbook.

Orientation, Training, Matching, Evaluation

The final sections of the LTM Guidance Document discuss Matching, Evaluations, Orientation, and Training. These are overall program themes that have been explained in depth in sections 5.1-5.3. The LTM Guidance Document contains specific instruction as to how to run orientation and training days and how to successfully use matching and evaluations throughout the program. These sections conclude the LTM Guidance Document which the London Transport Museum will be able to use to successfully implement the Inspire Engineering Mentoring Program.

5.5.2. Mentor Resource Handbook

The mentor resource handbook follows the outline below:

1. Program Overview and Structure
2. Goals and Objectives
3. Expectations
4. Mentor/Mentee Relationship
5. Safeguarding
6. Training
7. Evaluations
8. Contact Information

The Mentor Resource Handbook will serve as a guide for the mentors that they can use as a resource throughout the program. Mentors will learn the goals and objectives of the program as well as the structure that will allow them to reach those goals. After this they will find a section on how to be a successful mentor and the keys to building a relationship with their mentees. This will be followed by the mentor's safeguarding instructions so that they can practice proper safeguarding throughout the program. The mentors will also have references to the training program they will do at the beginning of the program, so that they can refer back to these later on in the program. Finally,

the mentors will learn about the evaluation forms necessary for the program.

Overview and Structure, Implementation, Goals and Objectives

The initial part of the handbook, sections 1-3, sets the scene for the remainder of the document as it contains the Program Overview, Structures, and Goals and Objectives (refer to the Student Handbook and report sections 4.1-4.2).

Expectations and Mentor/Mentee Relationship

Several mentoring tips were adapted from the National Mentoring Partnership. This section will help to adapt the mentor from an engineer to a mentor. Mentors can learn what is expected of them as a mentor and what the mentees expect from them. They will also learn how to build a relationship as a mentor and mentee. Every mentor may not need these tips, but they have been included to cover the complete scope of mentoring. The largest change that was made from the National Mentoring Partnership's resources was use of the word "friend." In many mentoring schemes, the mentor is an older friend to the mentee; however this is not the expectation of our program. The mentors should be role models to their mentees so that professional and personal development is a priority instead of adjusting behavior, which is the goal of many mentoring programs. These sections will serve as a good introduction for the mentors to the mentoring program, but can also be used as a reference later on in the program if they experience problems in the mentorship.

Safeguarding

Safeguarding is a key aspect of the Mentor Resource Handbook. This section is very similar to the Safeguarding section of the LTM Guidance Document, and therefore will also need to be revisited once LTM's safeguarding policy is re-developed. Again, three important parts of safeguarding have been included. First, the mentors are notified that they will be CRB (background) checked before taking part in the program. Next the mentors are given several important notes regarding safeguarding. This section focuses on the communication between the mentors and mentees, and explains that mentors should limit communication with the mentees outside of the program to monitored means (such as company email or the public e-mentoring platform). The final section of the safeguarding section details the confidentiality between the mentor and mentee. The two exceptions under which mentors should break confidentiality – if a mentee is in danger or if

there are problems with the mentoring relationship – are outlined and the mentors are given instructions on what to do in these situations.

The next section of the handbook addresses How to Handle a Variety of Situations, which has been adapted from the National Mentoring Partnership. Every situation the mentors could experience throughout the program cannot be addressed in this handbook; however there are certain situations the team felt were appropriate to address. Those two topics were difficult questions and behavior management. There will be many questions from the mentees over the course of the program, and in order to get the most out of the program these questions should be kept on-topic and appropriate. This section explains to the mentor that they should only answer questions that are appropriate and how to go about addressing any inappropriate questions. It also addresses how mentors should handle questions to which they do not know the answer. This section is completed with a small discussion of behavior management. Unlike some mentoring programs, these mentees are not in the program due to past behavioral issues; however, they are still teenagers who may occasionally act in a less-than-appropriate manner. This section explains to the mentors how they should act and respond if their mentees act in this way.

Training

The training day that the mentors attend before the program will be a very important aspect of the program, and it is expected that this will be an experience they can rely on throughout the program. The mentors are given a "takeaway" section for each of the activities they will do during their training. This section will allow them to quickly refer back to the activity, review what they learned, and apply this to improving their mentoring.

Evaluations

The final section of the Mentor Resource Handbook details what evaluations will be necessary for the mentors to complete throughout the program, which are described in section 5.3.1. This section concludes the Mentor Resource Handbook, which will serve as a valuable resource for the mentors. This handbook will help the individuals prepare to be a mentor, serve as a reference throughout the program, and allow the mentors to have a complete overview of the program.

