Spring 2020

Apprenticeship Participation at GE Appliances: An Insider's Ethnographic Study of Apprentice Participation and Factors Contributing to Student Success

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APPRENTICESHIP PARTICIPATION AT GE APPLIANCES: AN INSIDER'S ETHNOGRAPHIC STUDY OF APPRENTICE PARTICIPATION AND FACTORS CONTRIBUTING TO STUDENT SUCCESS

A Dissertation
Presented to
The Faculty of the Department of Educational Administration, Leadership, and Research
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Doctor of Education

By
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May 2020

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This paper is dedicated to my family and everyone in my life who has ever encouraged me to follow my dreams. I hope to inspire my children and others to know it is never too late to realize life goals. This work is also dedicated to every first-generation high school or college student who has broken the cycle to finish something that no one else in their family had done before. This paper is for those students in high school who want all of their options explained without bias, and for those brave high school counselors who are willing to present those options.

ACKNOWLEDGMENTS

I would like to thank my dissertation committee chair, Dr. Randy Capps, for your guidance on this project and for the wisdom you freely shared with me and my colleagues during this endeavor. Thank you to my dissertation committee, Dr. Lester Archer and Dr. Robert Boone, for your time and availability to me during this process.

I am grateful to Mr. James Zhan and Dr. Nicole Cobb for guiding my internships during this program. Thank you to Mr. James Atkinson and the entire GE Appliances leadership team for allowing me to conduct research within such a vital part of the GEA business. I offer appreciation to the MAP and FAME apprentice participants, for your time and honesty, during observations and interviews. I am truly thankful for your participation. Thank you to Ms. Brenda Demic of the U.S. Department of Labor, Kentucky Apprenticeship Division, for research information, and to Mr. Michael Hazzard, Dean of Technical Education at Elizabethtown Community and Technical College, for your contributions to this research.

I could not have completed this degree without the instruction and wisdom of my Educational Leadership Doctoral Program professors, my friends, and my colleagues of the infamous ELDP Cohort 19. Thank you for sharing of your life with me. Special thanks to Dr. Mark Martin for your friendship and leadership during this entire endeavor; I owe you, big brother.

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Berschel Robert Hunt May 2020 137 Pages

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The United States Department of Labor (DOL) has defined an apprenticeship as a combination of on-the-job training and related classroom instruction in which workers learn the practical and theoretical aspects of a highly skilled occupation (Smith, 1996, p. 5). General Electric Appliances (GEA) has viewed the DOL model as a viable solution to the decreasing numbers of skilled workers available to employers. Leaders at GEA determined a void existed between the number of skilled workers needed for GEA operations compared to the number of skilled workers available. GEA apprentice programs were suspended in 1995 but reinstated in 2015 to address the skilled labor shortage. This study assessed the Federation of Advanced Manufacturing Education (FAME) apprentice program offered at GEA for entry-level employees and the more traditional Maintenance Apprentice Program (MAP) for incumbent GEA workers. The purpose of the study was to better understand the programs' impact on employees compared to their perceptions of their career prior to entering the program. The primary research question was: What is the program impact on students who complete an apprenticeship through GEA? The secondary questions asked how mentorship, related technical instruction, and company-provided skills training contributed to the success of the student and the barriers that hindered student success.

The study involved 24 maintenance apprentices from both the FAME and MAP programs, as well as MAP and FAME graduates. All 58 current or former apprentices were asked to participate in personal interviews for the study, with 24 accepting. Interviews were conducted with participating apprentices, and observations were made of those apprentices on the job floor and at school. Feedback from mentors and GEA leaders was given to the researcher regarding the progress of apprentices participating in the program. In a structured interview, subjects were asked 10 questions relating to their overall experience in their respective program. Interviews were synthesized and analyzed for common patterns and themes. Results were organized by the research questions and summarized in outline form. The common themes that emerged were the following: (a) related technical instruction did not always align with in-plant instruction; (b) mentor engagement issues were present; (c) apprentices desired access to more technical training; and (d) some apprentices did not feel prepared to be journeypersons. MAP apprentices shared more challenges with work-life balance, related theoretical instruction (RTI) (Appendix D), and company seniority than the FAME participants. FAME apprentices struggled more with daily mentor placement in the early stages of their program than their MAP counterparts. Both MAP and FAME apprentices gave suggestions on that which they perceived as viable ways to improve the GEA program for current and future GEA apprentices.

CHAPTER I: INTRODUCTION

Apprenticeship training has been delivered to those seeking to learn a craft longer than the United States has been a country. Famous Americans Benjamin Franklin, Paul Revere, and Mark Twain all served apprenticeships within their respective trades before moving on to become leaders in government and literature (Smith, 1996). Apprenticeship programs provide skilled workers to organizations that cannot find crafts persons available for hire. The term *apprenticeship* has been defined by many people throughout multiple generations, and it is rare if any two definitions are the same. The U.S. Department of Labor (DOL) has called a registered apprenticeship a combination of on-the-job training and related classroom instruction in which workers learn the practical and theoretical aspects of a highly skilled occupation (Smith, 1996). Kentucky's government information website indicates that a modern apprenticeship is an employee training program that combines on-the-job training with classroom instruction under the supervision of an experienced industry professional.

General Electric Appliances (GEA) has viewed the Kentucky government model as a viable solution to the decreasing number of skilled workers available to employers. GEA has not always agreed that credentials are necessary. Some GEA leaders worried that if the employee received the credential, he or she would leave the company for better opportunities elsewhere. That way of thinking changed in January of 2018 when GEA registered its two apprentice programs with the DOL. According to the GEA apprenticeship requirement schedule, graduating apprentices who meet all necessary requirements receive a journeyman card credential as a skilled tradesperson, along with several earned certifications throughout the course of the apprenticeship program.

Apprenticeship requires student participation by a person learning a craft both practically and theoretically through on-the-job training and related theoretical instruction. Apprentices have an expectation of being rewarded and recognized with viable credentials once successful program completion is achieved.

Leaders at GEA have determined a void exists between the number of skilled workers needed to maintain each of its production lines and facilities maintenance operations compared to the number of available workers who possess maintenance skills. The company needs assessment revealed that 60% of the current maintenance workforce would be at retirement age within a seven-year period. The assessment determined GEA would need a comprehensive approach to bridge the skilled labor gap. GEA decided to implement a dual-strategy apprentice approach to meet those needs.

One part of the strategy offers incumbent workers the opportunity to up-skill into a more lucrative career with the company. This program is simply called the Maintenance Apprentice Program or MAP. Candidates for the MAP program are required to apply to the program and attend an informational meeting that presents program expectations. Candidates are then given a Basic Mechanical Aptitude and Reasoning (BMAR) exam to test their ability to reason mechanically. All who pass the exam are interviewed by a cross-functional panel of both union and non-union GEA leaders, and the top scoring candidates are admitted into the program. The MAP program is highly competitive with 75 to 100 applications every year, and only four to eight individuals are admitted into the program annually. Historically, the top 10 to 15 candidates have been separated only by fractions of points in the scoring system.

The other part of the GEA apprentice strategy partners the company with the Kentucky Federation of Advanced Manufacturing Education (KYFAME). KYFAME serves as a hiring pool of new apprentice maintenance workers for GEA and other businesses needing maintenance help. KYFAME originated in Georgetown, Kentucky, as part of Toyota Motor Company's apprenticeship strategy. KYFAME was then expanded in the Louisville, Kentucky, area with GEA as the first and primary sponsor of Greater Louisville FAME (GLFAME). GEA FAME candidates must apply to the GLFAME website, have an ACT score of 19 in math, and an ACT score of 20 in reading. Candidates are interviewed by KYFAME business partners. Business partners consist of representatives from participating companies in the GLFAME area. Candidates are ranked by interview scores and selected through a draft process by the sponsoring companies. This process contributes to the definition of an apprenticeship program, in that many companies identify and select apprentice candidates based on the individual needs of the company. Other organizations, like the United Aerospace, Automotive and Agricultural Workers (the UAW), select apprentices solely from the incumbent worker pool and follow skilled trades lines of demarcation to assign apprentices to individual trades such as electricity or pipefitting. The UAW selection process is in contrast to the GEA and FAME models of multi-trade maintenance technicians.

The rigorous selection process used in the GEA strategy highlights a distinct change in the structure of similar programs from the past. Apprenticeship programs in the past were primarily designed for at-risk students. Today's programs are designed to reach a more comprehensive group of students (Bailey & Merritt, 1993). In the 1980s, the students who were deemed not “college material” were encouraged to go to vocational school (Bailey & Merritt, 1993). Of course, the process of identifying at risk students was informal and relied upon the subjective eye of the high school counselor. Today, learning a trade is viewed as a viable option for every student, including higher achieving students who traditionally would be considered college bound. Career and technical education classes (CTE) and college and career readiness (CCR) offer alternative routes for students to pursue a career (Stone, 2014). Students are targeted for enrollment in these programs based on a holistic view of their interests, skills, and aptitudes. As an example, students may participate in a pre-apprentice type program to be work ready and prepared for apprentice program instruction.

In addition, benefits exist that make apprenticeship programs an attractive option for many students. One of the major attractions toward a FAME type program is the idea that a student can work three days a week and go to school for two days, while receiving 40 hours pay from their sponsoring company. The MAP idea is equally attractive to individuals working at GEA. The MAP program requires the working student to put in their regular hours for the company and then go to school at night or on the weekend. The company pays the tuition for the student, instead of wages for hours at school. Either way, the student is afforded an opportunity to get a two-year degree, learn a trade, receive a journeyman card, and earn trade certifications, with no debt at graduation. The program is an excellent return on investment for the student (or parent).

Both the GEA MAP and GEA FAME programs are registered with the DOL’s Kentucky Apprenticeship Division. The student gains “journeyman” status upon completion of the program. Both GEA tracks offer the employee on-the-job training by allowing the student to work with a skilled mentor to learn their respective craft. The mentor designs projects and works with the apprentice to achieve successful project completion. Throughout this process mentors also teach the apprentice to apply concepts they learned from their technical classes. Each apprentice receives related classroom instruction from the Kentucky Community and Technical College System (KCTCS). Many of the KCTCS instructors have extensive industry experience in the skilled trades culture. The programs are designed to expose each maintenance candidate to 10 categories or buckets of maintenance activities ranging from basic mechanical and electrical applications to the more advanced programming of robot controllers.

Maintenance apprentice skills categories were determined in discussions that included the GEA apprentice manager, GEA human resources representatives, and the DOL Kentucky Apprenticeship team. In terms of historical context and program goals, this group determined the apprenticeship program at GEA should directly reflect work being completed at GEA facilities rather than generic maintenance tasks for the sake of doing maintenance tasks. The requirement strategy of real-world applications has proven to be quite valuable to GEA.

Upon successfully completing the program, the graduating apprentice is able to confidently move into a skilled tradesperson role within the GEA system, thus helping to fulfill the organizational need. The GEA apprenticeship initiatives offer value to both the company and the individual in ways that are immeasurable. Each program has an element of “soft skill” development in addition to the trades-related education. KCTCS incorporates public speaking and leadership courses into the program curriculum to promote holistic development of the apprentice. Mentors or journeymen convey information to the apprentice regarding personal behavior in public and private situations (Christman, 2012; Miller, 1993). Guile and Young (1998) argued that apprenticeships can promote an opportunity for lifelong learning as an employee recognizes the investment a company is making in them as an individual. Four of the earlier apprentices in the GEA apprentice program proceeded to obtain degrees in business or technology, and two followed engineering tracks after graduating from the program.

The learning process does not end for the apprentice at program completion. As graduates begin their new role as a journeyperson, they continue to work with subject matter experts (SMEs). The SME serves as a process coach to help the new tradesperson hone individual skills related to tasks expected by journeymen. When the mentor teaches the overall aspects of trades-related work to apprentices, the students become better equipped to respond to maintenance issues within the organization. The apprentices learn to troubleshoot, and problem solve a vast array of issues as they arise in the factory. These actions help to reduce or eliminate production downtime.

Statement of the Problem

Due to a shortage of available, qualified, skilled tradespersons, GEA relies on apprentice programs to help offset or eliminate the impact of the shortage. The problem involves the perception that some of the graduating apprentices are not prepared to move immediately into journeyperson roles. Some GEA mentors and leaders have expressed concerns that a multi-trade apprenticeship such as GEA model may not prepare the student as holistically as a traditional apprenticeship program that focuses on a single craft. The multi-craft apprenticeship requires between 8,000 and 10,000 on-the-job completion hours (Appendix C) and 71 college credit hours of related theoretical instruction (RTI; Appendix D). Traditional apprenticeships require similar hours as GEA's multi-craft model, but the traditionalists focus on a single specific trade. Some leaders have questioned how an apprentice can be proficient at all necessary trade-related skills required by a multi-craft maintenance program. One leader expressed that electricians, pipefitters, and other tradespersons complete 8,000 to 10,000 hours yet continue to be considered beginners on their first journeyman day.

GEA is headquartered at Appliance Park in Louisville, Kentucky, where this study was conducted. Satellite facilities of GEA can use the findings to conduct similar studies at their facilities. In summary, the GEA apprentice program could be improved. This study considers student perspectives as to where those improvements might be made and how the program impacts the individual student.

Purpose of the Study

The purpose of this study is to gain better understanding the culture of the GEA apprentice program and to identify opportunities to improve student success on the job once they have finished their respective program. The research focuses on the student's perception of the program and gives each apprentice the opportunity to express their opinions on the way in which the programs have prepared them for success.

The study investigates how completing an apprentice program impacts the life of the individual student. Interview questions are focused on student perceptions of mentorship throughout the four-year apprentice period, how related theoretical and soft skill training aids in student success, and finally, apprentice evaluation of company provided skills in relation to the student's needs.

Programs such as GEA's MAP and FAME are necessary to help offset the shortage of skilled workers available in the job market. Christman (2012) noted that without apprentice programs available, employees are forced to outsource jobs that require advanced skills. Henderson (2012) said the Bureau of Labor Statistics (BLS) projected 20.5 million new jobs between 2010 and 2020 and noted that many would be skilled labor. Both construction contracting companies and industry maintenance departments will access the same pool of skilled candidates. Many of the Louisville, Kentucky, area businesses have posted maintenance job openings for skilled workers. Competition has been fierce to attract qualified maintenance personnel. Apprentice programs can be a viable solution to this deficit. The paramount challenge is to ensure apprentices are prepared for those opportunities once complete apprenticeship studies and related training are complete.

Research Questions

GEA has experienced some success since the 2015 reinstatement of apprentice program initiatives, but GEA programs have not achieved 100% student graduation success. One student left the company prior to program completion. Two struggled with maintenance tasks required of them as they proceeded through the program intervals and were disqualified. The goal of this research is to uncover barriers that persist in hindering student success and to assist with improvement of the areas that are detected as unacceptable to the success goals of the student.

The central research question is: What is the program impact on students who complete an apprenticeship through GEA?"

This research question could be further investigated by including the following questions:

1. What role does mentorship play in the success of the student and how do mentors impact the program culture?
2. How does related theoretical instruction received by the apprentice contribute to student success?
3. Are company provided skills training courses available to students during and after the program is completed?
4. What barriers exist that could deter student success in the GEA apprentice program?

General Methodology

The purpose of this research is to better understand factors that contribute to or hinder student success in GEA's apprentice programs. Specifically, the research task of this study is to gather subjective information from three different groups of participants in the GEA FAME and MAP programs.

In order to obtain perceptions of participants in these apprentice programs, an ethnographic study was conducted at GEA. Although there were minor narratives throughout the study, the research generally focused on the collective impact of the program on the participant. As in any ethnographic approach, subjects were interviewed, and observations of students were conducted in classrooms and on the shop floor.

Interviews were conducted with students in year one and year four of the program and with recent graduates from one of the two apprentice programs. The results gave insight to apprentice success at different stages of the two GEA programs.

Significance of the Study

Only a few published studies review the impact of apprenticeship programs on the actual student participants. No ethnographic studies were found that viewed the subjects from the perspective of someone who has inside knowledge of the culture and protocols of the students involved in apprenticeship activities. The information gained from the interviews and observations can help to develop best practice opportunities for the GEA MAP and FAME programs. Feedback from the research also can identify and acknowledge existing best practices. The participant sample of this research was 24 current or former apprentices across five of GEA's plants in Louisville, Kentucky's, Appliance Park. Stakeholders who supported the study were maintenance managers in each of the plants and the apprenticeship program manager. Due to the shortage of available skilled tradespersons from the general public, GEA has made a sizeable investment in each of the apprentice programs and is committed to MAP and FAME program success.

Delimitations

The population sample did not represent apprenticeships in other companies in the Kentucky area because of the GEA multi-trade approach. The research sample provided information resulting in an in-depth look into concerns with the GEA programs. Interview responses provided clear descriptions of opportunities for improvement in mentoring and company provided skills training.

Limitations

The largest limitation to the study involves the unique variance in skillsets of the subjects prior to entering their apprentice program. FAME students typically were recent high school graduates with little to no real-world work experience and with limited exposure to mechanical and electrical elements of the apprentice program. MAP apprentices were incumbent employees who were usually older and had at least seven years of manufacturing experience. Employee length of service seniority was a considering factor in a MAP apprentice candidate's entry into the program. Manufacturing experience and skillset differences affected candidates' perceptions of the program, and the range of experience was evident in the research interviews.

Billett (2002) wrote that learning is associated with honing, refining, or making links and associations to that which a person already knows, can do, or values, which is essential in occupational capacities. Two individuals may encounter the same training with the same mentor, and it may be unique to one and routine for the other. The instruction may be received differently because of personal intentions, interests, or values that have arisen through personal historical experiences (Tishman, Jay, & Perkins, 1993). Learning is affected by how these many complex factors are construed by the individual as they synthesize the information presented to them (Billett, 2016).