5.5.3 Student Handbook

1. Program Overview and Structure
2. Parent Guidelines
3. Parent/Guardian Permission Form
4. Mentee Roles and Responsibilities
5. Lesson Plan Worksheets and Information
6. Evaluation Forms

The first section of the student handbook consists of a program overview and four documents that have been adapted from the National Mentoring Partnership (The National Mentoring Partnership, 2005). The documents are as follows:

Orientation Agenda and Program Overview for Mentees and Parents/Guardians

This document is an agenda for the orientation session that the students will attend with their parents/guardians at the beginning of the program. It gives students and their parents and idea of what will be covered during the orientation. The program overview will be the same as that in the LTM Guidance Document and Mentor Resource Handbook.

Guidelines and Ground Rules

The second document in this handbook is a "guidelines and ground rules" document for the parents. It outlines the program's structure so that parents are aware of what their child's mentoring sessions will entail. It also outlines some rules and guidelines for the parents and tells them who to contact if they have any questions or concerns about the program. These rules state that parents should not contact their child's mentor privately (for safeguarding reasons), that they should be respectful of any advice the mentor may give their child, and that they should make every effort to ensure that their child doesn't miss any mentoring sessions.

Parent/Guardian Permission Letter

This document is a permission letter that the parents would sign to give consent to their child participating in the Inspire Engineering Mentoring Program. It is possible that the school already has its own permission form and would not need to use this one, or that a permission form would not be necessary as mentoring is a mandatory part of the child's curriculum. Therefore the school will have to decide what kind of permission letter – if any – would be appropriate for parents to sign.

Mentee Roles and Responsibilities

This final document outlines what will be expected of the students participating in the mentoring program. It explains the purpose of the program, its basic structure, and the time commitment required of the students. It also explains the benefits of mentoring and tells the students who to contact if they have any problems or questions.

Lesson Plan Worksheet and Relevant Information

Lesson plan worksheets have been developed for mentees as complimentary materials to the lesson plans provided in the Lesson Plan Handbook, which have been described in section 5.4. These worksheets will be used for effective communication of lesson plan objectives throughout the program.

Evaluations

Evaluation worksheets have been included at the end of the mentee handbook. Refer to section 5.3.2 for detailed information about these evaluations.

CHAPTER 6: RECOMMENDATIONS

Although this program has been planned out as thoroughly as possible, there are certain aspects of the program that the team cannot plan ahead of time. Consequently, the team has some recommendations these aspects, which are not outlined in the program handbooks but would be quite beneficial if implemented. These mainly include implementing e-mentoring and expanding the program after its first year, but also include some additional logistical recommendations that the program coordinator may want to consider.

6.1 E-mentoring

Frequent meetings are necessary for mentors and mentees to build a good relationship. However, interviews with TfL Engineering Ambassadors revealed that TfL engineers would likely not be able to attend mentoring meetings more than once a month. However, many ambassadors expressed interest in being able to communicate with their mentees through means other than face-to-face meetings, so that they could maintain more frequent contact. Mike Sharp, the principal of Greenwich UTC, was also keen to employ communication of this form. Because of this, the team highly recommends that the program utilizes some form of e-mentoring. For safeguarding purposes, private unmonitored communication should be avoided. Therefore it is recommended that a public message board be set up for the mentors and mentees to use between meetings. By keeping the message board public, a much safer environment is maintained for both the mentors and mentees. This forum would also allow mentors to support one another, because all mentors would be able to see the mentees' questions. If a student asked a question that their mentor did not know the answer to, other mentors could easily contribute an answer.

Discussions with Mr. Sharp revealed that Greenwich UTC already uses a virtual learning environment for academic purposes. This shared environment would not allow private interactions between mentors and mentees, and would therefore be suitable for the needs of this program. Thus, the team recommends that this learning environment be adapted for the program's use. A public message board should be set up that both mentors and mentees will have access to throughout the course of the program. Students should be encouraged to post any relevant questions that they think of, and mentors should be encouraged to check the message board and respond to these posts frequently.

6.2 Program Expansion

The team recommends that this program first be implemented with a small group of students. Greenwich UTC principal Mike Sharp suggested starting with the school's Year 12 A-level engineering students, as their academic requirements mandate that they have a mentor. The school expects to have approximately 100 engineering A-level students during the 2014-2015 school year: 50 in Year 12 and 50 in Year 13. Therefore the team recommends that this program be first implemented for the 50 or so Year 12 A-level engineering students. This would require approximately 16-17 mentors, which will hopefully be an achievable number to recruit. After this trial run, the program would be adapted as necessary and then could be expanded to all 100 students in the following year. If successful enough, the program could be expanded in future years so that all interested students at Greenwich UTC may participate.

To expand the program, several things would gradually need to change. First and foremost, a program coordinator would have to be appointed who has sufficient time to dedicate to the program. As the program gets larger, this time commitment would increase. This coordinator should be a staff member from LTM, TfL, or Greenwich UTC who is enthusiastic about the program and has a personal interest in its success. Secondly, mentor recruitment would have to increase significantly. To achieve this goal, mentor feedback would have to be faithfully collected and analyzed to make the program more appealing to potential mentors in the future. Transport for London would also have to accommodate their employees so that the mentors could attend their mentee meetings during school hours without much hassle.

As the program expands, accommodations would also have to be made to handle the larger volume of people involved. Facilities would have to be considered, and Greenwich UTC would need to ensure that all groups have enough space to work during their meeting times. Mentor orientations and check-in meetings would also become more difficult, and the program coordinator would want to consider splitting these up into smaller groups instead of meeting with all the mentors at once. The coordinator may also want to consider decreasing the number of evaluation forms that are completed throughout the program. Although these forms are vital for the success of the program in its beginning years, these forms will become less necessary as the program becomes established and more students and mentors get involved. To avoid being overwhelmed with evaluation forms, the coordinator would want to collect feedback less often (e.g., not collect reflection forms from every mentor after every lesson) or consider transitioning to more quantitative forms and possibly

also digitizing the forms for easier collection and analysis. Although quantitative forms (e.g., ranking statements on a scale of 1-5) are not as beneficial for gaining thoughtful feedback in the program's beginning years, they may become necessary if the number of program participants increases significantly.

6.3 Additional Logistical Considerations

Number of Meetings

Originally this program had been designed to last an entire school year, which for Greenwich UTC is 11 months from September to July. However, TfL graduates – the primary people who will be targeted for mentor recruitment – will be unavailable during the last two weeks of September 2014 due to commitments with TfL. Since their orientation and training will need to take place during the first two weeks of September, mentoring sessions would then not be able to begin until October. Therefore the trial program will last 10 months, from October to July. It would be ideal, however, if the program could be lengthened in future years to run for the full 11-month school year. This would provide the mentors with another open-ended meeting to focus on whatever subjects their mentees would benefit from most.

Large Group Meetings

For the first and final meetings of the program (lessons 1 and 10 in the lesson plan handbook), it is recommended that multiple mentoring groups try to meet together. For the first meeting this would be beneficial as new mentors may feel less intimidated if they are able to work with another mentor for the first half of the meeting. It would also allow the students to hear the perspective of multiple mentors during their "day in the life of an engineer" activity. During the second half of the meeting, the students would split off to meet with their assigned mentors to complete the rest of the day's activities. During the program's final meeting, a large group would again be beneficial because the students will be giving presentations about what they have gained from the program. Although students could still present to the other mentees in their group, allowing different groups to present to one another would allow the students to see a broader mix of perspectives and they could learn more about what other groups focused on during their open-ended meetings. However, this depends on when each group's mentoring sessions take place. Each group will schedule their meeting day and time based on what the mentor's availability is and when

works best for the student's school schedule. Therefore groups may all be meeting on different days and times, and it may not be possible to have multiple groups meet together at once. However, these group meetings should be arranged if at all possible.

Women in Engineering

When talking to students from Greenwich UTC, the team discovered that female students had little exposure to women working in STEM fields. Although female engineers are rare in the UK, the mentors should attempt to encourage their female mentees that women can in fact be engineers. When possible, the program coordinator may want to consider matching female students with female mentors; however, this should never take priority over matching mentors to students based on common interests. One student expressed a desire to have a female guest speaker talk to the students if having female mentors would not be possible. Therefore mentors will want to be mindful of this, and male mentors in particular may want to consider arranging a visit from a female engineer – especially if their female mentees seem discouraged by the lack of women in the engineering industry. This will provide the mentees with another perspective and may further encourage female students to continue pursuing engineering.