Definitions

Apprentice: A person participating in a program that has the necessary components that allows the training to be constituted as apprenticeship programs. The four agreed upon components are:

- Student participation,
- Educational content known as related theoretical instruction,
- Location of instruction-on the job training, and
- Credentialing. (Bailey & Merritt 1993)

Bucket: Categories used for apprentice training in the Registered Apprentice Worksheet

MAP: GEA's Maintenance Apprentice Program for incumbent workers

FAME: Federation of Advanced Manufacturing Education. An organization of industry partners and education providers that offers qualified students the opportunity to earn an associate's degree, learn a trade, and graduate debt free

Journeyman/Journeyperson: A maintenance employee at GEA who has successfully completed a recognized apprenticeship program

Mentor: The individual who trains the apprentice in any component in the required hands-on training

Registered Apprenticeship Program: A combination of on-the-job training and related classroom instruction in which workers learn the practical and theoretical aspects of a highly skilled occupation. (DOL, 2018)

Related Theoretical Instruction (RTI): DOL term for classroom apprentice instruction from a company's partnering educational provider

Turn out: The period when GEA apprentices complete all required RTI and 8000 hours of on-the-job training

Industrial Manufacturing Apprentice (IMT): A student who learns the aspects of the manufacturing environment in an approved program that helps the student gain employment in the manufacturing sector where higher-skilled, entry-level jobs are lacking qualified candidates

Summary

GEA is striving to have a world-class apprenticeship program to prepare students to fill the growing gap between the need for a competent skilled labor force and the pool of qualified candidates available to work. In order to understand the modern apprenticeship initiatives driving programs today, the origins of apprenticeship training and expectations for future skilled labor shortages should be considered. Chapter II provides both a historical review of apprenticeship training and insight into how modern programs provide solutions to labor shortages.

The findings of this program study will allow GEA leaders to view the program from the perspective of the student apprentice. Student-perceived obstacles and limitations of the program will be reported, as well as best practices within both the MAP and FAME programs, respectively. The focus of the study is how program culture impacts overall student success.

CHAPTER II: REVIEW OF THE LITERATURE

The GEA apprentice program was initiated to fulfill the growing need for skilled maintenance technicians in an economy in which it was difficult to hire those who are already trained. Christman (2012) noted the shortage of technically trained and skilled workers in America's workforce has led to many companies outsourcing maintenance jobs and contracts for manufactured products. Companies, high schools, colleges, and universities have worked to train and develop the skilled workforce of the future by supporting technical education and apprenticeship program initiatives.

This study examines many of those efforts, but primarily focuses on the push to create, improve, and promote apprenticeship learning. The design of the study is to understand apprenticeship program value to the participating students. The literature review examines the many definitions of apprenticeships, the reasons skilled training programs are needed, and how apprenticeships have evolved throughout history. The literature review explores technological advances in apprentice training and how programs have become more innovative in preparing qualified journeypersons. Finally, the literature review looks at empirical research studies focused on the early theoretical framework of apprenticeship programs of the past compared to today's models.

Definitions of Apprentice Programs

O'Connor and Harvey (2001) defined apprenticeship as the gaining of knowledge and skill over a specified period of time in order to practice a specialized profession or trade. Bailey and Merritt (1993) contested that no true definition of apprenticeship exists because of the varying needs of businesses regarding the apprentices they hire and train. The consensual aspect regarding apprenticeships involves the necessary components that allow them to be constituted as apprenticeship programs. The four agreed upon components are:

- Student participation
- Educational content known as related technical instruction
- Location of instruction, on-the-job training
- Credentialing

The DOL refers to an apprenticeship as "a combination of on-the-job training and related classroom instruction in which workers learn the practical and theoretical aspects of a highly skilled occupation" (Smith, 1996, p. 1). Goldstein & Dundon (1986) argued that apprenticeship training provides beginning workers with comprehensive training both on and off the job in the practical and theoretical aspects of the work required in a highly skilled occupation. The DOL website further states that apprenticeship is a proven approach for preparing workers for jobs while meeting the needs of business for a highly skilled workforce. An apprenticeship program is an employer-driven, "learn-while-you-earn" model. The training model combines on-the-job training, provided by the employer who hires the apprentice, with job-related instruction in curricula tied to the attainment of national skills standards. The model also involves progressive increases in an apprentice's skills and wages.

The DOL model consists of the following five key components of apprenticeship programs:

- Business Involvement

  Employers are the foundation of every apprenticeship program. They play an active role in building the program and remain involved every step of the way.

Employers frequently work together through apprenticeship councils, industry associations, or other partnerships to share the administrative tasks involved in maintaining apprenticeship programs.

- Structured On-the-Job Training

  Apprenticeships always include an on-the-job training component. Apprentices receive hands-on training from an experienced mentor at the job site. On-the-job training focuses on the skills and knowledge an apprentice must learn during the program to be fully proficient on the job. This training is based on national industry standards, customized to the needs of the particular employer.

- Related Instruction

  One of the unique aspects of apprenticeships is that they combine on-the-job learning with related instruction on the technical and academic competencies that apply to the job. Education partners collaborate with business to develop the curriculum, which often incorporates established national-level skill standards. The related instruction may be provided by community colleges, technical schools, or apprenticeship training schools—or by the business itself. It can be delivered at a school, online, or at the job site.

- Rewards for Skill Gains

  Apprentices receive wages when they begin work and receive pay increases as they meet benchmarks for skill attainment. Earned rewards help motivate apprentices as they advance through their training.

- Nationally-Recognized Credential

  Every graduate of an apprenticeship program receives a nationally-recognized credential. This is a portable credential that signifies to employers that an apprentice is fully qualified for the job (DOL, 2018).

Edjah (2011) defined apprenticeships as a full-time, on-the-job experience in which the apprentices learn how to do the job in the real world. Edjah further stated that apprenticeship learning may last from three to five years, depending on the learning capabilities of the student, and occurs in the actual job setting under the watchful eye of the master. Cantor (1997) defined an apprentice as someone who is learning to be industrious, reliable, and proud of good work.

The best definition of the GEA apprenticeship, and the focus of this study, varies slightly from all the aforementioned versions but borrows from many. The GEA apprenticeship committee seeks to find candidates who are motivated to become a better version of themselves by acquiring skills and knowledge from academic instructors and mentors from the GEA skilled trades community. The apprenticeship not only focuses on students learning a trade, but also on the holistic development of the individual apprentice by providing developmental courses for the participating students. Apprentices learn leadership skills and both written and oral communication techniques. Participants develop problem-solving skills and are required to communicate solutions to groups of colleagues and to the company leadership.

The Need for Apprenticeships

Fierce competition exists in the Louisville, Kentucky, area for competent skilled trades workers. Ford Motor Company, United Parcel Service, GEA and many not so famous companies such as Kentucky Trailer and Faurecia, currently have local advertisements seeking skilled tradespersons. Bevins, Carter, Jones, Moye, and Ritz

(2012) wrote that even though innovation remains one of America's great strengths, China threatens to overtake the US as the world's leading innovator because of skilled labor shortages, shortsighted business, government policies, and the deterioration of public education in the US.

In personal conversations from January 2020 with Brenda Demic of KY Apprenticeship, a division of the DOL, the following current data were shared for this study:

- Unfilled jobs in the Greater Louisville, Kentucky, area totaled 3,000 because of the skilled labor gap, and state and national totals are similar;
- As of January 24, 2020, there were 4022 registered apprentices on the rolls in the state of Kentucky participating in one of 302 apprentice programs;
- The average income of a completed journey worker was $60,000 per year in 2019; and
- Apprenticeship programs in the state of Kentucky have a 95% completion rate. (Demic, 2020)

According to Demic (2020), no current statistics exist on apprenticeship program participation for those who are not registered by KY Apprenticeship. GEA programs were started in 2015 but were not registered with KY Apprenticeship until January 2018. Apprentice programs are not required to become "registered apprenticeship" programs with the DOL. Some organizations pay for apprenticeship training for students, and the company will issue the graduating student a journeyman card that is recognized only within the issuing company. Internal credentials deter skilled laborers from leaving the sponsoring company to pursue employment elsewhere. GEA leadership viewed registration of the program as a necessity for creating loyalty. GEA desired that apprentices completing the program receive the earned national credentials in order to show apprentices that the company valued people over position.

The labor shortage and attrition of skilled workers has been problematic for Kentucky's neighbor, Virginia, as new jobs in manufacturing and healthcare began to emerge in 2015 (Galuszka, 2015). Virginia's skilled blue-collar workers were retiring in record numbers, and there were insufficient skilled workers trained to fill those roles (Galuszka, 2015). According to Galuszka, training experts in Virginia recognized that the lack of skilled labor was not the only problem facing the state. Skilled workers were lacking other attributes of success that only soft-skill training could provide (Galuszka, 2015). Those soft skills include, but are not limited to, critical thinking, teamwork, communication, and the basic habits of a good work ethic. Both the MAP and FAME programs at GEA provide courses to address soft-skill issues.

Morrison (2008) found that four key components of an economic perfect storm involved workforce shortages, educational attainment, global competition, and the decreasing value of the economy. The severity of these components was analyzed by Bevins et al. (2012) with the following considerations:

- Workplace and technical skills have become more important than land and buildings in the 21st century. Critically trained human capital must be developed through a complex educational system.
- Workplace skills are becoming just as or more important than basic technical skills. Educators are beginning to teach necessary soft skills.

- The retirement of baby boomers in key occupations is affecting the job market, causing potential labor shortages.
- As markets become uncompetitive, high-tax and high-cost communities must train their own skilled workforce. (p. 3)

Delano and Hutton (2007) supported these considerations by recognizing that many communities are lagging in understanding how businesses and education providers must work together to make the workplace connection.

On-the-job training benefits both employers and workers and can address both reskilling and up-skilling needs (Dimeny, Williamson, Yates, & Hinson, 2019). Dimeny et al. (2019) indicated employers who invest in workers increase the probability of retaining them, and the workers achieve greater productivity and can better benefit the firm by absorbing new technologies.

Work-based learning provides an on-ramp to a career by offering workers high paying jobs and certifications that can help to develop marketable skills (Johnson & Spiker, 2018). Johnson and Spiker (2018) pointed out that the National Skills Coalition (NSC) stressed the importance of pre-apprenticeship or pre-employment programs to provide foundational math and technical skills, as well as career coaching, to individuals seeking apprenticeships. The NSC recommended these programs be implemented to expand apprenticeship opportunities and education to traditionally underrepresented populations (Johnson & Spiker, 2018).

The DOL website outlines four essential benefits to the national workforce system in 2020 regarding performance measures:

1. Employment: Apprenticeship is a job. All apprentices enter employment when beginning an apprenticeship program;
2. Retention: Apprenticeship programs have high retention rates; 91% of apprentices retain employment after the program ends;
3. Earnings: The average starting wage for apprentices is $15.00 an hour, with wage increases as apprentices advance in skills and knowledge; and
4. Credential Attainment: All apprenticeship completers earn a national, industry-recognized credential. (DOL, 2020, p. 1)

GEA is partnered with Louisville Doss High School to help prepare students for careers in manufacturing. Much of the support GEA offers in the Doss training lab focuses on helping students connect academic curriculum to workforce applications. Student engagement is improved when a connection is realized between math and science compared to the real world. Some of this connectivity involves preparing students to enter future apprenticeships by Doss offering technical instruction at the high school level. This idea is in alignment with the DOL definition of pre-apprenticeship in which the following four components are present:

- An approved training curriculum based on industry standards;
- Educational and pre-vocational services;
- Hands-on training in a simulated lab experience or through volunteer opportunities; and
- Assistance in applying to apprenticeship programs.

Other programs around the country have similar initiatives regarding student career success.

The Industrial Manufacturing Technician Apprenticeship (IMT) helps entry-level employees in manufacturing to quickly enhance their skills and advance with their current company (Scott, 2016). Scott (2016) described the IMT as a stackable apprenticeship that is foundational for multiple career paths and adaptable for different manufacturing contexts, company sizes, and types of manufacturing shift schedules. “The IMT hybrid apprenticeship model integrates traditional time-based learning and competency-based education, allowing workers to progress at an individual rate” (Scott, 2016, p. 3).

The Scott (2016) case study indicated that benefits are realized for both employers and workers who participate in the IMT apprenticeship. The employer benefits include a highly skilled pipeline of talent, an up-skilled entry-level workforce whose talents match the needed skills for the job, and workers who are better prepared for further training (Scott, 2016). According to Scott, workers gain needed skills for career advancement without having to resign from a current job to go back to school. Scott outlined the following six key features of the IMT apprenticeship that mirror traditional skilled-trades apprenticeship criteria:

1. Apprentices are enrolled in training that leads to industry recognized credentials as well as college academic credits;
2. Apprentices are regular, full-time employees and earn regular wages while completing training;
3. Employers pay wages for the duration of the training;
4. Workers receive pay increases on completion of the training;

5. The IMT Apprenticeship is adaptable to production work in a range of industries and manufacturing contexts like machine shops, plastics extrusion, and food processing; and
6. Labor management intermediaries help employers and unions with all aspects of IMT implementation (Scott, 2016, p. 3).

Aerospace employers in Tucson, Arizona, discovered that most of their employees were in their 50s and companies could not find skilled workers to replace all of them (Revelli, 2016). Revelli described that students were hired by local companies to craft oil assembly pieces for passenger jets. Students in the Desert View iSTEM Academy in Tucson, Arizona, were given an opportunity to start developing foundational skills. Students were introduced to precision manufacturing, mechanical drafting and design, as well as engineering sciences in which students learned to create items with 3D printers and use engineering software (Revelli, 2016). According to Revelli, the iSTEM Academy partnered with nearby Pima Community College where high school students could receive professional certifications in SolidWorks and Mastercam, as well as earn up to 12 college credit hours while still in high school. Revelli further noted that students were offered 18-month internships that when completed, the student would need only three college classes to earn an associate's degree. Graduates went on to earn between $15 and $30 per hour (Revelli, 2016). Although this was not an apprenticeship program, Science, Technology, Engineering, and Math (STEM) students are great candidates for FAME programs like the one at GEA. STEM provides exposure to technologies that offer benefits for students seeking to enter apprenticeship programs.

The Learning Blade STEM initiative was introduced in Tennessee and Arkansas, with pilot projects in many other states, to promote STEM education and career readiness to high school students. The goal of Learning Blade was to offset the growing shortage of skilled workers (Boyington, 2018). Boyington (2018) outlined the intent of this initiative in six major objectives:

1. Introduce careers in the STEM industry by creating awareness of the careers available;
2. Illustrate the impact of STEM careers on both the student and society;
3. Create relevance between middle school and high school academic studies and real-life application;
4. Share with students the STEM careers that require both two-year and four-year degrees and credentials;
5. Integrate middle and high school math, science, and other skills with real-life career and societal problems needing solutions; and
6. Make the problems relatable to students and easy to teach. (p. 24)

Boyington reported that after 200,000 hours of engagement of students in the Learning Blade program, research was conducted to measure student awareness with the following results:

- Student interest in becoming an engineer or scientist doubled from results prior to the program;
- There was a 79% increase in the students' ability to connect how math helps to solve real-world problems;

- There was a 69% increase in the students' awareness of how school subjects are useful in real life; and
- There was a 57% increase in students wanting to take advanced math classes in high school. (p. 26)

The BLS projects that by 2022, STEM employment will account for 13% of total projected jobs in the US (Monis, 2018). Monis' (2018) research indicated that by 2030, over one million bachelor's degree graduates will be needed for California alone, just to meet high-tech demands. Another 1.5 million careers will require some postsecondary education, but less than a four-year degree, to meet skilled labor needs. STEM partnerships between businesses and two- and four-year providers are being formed to meet this growing need (Monis, 2018). Non-profit organizations are partnering with community colleges to provide academic support, enrichment, and opportunities for students to meet with companies and universities (Monis, 2018).

In a desperate need to fill thousands of skilled labor openings, Colorado has launched a statewide program to create paid apprenticeships for high school students in high-need industries (Gewertz, 2017). In the fall of 2017, 116 graduates began Colorado's new apprenticeship program and began working for 40 different companies throughout the state (Gewertz, 2017). Similar to Kentucky's FAME program, Gewertz (2017) explained that students get paid to go to school two days a week and work the other three weekdays for a 40-hour paycheck. Gewertz (2017) noted that Colorado companies are highly aware of the number of potential retirees looming over the next decade and the urgent need to develop viable replacements.

In 2016, Colorado's Governor John Hickenlooper organized a trip to Switzerland to learn how the world's leaders in apprenticeship programs carry out the apprenticeship mission by gathering information from companies and students (Gewertz, 2017). Gewertz' (2017) research shared the following results about the Swiss model:

- About 40% of all companies participate in the Swiss apprentice model.
- Approximately 70% of all Swiss students participate in the apprentice program.
- Participating Swiss students have lower unemployment than those who do not participate.
- Participating Swiss students have higher wage earnings than those who stick to the exclusively academic track.
- Swiss student participants are not stuck in the same career; it is common to go into other occupational fields later. (p. 3-4)

States are not alone in leading apprenticeship support initiatives. Sometimes individual companies step up to set the example for others to follow. Miller Brewing Company is a great example of industry leaders, educational providers, and non-profits working collaboratively for success of students in and graduates from technically trained programs (Van Pelt, 1999).

Van Pelt (1999) outlined Miller Brewing's Tools for Success program, which provides scholarships to graduates of technical programs. The scholarships are earmarked for the specific tools the graduate will need in their maintenance career. Between 1992 and 1999, Miller Brewing awarded more the $1.5 million in tool scholarships to more than 1000 technical program graduates with the help of community colleges and non-profit organizations supporting the cause (Van Pelt, 1999).

Miller Brewing Company representatives acknowledge the severe shortage of skilled labor in the US. Miller Brewing recognizes that the fulfillment of skilled trades positions was deterred because many recent apprentice graduates did not have the required tools for the job (Van Pelt, 1999). Van Pelt (1999) acknowledged that Miller Brewing Company does not stop at awarding tool scholarships, but company officials also are working with technical colleges and legislators to bring awareness to the skilled labor shortage. Company officials are committed to promote support of programs like Tools for Success with other business and industry leaders.

One interesting observation in this literature is that cooperation of community colleges and universities, together with industry and the non-profit sector, is the best solution to offer college and career options for students. Competition between institutions of higher learning limits only the success of the student. The student's ability to embark on successful careers that match their individual desires, needs, and skillsets could potentially be thwarted if cooperative options are not available. Students need choices when selecting the career path that will affect both themselves and their future families.

History of Apprenticeships

Modern apprenticeship programs originating in the US and around the world, were the products of necessity. Today's apprenticeship structure has borrowed from ancient idealisms and practices from as recent as a few decades ago. Most of the history of apprenticeship implementation is positive. The literature outlines that progress was possible because of the transfer of knowledge from one generation of artisans to another.

Some of the apprentice ideas and practices from the earliest apprenticeships would not support modern day programs. The literature review highlighted both.

Apprenticeship programs have existed for centuries in the form of artisan transfer of knowledge and later in the form of vocational education (Brewer, 2011; Lerman, 2009). According to Lerman (2009), ancient Egypt and Babylon conducted training to ensure that traditional craftsmanship was preserved. A DOL (1977) report stated that these ancient civilizations, along with Greece and Rome, valued the passing of knowledge from master to apprentice. The Code of Hammurabi, as early as 1754 BC, mandated that skilled craftsmen teach their trade or craft to the youth of that time (Martin, 2016). Early apprentices in England and Colonial America typically were groomed for positions of honor within their communities (Christman, 2012).

History of European Apprenticeship

Historical examination of the European apprenticeship programs is necessary because the British artisans established the first American apprenticeship initiatives. Britain is commonly known for having trades-related apprenticeships, and the British model has influenced the U.S. apprenticeship idealisms, dating back to the Colonial days (Christman, 2012).

Early British artisans were held in high regard and were prestigious members of English society (DOL, 1977). Snell (1996) generalized early trade apprenticeships into three major periods in which they were prominent: guild, statutory, and voluntary. The guild period lasted between the 12th century and 1563. Guild apprenticeships had state support and were prominently practiced. The period of statutory apprentice lasted from 1563 until the third period of voluntary apprenticeship period that began in 1814. The voluntary apprenticeship period was characterized by agreements between unions and companies and has lasted until the present day (Snell, 1996). Guilds were designed to protect the trade-related apprentices from oppression and ensure apprentices were learning a trade that would offer them a better status in life (Neff, 1996). Neff (1996) further described guilds as associations similar to modern day trade unions.

The guild period was a time when the local statutes and regulations governed labor and the skilled labor force. Guilds were ushered out with the issuance of the Statute of Artificers in 1563 (Snell, 1996). According to Snell's (1996) research, the Statute of Artificers' 1563 law highlights are as follows:

- Entry into profitable trades was restricted to children of masters and holders of certain property qualifications in defense of the social order of hierarchy of the day.
- The law backed the compulsions of apprenticeship, fixed quotas of apprentices in many trades, and set the length of apprentice programs to a minimum of seven years, with the apprenticeship time not expiring until the apprentice reached, at minimum, the age of 24 years for most trades and 21 years of age for those in husbandry (farming). Most trade apprentices began working at the age of 14 and worked for craftsmen in exchange for learning the trade (Neff, 1996).
- All apprentices, whether male or female, were required to obtain skills beyond the core craft. They were expected to learn religious doctrine, personal morality, literacy, numeracy, account keeping, needlework, knitting, sewing, "housewifery," and household management tasks (Snell, 1996).

Settlement laws regarding apprenticeships began to emerge in 1662 in Britain largely based on the guild and statutory periods of apprenticeships (Snell, 1996). Settlement laws required apprentices to complete at minimum a seven-year program and belong to another artisan's settlement until they were deemed eligible for settlement on their own (Snell, 1996). Snell defined settlements as "poor relief" (pg. #) from serving a legal apprenticeship. Settlements were earned by serving a full year while unmarried, by owning freehold immovable property, by paying rent above 10 pounds per year ($3,000 US today), by serving in a public parish office, or paying parish taxes. Both the yearly service people and apprentice lived with the settlement owner and either served the owner or worked with them to learn a trade. Normally, no compensation was offered, other than living arrangements and the knowledge gained (Snell, 1996).

Snell's (1996) research explained that upon earning settlement for completing apprenticeship training, rate payers would select those who were in their settlement to hire versus outsiders who had completed apprenticeships elsewhere, all in the spirit of keeping their own insider population out of the poor wage rates of the day. According to Snell (1996), artisans were legally linked to the head of the settlement where their apprenticeship was served, unless they began their own settlement. This practice protected artisan resources from being wasted on an apprentice who chose to work elsewhere when the training time was complete (Snell, 1996). These practices are as common in business today as they were in the master craftsman settlement days. GEA requires workers to sign retention agreements of up to four years for company provided educational benefits to be utilized. If the company funds employee education, workers are required to stay at GEA for up to four years or pay the benefit back to the company.

Parishes would commonly finance and oversee apprenticeships in 17th- and 18th-century England (Snell, 1996). Snell (1996) contested that parish systems operated apprentice initiatives similar to modern apprentice programs, in that apprentices could expect to rise to master or mistress level in due course of time. Historically, settlements would compete against each other for trained craftsmen under the former systems, but under the parish system the competition was between skilled practitioners for openings in which to practice independently (Snell, 1996).

An uncommon type of apprenticeship that began in the pre-industrial English-speaking world was referred to as the pauper apprenticeship (Neff, 1996). Neff described the pauper apprenticeships as something that was established during the period of England’s Poor Laws to provide orphaned, abandoned, neglected, and poor children with a home. Neff noted that pauper apprentices had no protections from the guild system that was afforded to trades apprentices and consequently received no opportunity to rise above the impoverished state in which they lived. Pauper apprentices were to be kept busy, off the streets, fed, clothed, and housed so they would not become public charges (Neff, 1996). Before the Elizabethan Poor Laws were enacted, vagrant children from 5 to 14 years old could be arrested and placed with parish families, not because of what they could offer the family, but because it was an expected civil duty for families to take in the troubled children (Neff, 1996). Neff explained that after the Poor Laws, the arrests stopped, but children were apprenticed, with the approval of two justices of the peace, to parish families for a term up to age 24 for males and 21 for females.

These types of apprenticeships were forerunners to apprentice indentures in Colonial America in which reliable farmhands were difficult to find, and these children were a valuable source of cheap labor that had the potential to be coveted adult workers (Neff, 1996). Unlike the British indentures described by Neff (1996), Colonial families took indentured servants in and paid them a meager wage for their contributions to the family rather than being paid to take paupers by the government.

Apprenticeship programs today primarily have a combination of formal classroom training and on-the-job training with a journeyperson, master craftsman, or mentor. This dual apprenticeship model is influenced by Great Britain but mirrors the German model shared with Switzerland, Australia, and New Zealand (Billet, 2016). Norway adopted a 2 + 2 model in which apprentices spend two years in a vocational college and two years in the workplace (Billet, 2016). Billet (2016) noted that apprenticeship models can differ in the United Kingdom within and across industry sectors. Billet explained that some programs are intensively work-based, with apprentices being employees, while others have apprentices largely as students in vocational colleges who engage with workplaces on varying bases and with varying frequency.

History of Colonial American Trades Apprenticeships

Many Colonial American artisans historically learned their craft from family with the knowledge handed down for generations (DOL, 1977). Other mid-teenager young men and women served apprentices under master crafts persons while becoming adults and preparing to become productive members of the community (Cantor, 1997). Two of the most renowned master craftsmen who served apprenticeships were Paul Revere and Benjamin Franklin.

Brothers Paul and Thomas Revere were silversmiths who learned the craft from their father, and two of Paul's sons served apprenticeships with him when he became a master craftsman (DOL, 1977). The DOL (1977) report claimed that as many as 500 pieces of Paul Revere’s crafted silver are still in existence today, as well as many of the church bells he fashioned after completing coppersmith training in New England. The report detailed that Revere ushered in the American copper and brass industry by opening the nation’s first copper mill in 1802 at the age of 67 in Canton, Massachusetts. One hundred years later the mill became known as the Revere Copper and Brass Company, and that name remains today, offering apprenticeship programs in metalworking in many of its plants (DOL, 1977).

The Colonial Williamsburg Foundation (2020) website explains that an indenture of apprenticeship was a legal contract expressing the obligations of both the master and the apprentice. The report noted that by the 18th century, the content was fairly well standardized (occasionally printed forms were used). The body of the following sample indenture is typical:

> Witnesseth that the said John Stevens with the advice and consent of his Mother Anne Stevens doth put himself an Apprentice to the said George Charleton to learn the Trade, art, and Mistery of a Taylor and with him after the manner of an Apprentice to serve till he arrives to the Age of Twenty-one Years to be fully complete & ended During which time the said Apprentice his said Master faithfully shall serve, his secrets keep his Lawful Commands Obey He Shall not contract Matrimony within the said Term he shall not haunt Ordinary's nor Absent himself from his Masters Service Day or Night unlawfully but in all things as a Faithfull Apprentice he shall behave himself towards his said Master and Family during the said Term AND the said George Charleton Best means he can

> shall Teach and Instructor cause to be taught and instructed AND doth hereby Promise and oblige himself to find for his said Apprentice Good and Sufficient Meat Drink Washing Lodging & Clothing during the Said Term and to Teach him to Read & Write and at the expiration of his term of servitude the said George Charleton obligeth himself to pay unto his apprentice what the law allows in such cases & agreements . . . At a Court of Hustings for the City of Williamsburg held the 5th Day of September 1748. (Handler & Gable, 1997, p. 17)

Benjamin Franklin was 12 years old when he was indentured to his brother James in 1718 to learn the art of printing (Handler & Gable, 1997). A DOL report explained that James was paid $10 ($630 today) by their father to train Benjamin and pay for his food, lodging, and other "necessaries," with the stipulation that if Benjamin made it to the last year of his apprenticeship just before turning 21, he was to be paid a journeyman's wage. Benjamin negotiated pay for his food with his brother and as a vegetarian was able to save money because vegetables were less costly than meat (Handler & Gable, 1997). Handler and Gable (1997) further stated that Franklin did not complete his apprenticeship due to complaints of his brother beating Benjamin, along with the constant fighting between the two brothers. Ben Franklin went on to become one of the premier scientists, writers, and inventors in the history of American artisans.

Modern Day Apprenticeships in North America

Canada and Mexico made strides in 2019 to invest and promote vocational education and apprenticeship initiatives (Dimeny et al., 2019). According to Dimeny et al. (2019), Canada has 400 trades designated to build a talent pipeline for the skilled labor gap. Mexico is investing in 2.9 million 18- to 29-year-olds to prepare them for careers in industry that have a scarcity of skilled workers (Dimeny et al., 2019).

Modern day U.S. apprenticeships made their debut when the Fitzgerald Act introduced the National Apprentice System in 1937 (Martin, 2016). When an apprentice completes training, certificates are issued by state apprenticeship agencies, or by the Bureau of Apprenticeship and Training (BAT) if such an agency does not exist within the apprentice's state (DOL, 1977). The DOL report outlined the following basic standards for apprenticeships that are registered by the BAT:

- The starting age of an apprentice is not less than 16;
- There is a full and fair opportunity to apply for apprenticeship;
- There is a schedule of work processes in which an apprentice is to receive training and experience on the job;
- The program includes organized instruction (a minimum of 144 hours per year is normally considered necessary);
- There is a progressively increasing schedule of wages;
- Proper supervision of on-the-job training with adequate facilities to train apprentices is insured;
- The apprentice's progress, both in job performance and related instruction, is evaluated periodically and appropriate records are maintained;
- There is employee-employer cooperation;
- Successful completions are recognized; and
- There is no discrimination in any phase of selection, employment, or training (DOL, 1977, p. 23).

Martin (2016) shared that the DOL Office of Apprenticeship reported more than 250,000 employers provided training for more than 500,000 apprentices in more than 37,000 registered apprenticeship programs in 2015.

In the 2015 State of the Union address, President Barack Obama called for more businesses to offer increased educational benefits and paid apprenticeships to help set young workers on an upward trajectory (Martin, 2016). In July 2017, President Donald Trump signed Executive Order 29 U.S.C. 3224a to expand apprenticeships in America (Dimeny et al., 2019). The executive order goal was to provide more affordable pathways to secure high-paying jobs by promoting apprenticeships and effective workforce development programs, as well as ease regulatory burdens on such programs and reduce or eliminate taxpayer support for ineffective programs (Dimeny et al., 2019).

In Louisville, Kentucky, some apprenticeship programs were implemented through cooperation between companies and educational providers. Other partnerships were established between local trade unions and education providers to deliver the necessary classroom training for specific trade apprenticeships. Interestingly, there are different areas of focus between some union training requirements compared to the same trade classification for a program in the manufacturing sector. The electrical apprenticeship offered to Ford Motor Company workers included focus on robotics, PLC programming, and maintaining industrial equipment. In contrast, electrical apprenticeship training from the local electrical union focused primarily on electrical installation for both residential and commercial applications. The union-trained journeymen often worked as contractors in factories and, in some cases, were hired by those companies as maintenance personnel. In addition to electricians, trades such as millwrights, iron workers, plumber/pipefitters, carpenters, sheet metal workers, as well as others have union led apprenticeship programs in the Louisville, Kentucky, area.

Today's apprentice is required on average to complete 8000 hours of on-the-job training and 500 to 700 hours of classroom training that includes job related skills and core academic skills (Martin, 2016). The GEA MAP and FAME models require 8000 floor hours and 71 credit hours of RTI. Martin (2016) noted that not all programs require all the same core skills, but many include basic math, algebra, geometry, measurements class, mechanical comprehension, spatial visualization, technical reading, and interpersonal relations. The GEA MAP program requires incumbent workers to successfully pass an entrance exam that includes math, spatial visualization, mechanical comprehension, and technical reading prior to being interviewed for acceptance into the program. GEA MAP and FAME related instruction includes Martin's core skills list but adds fine arts, machine reliability, and predictive testing instruction to the curriculum.

Predictive technologies are relatively new to the GEA maintenance department, but some have been utilized over the last decade. Today, five major predictive idealisms are integrated into the GEA reliability landscape, including infrared thermography, vibration analysis, ultrasonic testing, oil analysis, and motor testing. Apprentices are required to obtain 400 hours using the predictive tools to satisfy Registered Apprenticeship requirements (Appendix C). Additional advanced predictive and reliability training is offered to apprentices near the end of apprenticeship program requirements. Priority for advanced training like the predictive technology piece is given to existing journeypersons. Permanently assigned tradespersons work with apprentices to establish predictive inspection routes in the maintenance department.

Each specialization within the predictive umbrella carries a unique certification, and in most cases three levels of certification are available to qualified tradespersons. GEA plants have dedicated maintenance personnel who have been trained and certified to carry out most preventive and predictive inspection duties. As of 2020, GEA had 42 engineers and maintenance technicians trained in Level 1 Thermography and nine trained at Level 2. Most GEA plants have at least one or two technicians who are certified in multiple predictive technologies.

In the dishwasher plant there are over 50 new projects with 29 new pieces of automated equipment. State-of-the-art stamping and conveyance equipment is currently being installed in two of Appliance Park's assembly plants. Apprentices receive a basic course in robotics and PLC training at KCTCS, but additional training is required for those who interact with automated machinery as journeypersons. Robotics and PLC training is necessary as advances in manufacturing equipment are occurring at GEA. PLC programming is accomplished at GEA on three different programming platforms: GE Proficy, Allen-Bradley, and Siemens. Technicians who maintain automated equipment must be proficient in a combination of the programming platforms. The apprenticeship program at GEA is helpful in delivering the skills necessary to meet the technological needs of current and future equipment at Appliance Park.

Research by Martin (2016) divided apprenticeship offerings into the categories of construction trades and manufacturing trades. Construction trades training is normally accomplished through a union apprenticeship program specific to the trade union craft. Manufacturing apprenticeships have more options than union apprenticeships. Manufacturing apprenticeships may choose to follow the union model by training future craftsmen along specific trade lines of demarcation, such as electrical or plumbing. Some manufacturers including GEA prefer the more holistic approach of training apprentices in a general maintenance apprenticeship that exposes the apprentice to skills from several prominent trades. Martin (2016) claimed that there were over 1000 apprenticeable trades producing skilled workers in the US. Table 1 shows the major apprenticeable trades and how the trades are divided into construction and manufacturing categories.

According to Martin's (2016) research, 70% of high school students plan to attend college, but only 34% actually complete a two- or four-year degree. Many times, the student loses interest in paying tuition without a clear decision on the career field to pursue. In an apprenticeship, the student can discover in the first semester whether the program is the career in which they want to work. Maintenance apprentices work within a specific discipline and are exposed to factors necessary to determine whether the chosen field is the best fit for the apprentice. Other factors that contribute to low continuance in higher education are cost and debt to the student. Table 2 shares Martin's earning potential comparisons between the average college student and the average building or trades apprentice, including accrued debt.