APPENDIX A: PROGRAM HANDBOOK AND RESOURCE GUIDE

Program Handbook and Resource Guide (possible items to include)	
Mentors	
1. **Detailed Agenda**	Detailed Agenda for day/s of training program.
2. **Guidelines for Mentors**	Do and don't list for training a mentor.
3. **Mentors Roles and Tasks**	What a mentor is and is not. The four primary tasks of a mentor courtesy of the Mass Mentoring Partnership.
4. **Mentors Want to Know**	Common questions that should be addressed during a training session.
5. **Mentor-Volunteer Procedure**	Confidentiality rules and regulations as well as program director contacts for issues.
6. **Qualities of a Successful Mentor**	-
7. **Tips for Building a Mentoring Relationship**	Be there, be a friend, be a role model, help your mentee have a say in your activities, be ready to help out.
8. **Building Relationships**	Getting started things to know about building a relationship.
9. **Pair Interview**	Exercise to be used during a training session.
10. **Effective Communication**	Roadblocks in communication, what to avoid.
11. **Getting to Know You**	Worksheet inexperienced mentors can follow to get to know mentees.
12. **Communication Skills**	Helpful skills to open up communication.
13. **Ice Breakers**	Easy ice-breaker examples for mentors to use.
14. **Mentor Agreement**	Signed form for all things expected of mentor.
15. **Mentor Position Description**	Qualifications, responsibilities, and time commitment description.
16. **Mentoring Program Outline**	A condensed outline of mission, philosophy, objectives, and possible contacts.
17. **Stages of a Mentoring Relationship**	Breakdown of three stages of a mentoring relationship.
18. **Standard of Conduct for Volunteers**	Characteristics, responsibilities, and guidelines for conduct.
19. **What Makes a Good Mentor**	Specific skills that make a good mentor.
20. **Mentor Release Statement**	-
21. **Mentor Training Evaluation**	Evaluation to be completed by mentors after the training session to evaluate what can be improved upon in future sessions.
22. **Terminating Relationships**	An outline of why a termination is made and how to approach it.
23. **Program Liability and Risk Management**	Guidelines to designing liability and risk management for a mentoring program.
24. **Photo Release Form**	Form for both mentors and mentees/parents for photo consent.
25. **Contact Info**	Contact for program directors.
Mentees/Parents	
26. **Agenda**	Detailed agenda for day of program training/information session.
27. **For Parents Guidelines and Ground Rules**	Guidelines and FAQs with answers.
28. **Program Overview**	General program info and detailed timeline
29. **Mentee-Parent Contract**	Agreement to attend and participate in the program.
30. **Parent Guardian Permission Form**	Permission form for parents/guardians to sign for students under 18.
31. **Photo Release**	Form for both mentors and mentees/parents for photo consent.
32. **Mentee Roles and Responsibilities**	Purpose, responsibilities, requirements, time commitment, placement, and benefits.
33. **Contact Info**	Contact for program directors.
Other Helpful Documents	
34. **Developing an Orientation Plan**	List of things that should be included in a mentor and/or mentee-parent training session.
35. **Goals for Successful Mentor Recruitment**	Goals and recommendations for a successful recruitment event to keep in mind.
36. **Establishing Goals and Objectives**	How to describe goals and objectives worksheet.

Other Helpful Documents

37.	**Mentor Screening Process**	Detailed list of necessary step for the process of evaluating and accepting mentors.
38.	**Mentor Screening Standards**	A guide of what is needed to process and screen a mentor, application, criminal history, reference check, interview, training, etc.
39.	**Mentor Release Statement**	Release form and possible background check release.
40.	**Mentor Application**	Application form to be tailored to program.
41.	**Mentor Interview Form**	Proposed general interview questions for mentors.
42.	**Mentor Requirements Checklist**	-
43.	**Tips for Recruiting and Maintaining Mentors**	Tips for recruiting and retaining using the CARE communication, appreciation, respect, and enjoyment model from the Texas Governors Mentor Initiative
44.	**Tips for Mentor-Mentee Recruiting**	Simple list of documents to be included (most of which are contained in this table)
45.	**Mentee Application**	
46.	**Tips and Considerations for Matching**	Major themes to take into consideration when matching.
47.	**Mentor Matching Form**	Form to match mentor tailored to program.
48.	**Mentee Matching Form**	Form to match mentee tailored to program.
49.	**Matching Recommendations**	Major themes to take into consideration when matching.
50.	**Matching Worksheet**	Worksheet to help administration match mentor/mentees.
51.	**Mentor Match Agreement**	Agreement after matches are made.
52.	**Mentor Evaluation Form**	-
53.	**Relationship Development Checklist Check-in**	Questions to ask mentor, mentee, and parent to assess how a match is going and whether anything needs to be discussed or changed
54.	**Mentor Feedback**	Feedback form for on-going evaluation of the program.
55.	**Mentee Feedback**	Feedback form for on-going evaluation of the program.
56.	**Termination Ritual**	Termination rules and regulations as well as suggestions for handling the process.

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