This GEA project does not imply that students who have researched a desired career choice, investigated the future job market for a career, and measured the return on college investment should not pursue a college education. The implied problem is that at times students are encouraged to attend college, just for the sake of attending (Martin, 2016). Martin (2016) suggested that parents, teachers, and counselors often are unaware of the advantages of an apprenticeship and are reluctant to encourage students to pursue technical learning avenues. Falk and Blaylock (2010) recommended that both two- and

Table 1

Major Apprenticeable Trades

Construction Trades	Construction Trades	Manufacturing Trades
Asbestos Worker	Iron Worker/Structural Steel	Auto/Truck Repair
Boilermaker	Millwright	Die Designer
Bricklayer	Operating Engineer	Die maker
Carpenter	Plasterer	Draftsman
Carpet/Floor Layer	Painter/Drywall Finisher	Electrician
Cement Mason	Plumber/Pipefitter	Machinist
Construction Craft Laborer	Refrigeration and A/C	Machine Repair
Drywall Finisher	Roofer/Waterproofer	Millwright
Electrician	Sheet Metal Worker	Model Maker
Elevator Constructor	Sprinkler Fitter	Mold Maker
Glaziers/Glass Worker	Tile, Marble & Terrazzo Mason	Pattern Maker
General Laborer		Pipefitter
Iron Worker/ Structural Steel		Stationary Engineer
		Sheet Metal Worker
		Tinsmith
		Tool Designer
		Tool Maker
		Welder

Courtesy of 2015 United States Department of Labor Fact Sheet.

Table 2

Comparison of Earning Potential

Years	Wages Earned/Year in College, & First Year on the Job	Wages Earned/Year in Average Building Trade/Apprenticeship
1	$0.00	$31,794
2	$0.00	$37,908
3	$0.00	$44,022
4	$0.00	$48,619
5	$40,000	$54,724
Total 5 year Earnings	$40,000	$217,067
Debt	$80,000	$0.00

Courtesy of Jack Martin Research@www.techdirections.com, April 2016.

four-year institutional academic leaders should focus on, or at the very least, consider offering career-focused curricula, telecourses, online courses, credit-for-life courses, as well as service-learning experiences that provide options to undecided students.

The Falk and Blaylock (2010) study was designed to help students, parents, and academic advisors understand the necessity of providing students with all available information regarding higher education options. Students are better prepared to make educational and career decision, if all options are clearly visible (Falk & Blaylock, 2010). McDonald's (2019) dissertation outlines the top five things that are important to students in selecting an institution of higher learning. McDonald surveyed incoming freshmen from six Kentucky universities, including the University of Kentucky, Eastern Kentucky University, Morehead State University, Centre College, and Georgetown College, with the following results from the 224 student respondents (n = 224):

1. Over half of student respondents desired a strong major in field of interest;
2. Another 41.1% said the location of an institution and its nearness to home was important;
3. Nearly 39.7 % desired pleasant and attractive campus and facilities;
4. Respondents totaling 37.9% said the location of an institution regarding city and state mattered; and
5. Preparedness for a career was significant to 28.1% of the respondents. (McDonald, 2019)

McDonald's (2019) study is significant in that it shows how students are focused on the goal of personal success. McDonald's findings provide powerful insight that students desire to be prepared for life, and the research indicates training plays a major role in learning. Whether a student chooses a four-year institution or chooses to enter a trade apprenticeship at a regional school, the value of that education must be clearly conveyed to the individual student.

Figure 1 shows that for many students, college is the best choice, as long as it is understood that the payoff may not be realized for many years.

Advances in Modern Apprenticeships

Modern apprenticeships borrow from the traditional model in that a master or journeyperson provides repeated instruction to the apprentice and asks the apprentice to

Wage Comparison

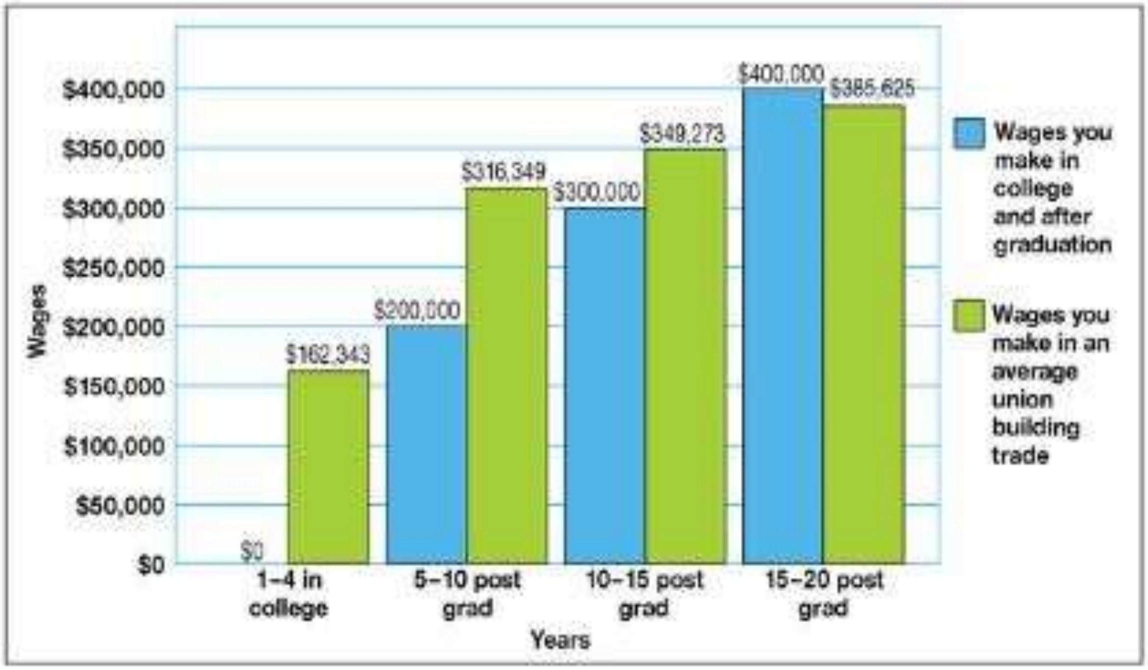

Figure 1. Wage comparisons between college and building trades graduates. Courtesy of Jack Martin Research@www.techdirections.com, April 2016.

demonstrate mastery of an acquired skill. Beyond that basic comparison, today's apprentice has the propensity to learn the craft by exposure to an eclectic assortment of training aids such as computer-aided learning and virtual reality labs. Nicaise (1997) suggested that modern mentors do an excellent job of guiding or scaffolding an apprentice through the process by offering clues, prompts, reminders, and encouragement as they progress through a more cognitive apprentice model of learning.

Modern cognitive apprenticeships are used to teach students how to conceptualize problems, construct knowledge, and develop skills (Nicaise, 1997). Nicaise (1997) described cognitive apprenticeships as an approach that provides students with learning tools to facilitate exploration, inquiry, and a personal construction of meaning by combining authentic problem-solving activities with expert guidance, assistance, and social discourse. GEA's programs engage apprentices in cognitive leaning by requiring students to demonstrate problem-solving techniques in the form of delivering Failure Mode and Effects Analyses (FMEAs) reports on equipment and by communicating findings to GEA leadership. The cognitive apprenticeship includes the following process:

- Teachers begin by providing repeated modeling of skills or thoughts for students *in situ*;
- Students, often in collaborative groups, attempt to execute the task with guidance and assistance from the teacher;
- As students gain self-confidence and skill, teacher support fades into an indirect role; and
- Students initiate the use of rudimentary conceptual knowledge or skills in specific activities. (Nicaise, 1997, p. 446)

Professors and mentors are necessary to train and mold students to be competent professionals, but in today's modern approach machine-mediated apprenticeships are beginning to develop and provide training based on the cognitive approach (Nicaise, 1997). Nicaise (1997) conducted software reviews to compare computer-supported apprenticeship software with the attributes of the cognitive process and found they all had some of the attributes, but none had all of the following:

1. Learning is embedded in social or collaborative activity;
2. The software provides repeated modeling of skills or thoughts;

3. Students attempt to execute a task with guidance and assistance from the teacher or computer; typically, the guidance is in the form of questions or prompts;
4. Likewise, guidance and assistance may take the form of indicating student errors, requiring students to engage in remedial activities, or comparing student problem-solving strategies to strategies selected by experts;
5. Moreover, assistance and scaffolding may come in the form of providing a discovery-learning experience or simulation where learners obtain hands-on activity with concepts or learners may even have access to inquiry tools such as calculators, laboratories, etc.;
6. As students gain self-confidence and skill, support fades into an indirect role; and
7. Students implement rudimentary conceptual knowledge or skills in an authentic problem. (Nicaise, 1997, p. 449)

In December 2019, GEA introduced a virtual reality (VR) lab into its Manufacturing Training Center. Engineering and maintenance workers, including apprentices, are offered the opportunity to learn new skills and technologies or hone existing ones with this technology. Participants in the VR lab can conduct troubleshooting exercises on mechanical and electrical simulators, including diagnosing high-voltage issues, without the risks associated with exposure to potential electrical dangers. The expectation of the VR lab from a holistic perspective is to offer a more hands-on experience for the student compared to the cumbersome training associated with the current online safety modules. Iterations of the VR lab capabilities also are being discussed for lean manufacturing and problem-solving applications needed in many sectors of the business. Incorporating VR training into the GEA workforce could easily begin with routine maintenance applications without having to deal with machine safety lock-out requirements or hazardous conditions that create unsafe dangers for employees.

Some of GEA's apprentices have expressed excitement about robotics, programmable logic controller (PLC), and VR training. Some have indicated they were born to do that type of work due to the video game and virtual reality age of today. Figure 2 shows apprentices being introduced to the new VR laboratory located in GEA's Manufacturing Training Center.

Stoner, Bird, and Gaal (2011) proposed that in order for apprenticeship programs and vocational education to meet the needs of the business sectors they serve, programs need to become more modernized and innovative. Stoner et al. (2011) explained that electronic media for delivery of some apprentice training is necessary and inevitable for apprentices today. Students today are different than any previous generation in terms of access to technological advances and in the way students relate to the world through personal electronic devices.

Partnerships in Kentucky that Support Vocational Education

Kentucky has joined Colorado, Michigan, Nevada, Tennessee, Washington, and Wisconsin in increasing budgets for apprenticeship and career and technical education (CTE), including money to improve career counseling (Dimeny et al., 2019). Dimeny et al. added that the federal government has called for the expansion of apprenticeship and vocational education as a policy priority and has received recommendations on ways to

Figure 2. Two apprentices and a Workforce Training Specialist being introduced to the VR Lab at GEA.

promote apprenticeships. Apprenticeship programs address the skills gap by immediately placing workers in unfilled jobs. Companies offering apprenticeships can adjust training to fit current organizational needs (Johnson & Spiker, 2018). Kentucky, and specifically KCTCS, is partnering with secondary schools and business organizations to begin addressing some of the worker gaps in highly skilled occupations. Michael Hazzard, Dean of Workforce Solutions and Technical Programs at Elizabethtown Community and Technical College (ECTC), shared the following information via email for this study:

1. KCTCS is rolling out a new apprentice initiative that will involve 16 colleges, including ECTC, and 450 new apprentices over the next three years that will be serviced by KCTCS;
2. ECTC has dual credit opportunities for most of the school districts in the ECTC service area of 28 schools that will allow students to take technical and vocational related training at the high school level and to receive college credit hours toward a certification or degree;
3. There are 30 registered apprentice programs currently in the ECTC service area that include several industry sectors;
4. ECTC has dedicated staff to support apprenticeship training including an apprenticeship project coordinator and someone who is focused on credit for prior learning as well as the AAS in apprentice studies degree program; and
5. On April 8, 2020, ECTC will be conducting a one-day apprenticeship conference designed to bring awareness to apprenticeship opportunities and to forge stronger partnerships between high schools, businesses, and KCTCS (M. Hazzard, personal communication, February 15, 2020). Hazzard cited the Strengthening

Career and Technical Education for the 21st Century Act (Perkins V) as another primary contributor of secondary and postsecondary coalition. Needs assessments based on local community feedback recommend that school districts work together to provide what is beneficial in regard to technical education for the population, not just individual school districts.

Theoretical Framework

Inquiry Worldview

This research study is approached from a constructionist perspective. Patton (2002) described constructionism as an evaluation of a program in which the researcher interviews different stakeholders in a program and expects those stakeholders to have different perspectives. The perspective variances are a result of the stakeholders having different experiences and perceptions while in the program (Patton, 2002). Patton further explained the researcher conducts open-ended questions and observations and examines the implications of different perceptions or realities on the program. The understanding is that no answer is better or more important than another, but all have value in the research and should be considered (Patton, 2002).

Substantive Controlling Theories

The analysis of this GEA study leans heavily on the idea of program theory because program theory incorporates both a theory of change and a theory of action (Funnell & Rogers, 2011). Suchman (1967) described two primary components that exist in program theory as implementation failure and theory failure. Watters, Hay, Pillay, and Dempster (2013) defined implementation failure as the failure to put the intended activities into operation and theory failure as the failure of the activities to bring about the desired effects. The results of this study target the areas of implementation of the program that need attention and address the activities of mentors, instructors, and the student to ensure the intended outcomes are being met.

Subjectivity Statement

The principal researcher is employed at GEA and has supported the FAME and MAP programs in the past. He understands the GEA maintenance department, including the apprentices, is a subculture within the GEA workforce and possesses working knowledge of processes and protocols within the maintenance organization. This study examines whether change is needed in any aspects of GEA apprenticeship program requirements and implementation. Student perception is the major contributor to this research study.

Interview responses are subjective in nature and based on the personal experiences of apprentices in different stages of the apprenticeship experience. Consideration also should be made that not all apprentices have worked under common management or received instruction from the same mentors throughout the course of the program. Both positive and negative responses are limited to each apprentice's personal experience while completing the program.

Summary

Apprenticeship programs offer recent high school graduates and corporate incumbent workers the opportunity for personal improvement by offering skilled training, educational credentials, and increased earning potential. Early apprentice concepts were directed at the apprentice's ability to watch a master craftsperson perform the functions of a craft, and the apprentice was to then mimic the actions of the master in a way to demonstrate proficiency in the craft or trade. The concepts have evolved over time with related technical instruction being introduced to help the student not only mimic a master, but also to improve the craft. Technology advancements require the skilled workforce to keep up with advances in necessary skills training.

This literature review discussed the necessity of apprentice programs by outlining the dire need for apprenticeship training. An ever-widening skilled labor shortage in the US and abroad requires action to fill the void. The literature review examined efforts of cities around the world and domestically that have presented viable solutions to some of the skilled labor woes facing the workplace. STEM education and IMT apprenticeship initiatives were introduced as ways to help with entry-level skills enhancement. Involvement in skilled trades apprenticeship program partnerships has increased around the US, including traditional MAP programs and FAME partnerships between corporate America and higher education providers.

Historical perspectives were captured from ancient days in Rome and Greece, through the beginnings of early European apprentice training.   Early artificers and craftsmen shared their knowledge with potential artisans of the future. The literature provided information about Poor Laws and Settlement Laws in Britain that offered insight into the Pauper Apprenticeship forced upon the orphans and orphan caretakers. Influences of the European model on Canada and Colonial America were described within the literature, and the evolution of the Modern Apprenticeship was outlined for the reader.

Historical information is significant for a study of any modern apprenticeship initiative because it offers insight into obstacles that some programs endured and ways in which they coped with those impediments. Some of the information regarding the current state of apprenticeship programs and labor needs was gathered by the primary researcher through personal conversations with technical college deans and program directors. Other information was gathered in like manner from Brenda Demic of the KY Apprenticeship office of the DOL.

The literature review helped the researcher to recognize common problems globally regarding labor shortage and apprentice necessity. Finally, the literature review offered ways that program theory can help the researcher determine whether implementation failure is present in the program being studied and whether the program activities are delivering their desired effect.

CHAPTER III: METHODOLOGY

Qualitative research results in "thick descriptions" of the situations and/or subjects being studied (Lincoln & Guba, 1985). Ethnographic studies are used by anthropologists to help clients learn how employees view their organization, as well as to learn things differently from existing personal biases (McCuistion, 2008). Marshall and Rossman (2007) identified an ethnographer as someone who studies culture, groups, communities, and organizations, often by way of total immersion, in order to capture patterns, roles, and daily interactions of life. Ethnography was chosen for this study to gain insight into the state of the GEA apprentice program culture at Appliance Park.

Slavin (2007) wrote that an ethnographic researcher should not have a pre-conceived idea to prove or primarily intend to compare one program to another. Ethnographic studies allow the researcher to understand the experiences of participants in the subject's environment and to "walk in their shoes," so to speak (Slavin, 2007). Slavin further noted that an ethnographic approach helps in making the taken-for-granted experiences explicit so that everyone can know from where the participants are reasoning. The expectation of this study, however, was to enlighten areas of the GEA apprenticeship program that can be improved through the perceptions of the participants.

This study examined 24 GEA apprentices from six GEA Appliance Park locations at different stages within both the GEA FAME and GEA MAP apprentice programs. Interviews of the apprentices, observations of academic tasks, as well as shop floor observations, were conducted. The triangulation of these three things helped the researcher paint a deeper picture and gain better insight into the impact the program has had on the individual apprentice.

Overview of Research Problem

GEA needs to train competent skilled tradespersons to fill attrition gaps and to help cope with the shortage of skilled workers available to hire. The program must be robust enough to develop competent journeypersons upon graduation from the program. The problem is the belief of GEA management that some of the graduating apprentices are not prepared to move immediately into journeyman roles. Some GEA mentors and leaders have expressed concerns that the multi-trade apprenticeship model offered by GEA may not prepare the student as holistically as a traditional apprenticeship program. Traditional programs focus on a single craft, rather than training in all basic general maintenance areas.

The multi-craft apprenticeship requires the same 8,000-10,000 on-the-job completion hour model (Appendix D) and the same amount of RTI (Appendix E) as a single craft apprenticeship. Some leaders have inquired as to how an apprentice can be proficient at all necessary skills required by a multi-craft maintenance program. Leaders have noted that electricians, pipefitters, and other tradespersons spend the same amount of time learning an individual craft, and they are still beginner tradesmen at completion of apprenticeship studies. The problem was addressed by collecting subjective interview information from apprentices regarding perceived student preparedness in the program, factors of student success, and barriers that hinder students from successful program completion. Observations of apprentices working with general maintenance journeypersons aided in providing clarity to the research problem as well.

Research Questions

The research questions included in this study were introduced in Chapter I and are included in this section for the convenience of the reader. They were intended to gather information from GEA apprentices to determine student perceptions of the program's components. Some students have struggled with maintenance tasks required of them as they proceeded through the program intervals. The goal of this research was to uncover barriers that persist in hindering student success and to assist in improving the areas that were detected as unacceptable to the success goals of the student.

The central research question was: What is the program impact on students who complete an apprenticeship through GEA? This research question was further investigated by including the following questions:

1. What role does mentorship play in the success of the student and how do mentors impact the program culture?
2. How does related technical instruction received by the apprentice contribute to student success?
3. Are company provided skills training courses available to students during and after the program is completed?
4. What barriers exist that could deter student success in the GEA apprentice program?

Research Design

Setting/Context

The primary researcher approached each apprentice and asked for participation in interviews and observations for the study. Students demonstrated a willingness to provide feedback for program improvement. Interviews took place at GEA Appliance Park in apprentice work areas and in the researcher's office. Observations were made at KCTCS during RTI classes; on the plant floor where maintenance work was occurring;

and in the training lab where respondents were working with robots, hydraulic training boards, and VR equipment.

Participants

The apprenticeship program population at GEA included a total of 43 apprentices and 15 recent graduates from the program. The sample size was eight first- and second-year apprentices, eight third- and fourth-year apprentices, and eight former apprentices working in the trades who were interviewed and observed (n = 24). Of the 24 respondents, nine were current or former FAME program participants, and the other 15 were current or former MAP participants.

Each participant in the evaluation was asked to sign an informed consent document and to give permission for photos and recordings to be captured in the interviews and observations. Their names were not released to anyone regarding the way in which they answered their interview questions, nor were the names on the interview sheets.

Other Data Sources

In addition to the interview process, the respondents were observed in classroom participation and while working on the job. Photos of apprentices working in various maintenance applications were taken to observe their ability to carry out apprentice tasks. Those photos are included in Chapter IV as artifacts for this ethnographic study. Field notes also were taken during the observation part of the study to compare apprentice tasks from each assembly plant maintenance team. Notes captured mentor feedback and levels of mentor engagement with apprentices.

Instruments

The research instrument for this qualitative ethnographic study was the researcher, who conducted in-depth interviews with the subjects and observed students both at school and during mentor training. Joppe (2000) wrote that the concept of reliability in quantitative research is closely tied to the replicability or the repeatability of experimental results or observations. In qualitative research, however, researchers are primarily concerned with the perceptions of subjects relative to a particular issue or phenomena; thus, the idea of truthful results becomes complicated or elusive (Golafshani, 2003). Lincoln and Guba (1985) said that a qualitative study could, however, convey consistency and dependability. As common themes began to emerge in the interviews, it became easier to see areas of the program where attention was needed. The interview guide is included in Appendix B.

The research's interest in this study was solely on the perceptions of those participating in the program and their resulting success. The observations conducted keyed on the students' ability to master necessary required tasks of each apprentice program. Photographic artifacts were collected demonstrating the technologies used by the apprentices while completing their programs of study and on-the-job training.

Application was made to the WKU Institutional Review Board (IRB) requesting approval of the informed consent agreement to be used in this research project. Upon receiving IRB approval, the participating respondents signed the informed consent agreement, and the primary researcher conducted the interviews in settings that were comfortable for the students. For internal validity purposes, during the interview the researcher read each apprentice's responses back to them for confirmation. When the questionnaire was complete, the researcher presented the response sheet to the apprentice for final respondent modifications.

External validity of the study is discussed in Chapter V by the researcher providing a "thick description" of the research findings for readers to observe in which the context of the study may relate to others (Lincoln & Guba, 1985). Merriam (2015) indicated the best way to achieve a thick description is to conduct interviews, take field notes, and find documents used by the respondents. A document depicting the 10 training and task areas required for each apprentice is included in Appendix C. Field notes included photographs of students completing maintenance related tasks and participating in technical training. The interview questions were fully structured and designed to gain student perceptions on the overall program and to help answer the research questions.

Interview Questions for Apprentices

1. In which program are you currently enrolled? MAP or FAME
2. Describe your experience in the program:
    a. What do you value the most?
    b. What were the greatest challenges?
3. How have your relationships with program mentors progressed through the program?
4. Describe how related technical instruction is incorporated into the workday.
5. Where would you like to see added focus within the program?
6. Are there any parts of the program that seem to be irrelevant to your success as a maintenance journeyman?

7. (for graduates only) Describe opportunities provided to you after the program to continue to hone your skills.
8. What would you like to see offered?
9. Were there any barriers you would consider detrimental to student success in the program?
10. How has the program impacted you, either positively or negatively?

Procedures

The primary researcher observed the participants in RTI and on-the-job settings and interacted with apprentices as they demonstrated their expertise in tasks associated with the program. Photos of some of these observations from Fall 2019 are included in Chapter IV. Upon approval from WKU IRB and after participants signed the Informed Consent Letter (Appendix A), the Interview Guide (Appendix B) was stratified by participant classification into the three following sub-categories; first and second year, third and fourth year, and graduates from the program. Interviews were then conducted by the primary researcher in September and October 2019, and observations were made of apprentices carrying out daily maintenance activities and participating in on-the-job as well as classroom training. Photographs were taken to capture some of the apprentice activities as artifacts for the study and are presented throughout this dissertation. An Interview Guide (Appendix B) was used to gather subjective information from program participants regarding personal apprentice experience at various stages of the apprenticeship program.

Data Management and Analysis

The interview and observation data were divided into several categories or codes based on the responses from the participating apprentices. Basit (2003) deemed coding or categorization as essential in qualitative data analysis as it subdivides the material being analyzed. The categories included: positive on the job experiences, negative on-the-job experiences, supportive mentoring, mentor challenges, management challenges, RTI benefits, RTI limitations, and accessibility of training. No pre-defined starting list was developed because the study sought to see the actual state of the program from the eyes of the apprentices. Once the groupings were made, the response data were entered into the outline, with some clear themes that emerged. Questionnaire responses were further divided to determine themes within each group of apprentice respondents. The respondents were categorized into three major groups; first and second year, third and fourth year, and graduates. Those groups were subdivided into FAME and MAP groupings to see how they responded as collective groups and to determine how their answers contributed to the primary and secondary research questions.

- First- and second-year apprentices
    1. FAME
    2. MAP
- Third- and fourth-year apprentices
    1. FAME
    2. MAP
- Graduates
    1. FAME
    2. MAP

These respondent categories were then coded to reflect how both the primary and secondary research questions were answered by apprentices in each category based on interviews and observations.

Ethical Considerations

Each person being observed and interviewed was asked to sign an informed consent letter from the Institutional Review Board (IRB) of Western Kentucky University (WKU) before observations and interviews took place. The participants were informed by the primary researcher that GEA would not be offered individual response information, but the overall thematic results would be offered to the apprentice program manager at GEA. Responses to interview questions were collected, with only the program and year designations written on the response sheets. No names were collected of respondents or anyone mentioned during the course of the interview sessions.

Limitations

Ethnography is difficult to define, and sometimes practitioners find conflicts of employers who misunderstand or misuse the data or findings (McCuistion, 2018). In this study, if the individual names of study participants were given to the employer, they might have begun to eliminate feedback from the respondents based on personal biases toward individuals with whom they have had some sort of history. As the ethical considerations noted, those individual names were not released to the company.

Other limitations that were evident included the individuality of each GEA plant and that the location was a union shop environment. The GEA makeup at Appliance Park consists of six separate buildings that may not have the same organizational focus. Apprentices have been viewed differently from building to building and subsequently have had different experiences as they rotated through the various building assignments during the program. Findings from this study were handled differently from building to building by management. In addition to those differences, management and union leadership may not have agreed on the interpretation of the findings or on what measures, if any, were to be taken to improve the program. Anonymity considerations were made by offering the results as methods that were working versus those that could have been improved upon, without indications as to which of the locations were lacking. Best practices were reported to the leadership at GEA, as well as respondent perceived barriers to student success.

A final limitation to the study related to mentorship. Each year, apprentices are assigned to rotate from one assembly plant (AP) building to another. Rotational opportunities for apprentices are dependent upon mentor availability. The mentor population consisted of full-time tradespersons with areas of an AP to maintain. Apprentice rotational assignments were inconsistent regarding mentors, causing the overall apprentice experiences to vary among the students. In some cases, five or six apprentices had access to the same number of mentors. In other situations, one mentor may have been assigned to several apprentices. Those differences impacted student experiences and the student's responses to the interview questions. In addition, some apprentices may have learned tasks from a mentor with an electrical background and others in the same area may have had a mentor who was more mechanically than electrically inclined.

Summary

Chapter III presented the methodology of this ethnographic study. The chapter began with an overview of the research problem and explanation of the research questions. The research design was then described, including setting and context and participants. Finally, data sources and instruments used to gather rich, thick descriptions of the study apprentices in each of the two GEA apprentice programs were described. The setting was divided between the GEA workplace and KCTCS in which the students received related theoretical instruction.

Procedurally, the population of 24 participants was observed, photographed, and interviewed about their personal experience in the MAP or FAME program in which they were involved. The response data were grouped according to program type and year in which the student was enrolled. Analyses were completed on the data to reveal common themes among the responses. Response data and recommendations were offered to the GEA apprentice manager for improvements in the overall student experience and success in the program. Ethical considerations were made by the researcher, refraining from sharing specific interview answers from individuals to GEA leadership, but rather, reporting the overall findings to the apprenticeship program manager upon completion of the study. In addition, all IRB procedures were followed, and anonymity and confidentiality were offered to participants to the extent required by law.

Finally, study limitations were described thoroughly in Chapter III. Future studies into the GEA program from management and mentorship perspectives would support the findings of this study. Future studies of other programs similar to the GEA model are necessary in order to gage GEA alignment with other apprenticeship initiatives.

CHAPTER IV: RESULTS

The GEA maintenance program is a unique micro-culture within the GEA organization. Maintenance has two primary responsibilities: keep the production equipment maintained to optimal running condition and continuously find ways to expand the life expectancy or reliability of machines that produce GEA products. Those efforts require skill and craftsmanship. GEA has the responsibility of hiring or training employees to meet the skill sets required to accomplish maintenance related tasks.

This ethnographic study examined the culture surrounding the development of maintenance apprentices in GEA's MAP and FAME programs and factors contributing to the success of participating students. The goal of this research was to gauge impact of mentorship, related theoretical instruction, related soft-skill instruction, and company provided skills training on the participating apprentices. The GEA research study examined individual apprentice perceptions regarding items that positively impacted student success in the program, as well as barriers that persisted and caused difficulties throughout the participant's apprenticeship time.

Respondents consisted of 24 apprentices, 12 each from the two major program divisions of MAP participant and FAME participant. Upon approval from WKU IRB and after participants signed the Informed Consent Letter (Appendix A), the Interview Guide (Appendix B) was stratified by participant classification into the three following sub-categories; first and second year, third and fourth year, and graduates from the program. Interviews were then conducted by the primary researcher, and observations were made of apprentices carrying out daily maintenance activities and participating in on-the-job as well as classroom training. Photographs were taken to capture some of the apprentice activities as artifacts for the study and are presented throughout this dissertation. An Interview Guide (Appendix B) was used to gather subjective information from program participants.

Research Questions

Findings were based directly on the interview responses and observations of the investigative research. The framework of this study was based on the program theory of a dual apprenticeship model of on-the-job training and related technical instruction. Through this qualitative process, information was gathered to answer the research questions of the study.

The central research question was: What is the program impact on students who complete an apprenticeship through GEA? Interview Guide responses constituted the data from which analyses were drawn to answer this question. The following five secondary research questions guided the organization and syntheses of the data:

1. What role does mentorship play in the success of the student and how do mentors impact the program culture?
2. How does related technical instruction received by the apprentice contribute to student success?
3. Are company provided skills training courses available to students during and after the program is completed?
4. What barriers exist that could deter student success in the GEA apprentice program?

As the study progressed, major themes began to emerge and were categorized thematically based on participants' perceptions of each GEA apprentice program. Those themes for the primary research question included program positives and program challenges. The themes for the remaining supporting research questions were positive mentor impact and mentor improvement opportunities, RTI relevance to student success, barriers to student success, and program improvement opportunities.

Research findings are outlined in Table 3 for each qualitative question. Narrative explanations of findings are provided in detail following Table 3. The narrative provides direct insight from apprentice program participants in the form of quotes and allusions.

Findings for Research Question 1

RQ1. What is the program impact on students who complete an apprenticeship through GEA?

The findings are summarized in outline form with in-depth discussion following the outline.

First- and Second-Year FAME Program Positives

FAME offered opportunity, valuable life skills, and the first real job for many students. Beginning GEA FAME participants overwhelmingly agreed that the opportunity the program affords students is priceless. Three of four respondents in this category said GEA was their first full-time job and expressed thankfulness for the opportunity. One second-year student talked extensively about how she can now do things that many of her friends cannot. The FAME student recently moved into an apartment with three roommates and found she could make repairs that usually required paying someone else to fix or required calling for a parent's assistance. The student said, "My roommates were impressed that I could do things that they could not. I fixed a leaking drain because I was learning plumbing at school!" Several FAME participants

Table 3

Research Question Findings

RQ1: *What is the program impact on students who complete an apprenticeship through GEA?*	
First- and Second-Year FAME	
Program Positives	Program Challenges
• First real job/Valuable skills for life/ Incredible opportunity • General maintenance trains holistically • GEA and FAME care about my safety • Soft skills help in life • Getting paid to learn	• New responsibilities/Real world • Placement issues • Mentor issues • Tool issues
Third- and Fourth-Year FAME	
Program Positives	Program Challenges
• Working every day/Learning faster • Paid to learn/Great opportunity • Secure/capable/confident • Promotes personal growth and positive work ethic	• RTI/Shop Floor Alignment • Learning the Lingo • Eclectic Mentor Styles • Shift Work
First- and Second-Year MAP	
Program Positives	Program Challenges
• Perceptions of Maintenance • Advancement Opportunity • Degree Achievement • Holistic Development	• Cultures/ Mentor Engagement/Seniority • Income/Overtime • Work-Life Balance
Third- and Fourth-Year MAP	
Program Positives	Program Challenges
• Nearing Journeyman Status • New Skills/Purpose/Respect • Technical Preparedness • Troubleshooting is Valuable • Robotic Training	• Cultures/ Mentor Engagement/Seniority • Scarcity of Project Overtime • Desire for More Training

(continued)

Table 3

Research Question Findings (continued)

FAME and MAP graduates

Program Positives	Program Challenges
• Opportunity/Pay-off • Confidence to Succeed • Personal Improvement/Communicator • Comprehensive Training	• Tracking Bucket List Hours • New Work Assignments • Shift Work

RQ2: *What role does mentorship play in the success of the student and how do mentors impact the program culture?*

MAP Students

Positive Mentor Impact	Mentor Improvement Opportunity
• Mentors Help Engaged Students • Transfer of Knowledge	• Seniority Issues • Pay Issues

FAME Students

Positive Mentor Impact	Mentor Improvement Opportunity
• Mentors Teach the Trade • Life Skills	• Frequent Reassignments • Condescension • Unclear Mentor Expectations

RQ3: *How does related technical instruction received by the apprentice contribute to student success?*

RTI Value Discussion

• Technical Courses • Degree Requirements	• Need for Relevant Electives

RQ4: *Are company provided skills training courses available to students during and after the program is completed?*

Company Provided Skills Training

• On-site training	Off-site Training

(continued)

Table 3

Research Question Findings (continued)

RQ5: *What barriers exist that could deter student success in the GEA apprentice program?*
MAP and FAME Barriers
• Inconsistent Manager Relations • Unclear Mentor Expectations • Need for Further Training • Work-life Balance Issues

expressed that this type of independence is helping them make the transition into adulthood more easily.

GEA trained maintenance workers holistically. Most first-year apprentices are assigned to the Dishwasher Division in building AP3 for the first year to be near the training center. This assignment allows the apprentice easy access to safety training rooms and allows the program manager to interact with them more easily. When necessary, an occasional first-year is assigned to a different building than AP3 to fill a vacant spot. Those apprentices then rotate to AP3 on the next rotation. The apprentice rotation process is designed to expose students to every aspect of general maintenance. Apprentices learn skills and tasks from journeypersons with varying skillsets across the maintenance spectrum. A second-year student said, "I love the general maintenance idea. Last year I worked mostly with electricians, and now I work with a mentor who knows the mechanical side of maintenance." The response consensus of FAME students in their first two years was a feeling that they were needed. A general feeling that apprentices were supported by both the company and their individual mentors came from this group.

One respondent shared, “It seems like someone always has time to answer my questions and address my concerns.”

GEA cared about safety. Safety was mentioned in some capacity by every respondent in this category. One first-year apprentice shared, “I couldn’t believe how much time was dedicated to safety; it is nice knowing the potential dangers.” Another remarked, “Everything at school and work was about safety when we started the program and it continues to be a part of each task we are required to do.” Every FAME participant is required to state a personal safety commitment each time information is presented to classmates, informally or formally, to school and work leadership. During the interviews, several of the FAME students stated a personal safety commitment prior to answering the interview questions.

Soft-skill training helped at work and in life. Related technical instruction from KCTCS was discussed during the interview process and is detailed in the section for the supporting research questions. Regarding program positives, earning a degree was at the top of the list for FAME students. “FAME is not just about learning a trade for me, I’m getting a degree, too” remarked one of the respondents. Another shared, “I love the school part of the program. Communication classes have helped me face my fear of public speaking, and now I am not intimidated when sharing my ideas.” FAME students are required to give project presentations on problem solving and lean principles in manufacturing maintenance to GEA and KCTCS leadership.

Students got paid to learn. The GEA FAME program requires students to work three days a week and go to school to receive related theoretical instruction two days a week. This schedule works great for FAME participants because students are not required to attend school at night like their MAP counterparts. FAME students attend school eight hours per day, twice a week, for five semesters. Compensation for school hours was the topic discussed most often by respondents in this category. Responses ranged from the expressed disbelief that students were getting paid to go to school to parents being happy that no student loans were required. Five of the eight interviewees expressed disbelief for getting paid to learn a trade that offers a lifetime of opportunities for advancement at GEA.

First- and Second-Year FAME Program Challenges

Apprentices faced new responsibilities. The first- and second-year FAME cohort was very vocal regarding some *real* student challenges in the program. Most early FAME students found school to be manageable, but a few commented that learning at work and learning at school (with occasional homework) could be difficult at times. Most FAME students working at GEA were interviewed for a FAME position while still attending high school. Working in a public facility can be intimidating for a student just completing school and entering the workplace for the first time. The struggles of entering a life of adult responsibilities can be daunting.

Placement issues were common for apprentices. The biggest respondent complaint was job placement. Apprentices are assigned to a specific building for a one-year period. Within each building rotation the apprentice completes internal rotations among mentors in many areas of the assigned building. In the best scenarios, apprentices have several opportunities to rotate within an assigned building during a one-year period. Rotational assignments allow the apprentice to learn as many maintenance operations as possible and to be exposed to an assortment of maintenance tasks. Normal protocol calls for placing apprentices with mentors for three to six months to allow mentors and students the opportunity to become familiar with each other. The time allows apprentices to gain mentor trust and to learn valuable skills from a seasoned tradesperson.

As apprentices gain a mentor's trust, the mentor is more likely to allow the apprentice to assume greater responsibilities. When an apprentice is bounced from mentor to mentor on a daily basis, little opportunity exists to learn. One student expressed the concern that his mentors would not think he showed proper initiative because of his hesitance to ask questions of someone he just met. First-year students were more reluctant to ask questions, so sometimes the opportunity to learn was lost until the apprentice gets more familiar with the mentor. Apprentice feedback regarding this issue should be taken seriously because when the apprentice has completed the program, the graduate needs the confidence to troubleshoot maintenance issues and to make necessary repairs. Confident apprentices are more likely to ask questions without fear of appearing ignorant to journeymen. Last, when a mentor has an apprentice for only a day, it is difficult to start the apprentice on a project or to conduct in-depth training with the student.

Mentor issues caused some apprentice concerns. The mentor is a maintenance technician whose first responsibility is to ensure production operations are continuously running. When a maintenance breakdown occurs, the primary concern for the maintenance technician is to get the line running again. An effective maintenance person gets the line operational and then works to find the root cause of why the downtime occurred. The technician may not have time to explain each step in the recovery process to the apprentice during the breakdown, and some first-year students found that to be discouraging. Mentors who are invested in teaching the apprentices will explain what happened during a maintenance breakdown and the steps to get the line running once it is operational.

Apprentice engagement and initiative are two attributes that GEA mentors highlight when evaluating apprentices in their annual review. Most said they are willing to share information with a student who is engaged and has a desire to learn. Some apprentice respondents shared that at times apprentice engagement was not always welcome. Two student respondents shared instances in which expectations from maintenance leaders and mentors were unclear. One said, “It is like a chess match for me. Some journeymen expect me to jump in and help, but others want me to just stay out of the way. It gets confusing at times.” Another confirmed, “There are days when my mentor is open to questions, and days when I know to keep quiet.”

Younger apprentice respondents told of times that maintenance leadership did not value FAME contributions to the business. One concern mentioned by several FAME apprentices involved the use of the term “FAME kids” by some of the maintenance leadership. One student said, “We just want to be taken seriously. Hopefully leadership will see our worth in time.”

Tool availability was problematic for some apprentices. A few apprentices complained of not having the proper tools needed to do the jobs required in each building. The students attributed the deficit to frequent moving from one plant to another. A third-year apprentice said, “I have a basic tool set, but sometimes I need specialty tools, and that gets expensive.” For example, press maintenance consists of different maintenance functions than assembly line maintenance, and facilities maintenance is different than carrier repair maintenance. Each maintenance function has unique tools to carry out work requirements. Recommendations are outlined in Chapter V for apprentice tools.

Third- and Fourth-Year FAME Program Positives

Students could now work every day with consistent mentorship. Midway through the third program year, FAME students finish the RTI portion of the program. At that point, the apprentice works a full 40-hour work week for the company. Assignment rotations continue for these FAME students until the apprentices have achieved 8000 training hours on the job and have completed the necessary hours within all required maintenance categories for the program. Working a straight 40-hour week, versus having interruptions to attend school, creates a better opportunity for the apprentice to be with a consistent mentor. Concerns were expressed by first-year FAME students of having a daily change in mentorship. Intermittent mentorship was due to students working every other day while attending class on Tuesdays and Thursdays. One FAME student said, “It is nice to be working every day. I am picking up things faster.”

Students were getting paid to learn skills that created opportunities. Like first- and second- year respondents, the third- and fourth-year group liked the idea of getting paid to learn, but many expressed relief for the RTI portion of the program being finished. Five students in this category had already received associate’s degrees from KCTCS and certificates for completing trades related training. Appendix E outlines the RTI and certifications received by MAP and FAME students during the program of study. One student noted, “What a relief to have my degree finished. Now I’m writing my own ticket for success.” The consensus was the same for the rest of the respondents who were finished with RTI. “I’m glad to be working everyday doing something that I can call a career," said a fourth-year apprentice. A third student expressed, "I still cannot believe I have been offered such a fantastic career opportunity."

Third-year students were beginning to be more secure, capable and confident. The interview process revealed a sense of security for those who had completed their degrees. One student shared, "The money is great, and I now have a bright future, so I recently bought my first house. The best part is I'm only 20!" Others echoed this sentiment by expressing their confidence in being capable of doing things that seemed impossible before starting the program. One apprentice said the program helped him overcome his shyness interacting with people. The more the shy student learned, the more confidence he had in expressing himself. The personal communications class also helped the timid student to be more confident in explaining findings when troubleshooting maintenance problems. "I can do things I never dreamed possible!", exclaimed a fourth-year FAME student.

FAME provided for personal growth and supported a positive work ethic. A student in the year-three cohort reluctantly admitted he was a bit immature when he entered the program. The student said it helped him grow up and be more responsible at work and at home. During the weekly maintenance meeting, mentors shared that some of the apprentices had positively transformed over the course of the program. One mentor discussed a fourth-year student who had struggled early in the program but eventually became a very strong addition to the maintenance team. Another apprentice expressed that the program helped in developing a personal work ethic and provided an opportunity to lean a skill that could be passed along to his children. He said, "I can't describe how much I have grown up in every aspect of my life. I am thankful."

Third- and Fourth-Year FAME Program Challenges

It could be difficult to merge RTI with work being performed on the shop floor. There are challenges with any program if one observes with enough detail. One interesting result of the research findings showed many similarities regarding program positives between the two FAME groups in this study, but the program challenges tended to differ with time through the program. The best example of a program challenge was the correlation of RTI to actual shop floor training. Early apprentices learn basics of electrical, mechanical, pneumatics, hydraulics, and other basic maintenance theory during RTI training. In early apprentice rotations, mentors understood apprentices are just starting out and primarily are getting fundamental instruction on the shop floor. As the apprentice progresses through the program, it becomes increasingly difficult to relate current classroom training to that taking place on the floor. Third- and fourth-year students are more heavily involved in the details of specific maintenance areas regardless of current classroom topics. Many respondents from this category discussed that the disconnect was getting wider in the later classes from that which was actually occurring on the job floor. Later related theoretical instruction might cover control logics or robotics for everyone in the cohort, but not all work with robots. Although some apprentices could directly apply the learning in their current rotation, others in the cohort likely might be dispersed into areas where unrelated learning was taking place.

Learning the skilled-trades lingo could be difficult. Two FAME respondents shared that early in the program the hardest part was learning maintenance culture and specifically the *language of the trades*. One respondent noted tradespersons from different backgrounds use different names for the same things. For example, a fork truck to one journeyman is called a tow motor by someone who came from a different maintenance cultural background. Similarly, a maintenance buggy to one person may be called a gitney by another. Tool recognition issues were equally as confusing. Lineman's pliers to one mentor was referred to as side cutters by someone else. Other tools of the trade have multiple names depending on the trade in which they are used. One of the concerned students said, "It is difficult to sort out the lingo at times when you are in this environment for the first time. We need a tools recognition class with all of the aliases."

Mentor styles were eclectic. Troubleshooting styles of mentors is as eclectic as tool nomenclature. Students who have had exposure to numerous mentors in several buildings attested that one must quickly learn from which style and culture the mentor is operating. A student in the Refrigeration Division of Appliance Park said, "It is almost like being a first-year apprentice every time we rotate to a new training area. There's a bit of a learning curve each time." The same was said when apprentices work with mentors with different trades backgrounds. The advantage as expressed in the earlier program positives section was the ability for a general maintenance apprentices to learn all aspects of factory maintenance from experts in their given trade classifications. The interview results showed the scope of knowledge required in a general maintenance environment was intimidating to some apprentices. One apprentice shared, "Last rotation I worked with an electrician who came from the construction trades. This rotation I am with a factory trained electrician and the training and troubleshooting styles could not be more different."

Some concerns were revealed by apprentices who questioned whether they could possibly learn enough in four years to be proficient in each aspect of factory maintenance. Three interviewees pointed out the electrical, logic, and robot training they received was introductory at best and expressed the desire to learn more about wiring and electrical applications that would transfer to actual tasks expected on the shop floor. One respondent said, “My hope is to learn every aspect of robotics during my maintenance career."

Shift work was inevitable for FAME apprentices completing RTI. One prominent concern apprentices mentioned was that students may be sent to afternoon and night shift rotations when the RTI portion of the program is complete. Plant leadership is permitted to put apprentices on off shifts to finish program requirements if the apprentice has completed school. Two FAME apprentices expressed disdain for the move to nights, while others liked the idea of getting a shift premium above base pay for working the off shift. Tradespersons receive a 5% increase in base pay to work an off shift. Most FAME students go to night shift when they become journeypersons because of low seniority compared to existing maintenance personnel.

First-and Second-Year MAP Program Positives

GEA maintenance workers were held in high regard. Although the opportunity to achieve an associate’s degree and learn a trade was ultimately the same for participants in both FAME and MAP programs, the MAP program was considerably more competitive. FAME leaders in the Louisville, Kentucky, area have struggled at times to get area students to participate in the FAME program, but there are always 75 to 100 GEA workers vying for one of four to eight slots in the annual MAP selection process. GEA MAP candidates are selected from a pool of hourly workers currently in the production supply chain sectors of the business. Incumbent GEA workers view the MAP track as a fresh start opportunity. All MAP apprentices have spent time on the assembly line and have been exposed to production demands within the GEA environment. In some cases, MAP apprentices have worked alongside maintenance technicians prior to entering the program and have been fully aware of the opportunities the maintenance program offers. A beginning MAP student with 15 years seniority at GEA said, "Maintenance was viewed as the *lifeline of the business*." He further expressed, "Maintenance keeps the place running. I want to be a part of a team that makes that kind of a difference!"

The MAP program developed apprentice skills that promoted advancement and degree credentialing. Opportunity was cited by students as the most valuable part of the apprenticeship program. Completing the MAP program creates opportunity for line workers to move from a mundane repetitive work environment into a career that offers advanced skills. Some respondents saw the MAP program as the only way they could earn a degree or learn a marketable skill. Others have struggled to find opportunities for advancement due to not having a degree or a skillset that would support an upward move. Those students reflected that the MAP program would create the advantage needed to pursue opportunities seemingly out of reach before entering the program. One student in this group shared, "I am capable of much more than my previous job required of me. MAP gives me a chance to prove what I can do." A second-year MAP student noted, "I learn something new with each rotation and journeymen have been willing to pass some of the tricks of the trade to me. I feel blessed."

Multi-craft learning developed apprentices holistically. Some apprentices got the opportunity to work in repair areas maintaining material handling vehicles and moving equipment that supports production operations. Other apprentices were assigned to automation areas where robots are used to weld and move appliance parts through the plant. Figure 3 shows a second-year MAP apprentice inspecting a parts carrier used to move products through AP3. Figure 4 shows the same apprentice making repairs to the carrier.

Cultural differences and seniority issues across Appliance Park contributed to poor engagement between mentors and apprentices. Interview responses showed that MAP and FAME apprentices experienced the common challenges of the cultural differences from plant to plant. Mentor engagement was problematic for some apprentices in each of the programs but appeared to be a bigger challenge for the MAP students. MAP apprentices face a unique set of mentor challenges compared to the FAME students. Many MAP candidates enter the apprenticeship program with more GEA seniority than some of the tradespersons who have agreed to be mentors. Several of the MAP respondents mentioned times when difficulties arose regarding mentor engagement due to seniority issues. One MAP student with 20 years of seniority said, "Some mentors will not talk to me when they find that I am senior to them." Details are explained in the supporting research question section regarding mentor impact on the program.

Figure 3. A MAP apprentice is inspecting a parts carrier in AP3.

Figure 4. An apprentice is straightening a parts carrier.

First- and Second-Year MAP Program Challenges

Overtime opportunities for apprentices were inconsistent across the park.

Income was mentioned as a challenge by two of the respondents in this MAP category.

Although the MAP candidate does not lose base pay when entering the program, if the student had been on a shift where premiums were paid above their base, the student was no longer entitled to the premium as a day shift apprentice. Likewise, if a new MAP apprentice historically had worked in a production area where overtime was common, take-home pay could have been less if overtime was not available to the apprentice. Apprentices are contractually eligible for overtime only if the journeypersons in the same work area and on the same shift are all scheduled. Consequently, there was no guarantee of apprentice overtime in any area of any building. The understanding of this fact caused at least two MAP candidates who were offered positions in the program to decline the opportunity.

MAP students sought work-life balance while in the program. Work-life balance was a common response regarding challenges for students in this category. Unlike the FAME model, MAP students work 40 hours a week and then attend technical school two or three nights each week. The number of nights required depends on the number of academic courses needed for individual degree completion. Many in this group had children involved in school and other activities and found it difficult at times to balance home life with school and work. At times, family vacations had to be rescheduled and responsibilities at home were neglected, according to some of the respondents. Along with balancing life, more than half of the interviewees acknowledged it had been a very long time since attending school, which presented some unique challenges. One student reluctantly admitted, "My seventeen-year-old daughter has helped me with Math and English classes." Some of the students formed study groups to help one another in re-acclimating to the higher education environment.

Third- and Fourth-Year MAP Program Positives

Fourth-year students were nearing journeyman status. This GEA study relates the story of how apprentice perceptions for those nearing the end of the MAP program change over the course of the program. Adaptation to the culture is paramount to apprentice success in the program. MAP apprentices in this category looked forward to completing the program and were very positive about the possibilities for career advancement. By middle of the fourth year, MAP students had completed school and were beginning to apply the theoretical instruction to day-to-day activities. One fourth-year quipped, "I am nearly a journeyman. I am looking forward to the challenge." Many of the fourth-year apprentices now work independently and are a respected part of the maintenance organization. At this point, maintenance leaders begin to have discussions regarding permanent placement of graduates as journeypersons in each assembly plant maintenance area.

Apprentices gained new skills that created a sense of purpose and garnered respect from others. Third-year MAP students continue to develop their skills at school and work. One student said, "I really enjoy coming to work. I have a purpose now." Another liked the respect and independence she received from journeymen who trusted her to make the right decision regarding problem solving and taking the necessary corrective action. A student nearing the end of his last rotation said, "I have the skills now to identify issues with equipment and the ability to make improvements. It really is empowering for me." The same student said, "If GEA ever decides to reduce the workforce, I am marketable. It sure helps your peace of mind knowing you are employable." Another fourth-year student said he had found through the course of the program that if an apprentice was dependable by showing up and doing the job, they would gain the respect of their mentors. He further stated, “If you are engaged, so are the mentors assigned to you. That was a hard lesson.”

Preventive and predictive leaning opportunities helped prepare students for technological advancements. Apprentices discussed the new opportunities offered to students in preventive and predictive maintenance technologies and that students were learning to set up infrared thermography routes with journeymen. Respondents admitted the desire to receive more training in the reliability area similar to those classes. One AP3 student shared, “I took the thermography class at the GEA training center and several of us have had the hydraulics course that was offered at GEA. Both are useful on the job for me.” Another apprentice said, “I would like to see ultrasound and machine vibration training offered to apprentices. The training would help us to get out required predictive training hours completed.” Apprentices were required to complete 400 hours of predictive technology learning during the course of the program (Appendix D).

MAP students viewed troubleshooting training as the most valuable part of the program. MAP students nearing program completion spoke of how troubleshooting skills had developed over time. A fourth-year student mentioned that exposure to programmable logic controllers and robotics helped students to find a niche as technology became more advanced on new equipment. GEA apprenticeship students had the opportunity to learn troubleshooting skills in electrical, mechanical, hydraulic, pneumatic, and motor analysis during the four-year program. Figure 5 shows MAP and FAME students working with the hydraulic troubleshooting trainer.

Figure 5. MAP and FAME students working with the hydraulic troubleshooting trainer.

Technology courses such as robotics and programming were favorites of all apprentice groups surveyed. A MAP student shared, "It is exciting to see new technology come to Appliance Park and even more exciting to know I have the skills to work with it." Another noted, "Robot programming is the reason I wanted to be in this program." Students who successfully completed the robotics course offered through either of the GEA apprentice programs received a FANUC robot operations certificate that is nationally recognized in the maintenance trades. Student success in robot coursework prompted GEA to send journeypersons to KCTCS for the same robotics training. To date, over 50 GEA tradespersons have attended the FANUC courses, in addition to the apprentices from each cohort.

Several MAP and FAME students have been observed using robot recovery functions on the plant floor, and a few have done some basic robot maintenance programming. Apprentices rotated through each area of the business and were subject to work on any number of maintenance related items. As apprentice skills developed and the mentor's confidence in the ability of the apprentice grew, the student was allowed to perform more advanced maintenance functions. Figures 6, 7, and 8 show apprentice interactions with the robot *teach pendants* used for programming at GEA.

Figure 6. A third-year apprentice refreshing his basic programming skills with the Manufacturing Training Center's FANUC collaborative robot.

Figure 7. A third-year apprentice working on FANUC robot fault recovery.

Figure 8. An apprentice and journeyman working together at the robot cell.

Third- and Fourth-Year MAP Program Challenges

Work-life balance was problematic for some. Apparent challenges for apprentices in the MAP program tended to wain as they progressed through the program. Things that appeared to be major obstacles to the early MAP apprentices were not as important to some who were nearing completion of the program. Although there were still work-life balance issues for those who were still in school, the general consensus was relief for being so very close to journeyman status. Mentorship also was less of an issue with this group as they learned to assume more personal responsibility for their development. "We have learned to seek out those who can teach us how to be a good technician," said one respondent.

Weekend overtime and project work was scarce for apprentices. Apprentices in this category desired the opportunity to get more weekend work and to learn from journeymen working on maintenance projects. Project work that could not be done when the production lines were running offered excellent exposure opportunities for apprentices to learn from mentors without the pressures of maintaining production line operations. Apprentices said a need existed for students to see how things were dissected, repaired, and reassembled. Over half of respondent MAP apprentices mentioned the need for weekend training. An apprentice in AP4 COE said, "It is not just about the overtime money, but I can learn as much in one day when no production is running, as I can in a week when it is." Another said, "Saturdays are filled with unique opportunities to learn how things really work. That type of training is not possible during weekdays." If production lines were idle, weekend overtime was based on individual project needs of assembly plants at Appliance Park.

Apprentices wanted deeper training after the program ends. The topic most emphasized among all respondents in the third- and fourth-year MAP category was the understanding of future training needs. Most students from this group shared fears that training was not as comprehensive as they expected. All but one of this group said more electrical training was needed as soon as possible. Others who believed they would be going into areas where robots were prevalent desired to get into more advanced robot and logic training.

Predictive technology and reliability training were requested by apprentices in every group that was surveyed. Complaints surrounded the belief that most of this training was not available until after apprentices graduated as journeypersons. The issue, according to some apprentices, was that management was less likely to release a journeyperson to go to specialized training once assigned to a permanent area. A replacement tradesperson must work overtime to cover for the individual attending the class. Students were convinced the best opportunity for apprentices to receive the training was during a time when replacement coverage was not needed (while they were apprentices).

MAP and FAME Graduates Program Positives

Graduates viewed the new opportunity as payoff for personal sacrifices. By the time apprentices reached the end of the apprentice program in either of the two GEA pathways, students had completed identical curricula and on-the-job training requirements. The difference from MAP to FAME was the format in which it was accomplished. Graduate responses for both groups are included in this section. The overall view of the program was positive from graduates of both MAP and FAME.

Similar to the third- and fourth-year apprentices, the graduates showed appreciation for the opportunity to create a better way of life for themselves and their families. Although apprentices were not at the top pay rate for maintenance, graduates would achieve that rate over the next several months. A graduate remarked, “I am finally at a place where all of my sacrifices are paying off.”

New skillsets learned in the apprenticeship program gave graduates confidence to succeed in other areas of life. All eight respondents in this category mentioned that their new skillset was valuable both at work and at home. Many shared the belief that they were a better person for having completed the program. One said, “My confidence, compared to when I started the program is off the charts.” Another was not as enthusiastic saying, “I have the ability to do things, but my real test is learning the area that I am required to maintain.” Recent graduates supported the idea that daily learning was required to master an area. as they became acclimated to their assignment areas and began to understand the nuances of the equipment and processes in which they were required to maintain.

MAP and FAME programs helped students become better communicators. Many graduates shared the belief of being a better communicator than before entering the program. Communication courses and daily conversations with mentors and other tradespersons required the concise transfer of information. Troubleshooting required a level of precision when tradespersons relayed their findings to other tradespersons or the leadership for follow-up. One new journeyman said, “I learned both, how to communicate and what to communicate regarding maintenance issues, in the apprentice program.”

Building rotations provided comprehensive training to apprentices. One surprising response centered around the value of apprentice rotations through different buildings and maintenance areas. Most graduates viewed the exposure to the various aspects of the maintenance culture as positive in nature. Some apprentices in the earlier years of the program had expressed it was information overload trying to understand concepts of facilities, plastics department, stamping, and production lines. Several of the graduates remarked that rotating through multiple locations helped prepare students for any assignment. Two students mentioned the rotations helped apprentices apply the theory from the RTI classes, even if the classes were not offered at the same time of the assignment with which they corresponded.

MAP and FAME Graduate Program Challenges

Tracking *bucket list* hours was challenging. Many perceived challenges of apprentices in the earlier stages of the program were gone from the graduate's list of obstacles. Work-life balance was easier now that school was complete. There were no longer mentor concerns and overtime issues were no longer a factor. A MAP graduate noted, "Things seemed harder early on, but most of the program issues worked out over time."

One challenge, echoed by several of the graduates, was the tracking of hours worked and designating those hours into each of the Registered Apprenticeship 10 categories or buckets. One graduate said, "The hardest part for me was tracking my hour requirements into the proper buckets. Some training could fit into several buckets." Throughout the program, the apprenticeship manager and the apprentice logged work hours to fulfill GEA apprentice training requirements. Building rotation assignments were designed to ensure apprentices, nearing the end of the program, were placed in areas for *bucket list* completion. For example, if an apprentice completed all required hours for nine buckets but needed more plumbing hours to complete the 10th bucket, the apprentice would be assigned to an area to complete those hours of plumbing training. Completion of bucket hours was a logistical nightmare if assignment openings for apprentices were unavailable in the required areas.

The greatest challenge for graduate apprentices was learning the work assignments in new areas of the maintenance organization. Two of the graduates mentioned the difficulties of being patient with the assignment process because new journeyman assignments took some time. In a union shop if an area had an opening for a journeyperson, that assignment was put out for bid. The qualified tradesperson with the highest seniority, who bid on the job, received that assignment. After the process was complete, the new journeyperson filled in where the void existed. Final assignment designations took several weeks. As stated in the positives section, the *real education* began once the new journeyperson started working in a newly assigned area. Some graduates viewed learning a new area as a manageable challenge. Others, who were assigned to critical production areas, were more concerned.

Graduates were subject to work off shift assignments. Finally, some students were required to fill openings on second or third shift upon graduation from the program. This concern was expressed by some of the FAME graduates who had not previously worked a night shift job. A fourth-year student said, “I have never worked nightshift before, this will destroy my social life.”   FAME students with off shift experience were not concerned with the potential assignment. One said, “Night shift is easier. I am not a morning person." Most MAP graduates had enough seniority to remain on day shift. The issue looming for MAP graduates was that they could displace someone with less seniority to an off shift. The displacement could potentially include a journeyperson with whom the apprentice has worked or a mentor from whom the student received training.

Findings for Supporting Research Questions

Themes for remaining supporting research questions included positive and negative mentor impact, RTI relevance to student success, barriers to student success, and program improvement opportunities as perceived by the apprentices who participated in this research study. Answers for supporting research questions were derived from apprentice interview responses and observations conducted at GEA Appliance Park. During the observation process, feedback was given to the researcher by mentors who were working with apprentices on the shop floor. Overall, feedback was positive regarding the progression of apprentices through the program. MAP and FAME mentors expressed the program was necessary for sustainment of the maintenance program at GEA.

Findings for Research Question 2

RQ2. What role does mentorship play in the success of the student and how do mentors impact the program culture?

MAP Students Positive Mentor Impact

The mentor was the key component in helping apprentices apply theoretical information into practical application. Each assembly plant at GEA had designated mentors to whom apprentices were assigned. Although trainees were assigned to mentors, the students likely would work with several tradespersons in an assignment area.

GEA maintenance journeypersons had eclectic backgrounds of trades-related experience. A single area may have had electricians, plumber-pipefitters, millwrights, and several people trained in general maintenance. There was a wealth of knowledge in every area of apprentice assignment location. An apprentice assigned to an area may had been asked to assist any nearby tradesmen on projects or line coverage. This afforded the student the opportunity to learn at many different levels and to respond to maintenance calls, both in and out of the mentor coverage area. Assignment designations were determined by the hourly maintenance coordinator in a plant, unless the apprentice was assigned by leadership to a dedicated mentor in a specialty area, such as the preventive maintenance group or shop repair.

Mentors helped those who were engaged. Interview responses in the GEA study showed mostly positive mentor impact from participants in each of the MAP categories. Mentors and other tradesmen in general shared information freely with apprentices, and most respondents shared experiences in which mentors were not only their coach, but also their cheerleader. In observations, mentors were found teaching tasks like basic robot programming and machine repair to apprentices in their area. Others were seen working with apprentices to establish predictive inspection routes. One MAP apprentice shared, “Mentors will help us if we are engaged and open to learn. I have had a great experience with every mentor that I have encountered. We have to earn their respect.” Another noted, “Many of the mentors, are now my friends.”

Mentors shared technical knowledge with apprentices. Mentors in AP3 acknowledged that if an apprentice wanted to learn, there were people willing to impart information to them. During observations of apprentices working on the shop floor, mentors were forthcoming in sharing how most of the third- and fourth-year students were excelling beyond expectation. One mentor shared, “The degree of mechanical inclination varies from apprentice to apprentice, but by the time the apprentice reaches year three, they normally have a better understanding of how things are done in the maintenance culture.” Things became much easier for apprentices as they became part of a plant’s maintenance culture and as the student gained the respect of tradespersons.

MAP Mentor Improvement Opportunities. Seniority issues hindered mentor engagement in every assembly plant in some capacity for MAP students. This was especially true in the AP5 Refrigeration Division and to a lesser degree in the AP4 Plastics Center of Excellence (COE). Some new MAP apprentices had as much as 25 years of seniority working for GEA. Many maintenance personnel were hired in the last 10 years, and some began careers at GEA as recently as 2019. Apprentices with high seniority reported animosity toward them because upon becoming journeypersons, an apprentice potentially could roll current journeypersons with less seniority to an off shift.

Sometimes issues arose because apprentices may have been at a higher pay rate than some journeymen with whom they were assigned. Pay issues apparently were problematic with some journeymen, even though new journeymen eventually topped out at a higher rate. MAP apprentices in each respondent category mentioned instances in which seniority issues arose with mentors that caused discussions and, in rare instances, created conflict.

Although mentors were not formerly interviewed for this study, several journeypersons were forthcoming about apprentice seniority issues. Some tradespersons expressed unhappiness about the potential of being rolled to an off shift by an apprentice.

One mentor admitted the seniority issue was why some journeymen refused to train apprentices.

FAME Students Positive Mentor Impact

Mentors shared technical expertise with apprentices. FAME respondents generally saw mentor engagement as very positive. A recent graduate said, “I’m not sure if it is our age or the fact that we are not a threat to roll anyone off shift, but there have been no issues getting mentors to teach us the trade.” FAME students were required by program guidelines to present projects to leadership from KCTCS and GEA. Mentors have supported apprentices by attending and participating in student presentations. A third-year remarked, “Our mentors are with us at every step of our projects and their input and support are wonderful.”

Mentors taught life lessons to apprentices. MAP graduates collectively agreed mentor relations were a significant part of their success in the program, Several MAP graduates spoke of their mentors with admiration but acknowledged that some mentors were not as forthcoming with information as others. One graduate said, “I truly received a great mentor education even though I had to be patient and find out who in each area would take to time to share with me. There were struggles, but it was an overall positive experience.”

FAME Mentor Improvement Opportunities

Reassignment was common with FAME apprentices. Although two thirds of FAME students surveyed had a positive mentor experience, there were exceptions to the rule. FAME students said they were moved more frequently within building rotations in the first two years than MAP students due to school schedules. FAME apprentices were assigned to a journeyman to assist with a maintenance project, but sometimes the apprentice was not present to complete the project. Issues arose if the project lasted more than one day because FAME students attended school twice a week. The apprentice likely was at school for the second day of project work, but the project was completed with or without the apprentice. Then when the apprentice returned to work, there was a different assignment. “It takes a long time for a mentor to trust us to carry out tasks on our own. If I work with someone different every day, I may never gain that trust,” remarked a first-year FAME student.

Some condescension was evident from mentor to apprentice. The same student reflected that sometimes there was a level of condescension from tradespersons to FAME students. Two students shared at first feeling as outsiders because some tradespersons and maintenance managers called them “FAME kids”. Three FAME apprentices mentioned unkind words from production workers because FAME students were external direct hires into maintenance. Some production workers had attempted to enter the apprentice program since 2015 and were very vocal in sharing contempt with FAME apprentices.

Unclear expectations for mentors caused issues. A frustrated first-year student said respectfully, “I’m really not sure if all the mentors understand the expectations of their role in the program. I know I’m green, but isn’t that what they are for?” The new apprentice added, “ My mentor got upset with me many times when I didn’t know what he was talking about.” Others found confusion when mentors from different backgrounds used alternative terms for the same tools or devices in the shop. One apprentice requested a tool recognition course with all the aliases included.

FAME graduates relayed similar thoughts regarding mentors. One said, “Now that we are done with the program, I hope they take us more seriously. We worked hard to get here.” The same FAME graduate clarified that only a few tradespersons were dismissive of the FAME students, and apprentices were treated fairly by all but a select few tradesmen. A FAME graduate remarked, “I’m thankful for the time that was taken to train me in the trades. I hope I’m up to the challenge in my new assignment.”

Mentors’ concerns for new FAME students included lower maturity levels for some of the younger apprentices and the need to constantly remind younger students of the dangers of the workplace, even though the apprentice had completed extensive safety training.

Findings for Research Question 3

RQ3. How does related technical instruction received by the apprentice contribute to student success?

RTI Value Discussion

Technical courses established a base of principles. Twenty-three of the 24 student respondents in the GEA study listed troubleshooting as one of the most valuable courses they received during their RTI training (Appendix E). Student respondents deemed technical courses in the program as highest in value of all RTI. Students spoke of applying principles from technical courses directly to practical application at work, and some expressed the desire to further their technical education by continuing to take courses when apprentice training was completed. Most of the RTI was seen as valuable to the students in relation to personal success in maintenance environment.

Students took core classes to fulfill degree requirements. English and science were listed by students as valuable to personal success. According to student interview responses, no issues existed with taking the basic core classes that would qualify them for degree eligibility like English and Math; many were thankful that tutors were available to assist those who had been out of school for an extended period of time. They remarked that the support structure offered by KCTCS in both the MAP and FAME programs was appreciated regarding small class sizes, as well as access to instructors and other tutors when working on difficult assignments from school.

Students wanted electives that were relevant to skilled trades work. The only significant pushback regarding RTI in the student responses dealt with the required elective courses like Theatre and the History of Dinosaurs, and some disliked having to take a science class. Student responses suggested offering more advanced electrical training, or other courses with certifications attached such as thermography or ultrasound for maintenance, instead of current elective choices. One student remarked, "I understand degree requirements, but classes more closely related to our careers would be better options."

Findings for Research Question 4

RQ4. Are company provided skills training courses available to students during and after the program is completed?

Company Provided Skills Training

Company provided skills training for maintenance was administered two ways at GEA. The most common delivery method of this training occurred in GEA's Manufacturing Training Center (MTC) located in building AP3 at Appliance Park in

Louisville, Kentucky. Satellite plant locations around the country have similar training facilities. The other method involved GEA sending maintenance and engineering personnel off site to conferences and other training venues for advanced training and certifications.

Onsite training was becoming more available to apprentices. Training providers at the MTC were required to be on an approved educational provider list at GEA to offer training onsite. Ivy Tech was a regular in-house provider of electrical, mechanical, control logics, basic hydraulics and pneumatics, hydraulic troubleshooting, mechanical drives, and welding courses. KCTCS trained maintenance journeymen in basic robotics for GEA. Other providers like the Academy for Infrared Training (AIRT) and TESTOIL offered reliability training and certifications at the MTC location. Advanced training in vibration analysis and motor testing, along with certifications as a Certified Reliability Leader or a Certified Maintenance Manager, usually were acquired offsite.

Historically, apprentices have had little access to the company provided training option during the course of their apprenticeship studies. Recently, apprentices have been offered seats in the advanced training classes. Apprentices are now invited to fill the empty slots in classes offered to journeymen if they are available and have permission of a supervisor. Several apprentices reported they had completed company provided training in hydraulics, mechanical drives, and thermography since given the opportunity. Others said they had been told apprentices were expected to participate in upcoming training at the MTC.

Offsite training was unavailable to GEA apprentices. No apprentice respondents reported going off site for certification training. To date, only the certifications offered within the apprentice curriculum have been offered to apprentices.

Findings for Research Question 5

RQ5. What barriers exist that could deter student success in the GEA apprentice program?

MAP and FAME Barriers

When discussing barriers to student success with current and former MAP students, the experiences seemed as diverse as the personalities of the group. One simply replied, "I experienced no barriers in the program." Another said, "I have been fortunate to have had a positive experience throughout the program." Other MAP and FAME student respondents cited apprentice-management relationships, mentor issues, lack of advanced training, and work-life balance as potential barriers to apprentice success.

Apprentices had unique experiences relating to maintenance management in each assembly plant. Interview responses revealed that some managers frequently pulled apprentices away from training and put them doing what was called *grunt work*. Apprentice respondents believed that management did not value apprentices enough to allow time for necessary mentor training. One apprentice said, "The mentors will never train us if they think the boss is going to pull us away every day to sweep the floor and paint." Another apprentice said, "I am not convinced that some of management value the program. It is like we are just one more thing for the boss to deal with."

Mentors needed clear expectations regarding apprentice training. Apprentices stated that some mentors had not received communication or mentor training and not all mentors are good at conveying information. A FAME graduate said, “It is difficult to learn from people who can’t communicate.” The common mentor perception of apprentices, according to the FAME student, was that apprentices should already know things and mentors should not have to teach the basics. Unfortunately, that was not true in many instances. A third year FAME student remarked, “My journeyman asked me what he is supposed to teach me. They expectations are not clear.” Similar to other groups interviewed, MAP and FAME graduates listed mentor willingness to teach in several of the barrier responses.

Advanced training was desired by students in some maintenance subjects. At the end of the program, both MAP and FAME students had met the same criteria regarding hours worked and related technical instruction. One FAME student expressed that his FAME cohort received no electrical wiring or panel building training during the program and was a bit lost when required to do it at work. He said, “We need more in-depth electrical training.” Another remarked, “My plan is to enroll in additional maintenance courses at the end of the program.” Others in the program said they had been introduced to a wide selection of maintenance applications, but not in great detail.

Work-life balance issues affected apprentices in both programs. One MAP graduate cited balancing school, work, and life was difficult at times, but it did not stop her from completing the program. She noted, “I did not expect it to be easy, but I had to make many work-life decisions throughout the program.” Other MAP graduates told of struggles adjusting back into the classroom after being out of school for many years. FAME graduates were concerned about whether they were properly prepared to become journeypersons because of being constantly shuffled between mentors. One FAME student responded, "It is like little just eating nibbles of information, but never a whole meal." There were few complaints from FAME graduates regarding the RTI.

Summary

The findings are better understood with reminders of those who participated in both the MAP and FAME programs. FAME participants were primarily, but not exclusively, made up of students just finishing high school. FAME students were sponsored by GEA and required to have ACT scores of at least 19 in Math and 21 in Reading. GEA FAME apprentices typically were much younger and inexperienced than those who were participating in the GEA MAP program. FAME students were fresh out of school, and though they had little experience, personal observations proved that FAME students tended to grasp technology better than someone who had been away from school for an extended period of time.

GEA MAP apprentices were incumbent workers who had at least five years of company service and passed the Basic Mechanical and Reasoning exam (BMAR). Candidates were then interviewed by a cross-functional panel, and the top scoring candidates were offered entrance into the program. The number of MAP candidates selected was dependent upon the annual needs for the program. Candidate entrance into the MAP program was highly competitive. Interested production workers viewed the maintenance apprenticeship program as a golden opportunity for career advancement without having to leave the company.

Several program positives were identified in all groups. Findings indicate both, GEA MAP and FAME programs were positive career advancement opportunities for participants who successfully completed the program. Apprentices agreed skills and credentials gained from their experience in the GEA program were worth the effort. Most students responded thankfully for the advancement opportunity and expressed that apprenticeship training would pay lifelong dividends. Observations showed positive mentor interaction with apprentices during maintenance training on the shop floor. The opportunity for apprentices to learn through company provided training was becoming increasingly available as advanced technologies were introduced to the business.

Improvement opportunities were identified in respondent feedback. Findings showed areas of opportunity for improvement based on feedback from respondents. Common themes arose from the interview data to lend validity to most of the student responses. Students from both MAP and FAME programs expressed worries that they may not have been trained well enough to make an immediate impact because of some of the barriers they endured in the program. Those worries supported the problem statement in which GEA leadership believed some apprentices would fail to be ready for journeyman status upon completion of the program. Observations showed that apprentices were performing well, and some mentors mentioned that many of the apprentices under their tutelage performed better than expected.

Apprentices made suggestions for improving course curriculum by adding more advanced maintenance related and machine reliability courses as electives during the RTI requirement. They also made suggestions for mentor and supervisor training regarding areas of communication and leadership. Two MAP graduates suggested moving to a more task-based method for tracking apprentice work versus the bucket system currently in place. Apprentices contended that a task-based system would be easier for the apprentice to track and easier for the mentor to focus the training. One said, “I can track my training better when I can associate an actual workplace task with it. It is difficult to put everything I do into a box." These and other recommendations are included in Chapter V.

CHAPTER V: DISCUSSION

GE Appliances in Louisville, Kentucky, instituted a maintenance apprentice program in 2015 to offset the need for hiring skilled maintenance personnel. GEA currently offers two paths for apprenticeship education: MAP and FAME. The MAP path offers incumbent workers the opportunity to up-skill from production jobs into careers in the maintenance department. GEA FAME finds local recruits, primarily high school seniors and recent graduates from nearby partnering schools. Programs like GEA's MAP and FAME are necessary to help offset the shortage of skilled workers available in the job market. Christman (2012) noted that without apprentice programs available, employees are forced to outsource jobs that require advanced skills. The DOL (2020) webpage forecasts 692,800 new construction jobs over the next six years and tens of thousands of maintenance related jobs in addition to those.

Construction contracting companies and industry maintenance departments seek employees from the same pool of skilled candidates. Many Louisville, Kentucky, area businesses have posted maintenance job openings, and competition has been fierce to attract qualified maintenance personnel. Company funded apprentice programs can be a viable solution to this deficit. On-the-job training benefits both employers and employees and can address both re-skilling and up-skilling needs (Dimeny et al., 2019). Dimeny et al. (2019) indicated employers who invest in workers increase the probability of retaining them, and the workers achieve greater productivity and can benefit the firm's bottom line by absorbing new technology. The paramount challenge is to assure apprentices are prepared for those opportunities when they complete their apprenticeship studies and related training.

Due to a shortage of available, qualified, skilled tradespersons, the GEA apprentice programs are relied upon to offset or eliminate the impact of this shortage. The problem is the perception that some of the graduating apprentices are not prepared to move immediately into journeyman roles. Some GEA mentors and leaders have expressed concern that a multi-trade apprenticeship such as the GEA model may not prepare the student as holistically as a traditional apprenticeship program that solely focuses on a single craft. The multi-craft apprenticeship requires the same 8,000-10,000 on-the-job completion hour model and the same amount of related technical instruction (RTI) as a single-craft apprenticeship. Some leaders have questioned how an apprentice can be proficient at all necessary trades-related skills required by a multi-craft maintenance program considering that electricians, pipefitters, and other tradespersons spend the same amount of time honing their individual crafts.

This ethnographic research study was designed to gather insight into the state of the GEA apprentice program culture. The study collected subjective information to help determine whether program objectives were being achieved. Marshall and Rossman (2007) identified an ethnographer as someone who studies culture, groups, communities, and organizations, often by way of total immersion to capture patterns, roles, and daily interactions of life. The target population involved 58 current or former participants in both of GEA's apprenticeship program offerings at Appliance Park, of which 24 participated as the sample for this study. The sampling matrix was developed to include representation of apprentices in both the MAP and FAME programs. The second sampling category was designed to gather responses from students in (a) first and second year in each program, (b) third and fourth year in each program, and (c) graduates of each of the programs.

The Interview Guide was based on the primary and secondary research questions for the study. The central research question was: What is the program impact on students who complete an apprenticeship through GEA? Interview Guide responses and classroom and workplace observations constituted the data from which analyses were drawn to answer the question. The following four secondary research questions guided the organization and syntheses of the data:

1. What role does mentorship play in the success of the student and how does it impact the program culture?
2. How does related technical instruction received by the student contribute to their success?
3. Are company provided skills training available to students during and after the program is completed?
4. What barriers exist that could deter student success in the GEA apprentice program?

WKU IRB permissions were requested and approved, and consent forms were presented and signed by participating apprentices in this research study. The primary researcher then gathered findings for this GEA apprenticeship study in the form of apprentice interviews and observations of apprentices during related technical instruction participation and when working with mentors on the shop floor. During the observation portion of this study, photographs were captured of some of the apprentices as artifacts for the study.

Discussion of Findings

FAME Program Positives

According to student interview response feedback, the overall impact of both MAP and FAME was positive. Students in every category talked favorably about the unique opportunity of participating in one of the two apprentice initiatives. Opportunity, self-confidence, and the acquisition of new skills were the primary positive themes that were shared across the interview categories. New FAME students cited independence and the ability to join the workforce for the first time as priorities on their list of positives, along with getting paid to learn while earning a degree. FAME students who had completed the RTI portion of the program were happy to be working every day with mentors, instead of going to school two days a week as in their first five semesters. Three FAME participants shared plans of continuing education into business management and engineering in the future.

MAP Program Positives

MAP student respondents listed learning a trade and developing a skill set as the top two positives on the impact list. Many of the MAP respondents, especially those completing years three and four, spoke of moving from a job to a career and shared the sense of security that came along with acquiring those skills. The degree was important to some of the MAP participants, but seemingly not as important as learning technical skills. Several MAP apprentices have had jobs at GEA that required problem-solving skills, and the program helped develop those skills to higher levels, according to some of the interview responses. Troubleshooting was one of the favorite courses among MAP respondents. Troubleshooting challenges individuals in problem-solving activities directly related to maintenance activities.

Once the program for apprentices is completed, they will reach journeyman status in which their rate of pay is potentially much higher than working on an assembly line operation. Respondents discussed that those changes in personal financial status were worth the efforts of completing the program.

FAME Program Challenges

First- and second-year FAME students called the combination of work and school a huge responsibility with early start times and the transition into the real world. At times, new FAME apprentices were reluctant to ask questions of mentors due to feeling the mentors did not view FAME apprentices as adults. Some early FAME students said they had been referred to as *FAME kids* and were not taken seriously by management or mentors.

FAME students worked three days a week and went to school two days during the week. The belief from FAME respondents was that the school schedule created barriers for them to create rapport with individual mentors. Some suggested going to school two consecutive days and working three consecutive days to help apprentices forge better relationships with mentors. Apprentices further suggested apprentice assignments hindered mentors from trusting apprentices with daily tasks because apprentices were assigned to different mentors at the maintenance coordinators' discretion. One FAME student said, "It is difficult to build trust, if you are assigned to a different journeyman every day." In some buildings it was common for apprentices to work with several mentors each week.

Mentors expressed frustrations with the intermittent schedules and with engagement from individual apprentices. Some mentors suggested apprentice work during the first three workdays and school the last two days of the week for continuity of learning. One mentor said, “Apprentices are better engaged when they see a program through from start to finish.” Consequently, some apprentices cited the problem with engagement as differences in mentor styles when teaching, which caused unclear expectations at times. One individual expressed, “Sometimes I find myself guessing what my mentor’s expectations are of me. Communication could use some work.”

One mentor noted that all apprentices learn in a unique manner. GEA mentor thinking is supported by the literature research of Tishman and Perkins (1993). Tishman and Perkins indicated two individuals may encounter the same training with the same mentor, and it may be unique to one and routine for the other. The instruction may be received differently because of personal intentions, interests, or values that have arisen through personal historical experiences (Tishman & Perkins, 1993). Learning is affected by the way in which these many complex factors are construed by the individual as they synthesize the information presented to them (Billett, 2016).

Some apprentices found the trades lingo cumbersome to master. Tools and other trades-related items were identified differently by different craftsmen. Students expressed that the lingo variances and the broad scope of general maintenance learning caused anxiety at times. One apprentice remarked, “There is a tremendous amount to learn, and it is even more difficult when tools have more than one name.”

Students in the GEA program were issued a basic set of hand tools at the beginning of the apprentice program. As students progressed through the program, there were times when unique tools were necessary to complete maintenance tasks. The literature indicates this common problem exists for apprentices everywhere. Van Pelt (1999) reported Miller Brewing Company created Tools for Success to help graduating apprentices without company sponsors land lucrative maintenance jobs. Miller Brewing recognizes that the fulfillment of skilled trades positions had been deterred because many recent apprentice graduates did not possess the required tools for the job (Van Pelt, 1999). Van Pelt noted Miller Brewing scholarships met the need for hundreds of students who needed tools.

MAP Program Challenges

Commonalities existed across each of the categories in response to program challenges for several issues, including mentor struggles, work-life balance, and apprentice expectations. The mentor issues are discussed in detail in the Research Question 2 discussion. Work-life balance issues were mentioned by each of the three MAP apprentice respondent groups. For many of the MAP students, it had been many years since being in a classroom. MAP participants were required to work the usual 40 hours (or more) and then attend night school two and sometimes three nights a week. Students with children and those who lived a considerable distance from the Louisville area were the most vocal regarding work-life balance issues. Some MAP graduates cited the work-school-life balance as the number one challenge they faced during their four-year program. Others said seniority issues with mentors topped the list.

MAP apprentices in the first two years of the program were displeased in general that overtime was intermittent for them. Some had moved into the apprentice program from production areas where overtime was bountiful. Although most respondents did not see an issue with the overtime reduction because of the school requirements, several acknowledged losing money in the early years of the program.

Leadership support and buy-in from each building played a major role in the expectations of the apprentices on the shop floor. Interview responses suggested rotations in some buildings expected them to stay back and only observe, while leadership in other buildings expected them to be an extra set of hands to the journeyman with whom they were working. Frustrations were evident from some of the respondents, but the general consensus was that apprentices would be available for any opportunity for learning that may arise.

FAME and MAP Graduates

Graduates shared that mentor relations, related technical instruction, and company provided training impacted their progress in the program. Program graduates shared minor issues that arose throughout the course of the program but perceived the experience positive overall. MAP graduates experienced more seniority issues than FAME graduates, but respondents from both MAP and FAME reflected the issues as being minor compared to the reward. One graduate said, “We just had to be patient with the process. It all worked out fine.” Three challenges that were noted by graduates regarding the GEA program involved logging hours into buckets, learning the journeyman assignment area, and adjusting to shift changes.

Mentorship

Mentorship is a major component of any apprenticeship program. Professors and mentors are necessary to train and mold students to be competent professionals (Nicaise, 1997). Mentors serve as trainers, teachers, and guides for students in each GEA apprentice program.

Apprentice feedback for mentors was positive overall. Respondents described that mentors and other journeypersons on the plant floor shared valuable information regarding maintenance tasks. Others noted mentors shared more than just the basics to apprentices. A recent graduate said, “Mentors taught troubleshooting techniques and basic machine maintenance to apprentices who were open to learning.” Another apprentice noted that information was shared freely from journeypersons who were skilled in many trade backgrounds.

Graduates suggested an apprentice could learn anything if the student took the time to get to know the subject matter experts for each craft. FAME students spoke of how mentors had supported school and work projects for the apprentices and even participated in the projects when asked. Others said they made life-long friends of some of the mentors at GEA.

Mentorship was challenging in isolated areas of Appliance Park. Some plants had maintenance teams that did not fully support the apprenticeship initiative. Respondents claimed seniority issues of apprentices were problematic with journeypersons who had less time at GEA. Interview responses suggested seniority issues caused tradespersons to refrain from supporting GEA apprenticeships and caused the same tradespersons to lobby against apprenticeship support from other maintenance personnel. According to some apprentice respondents, the same issues led to condescending comments from a small number of managers and tradespersons.

Apprentices suggested some mentors were unclear regarding apprentice expectations due to communications barriers that existed Some apprentices recommended mentors receive the same communication training as the apprentices and suggested the program create an expectations list for mentors in both the MAP and FAME programs.

Related Theoretical Instruction

Findings for Research Question 3 indicated current and former students from each response category were overwhelmingly in support of the current technical curriculum. Each apprentice discussed the courses that had the most positive impact on their learning success in the program. Apprentices agreed that all required technical courses were important to student success.

Other than the technical courses, respondents said their communications and problem-solving classes would have the most positive impact on their success in the maintenance environment. Core classes such as English and Math, and some science-related classes, also were seen by students as necessities for success. Students recommended replacing the electives in Dinosaur studies and Theater with advanced courses in electricity or reliability related courses like machine ultrasound and infrared thermography.

Last, students remarked that the KCTCS system was invested in student success. Many students took advantage of school provided tutors for help with Math and other challenging courses. FAME coordinators at KCTCS and the local FAME chapter also supported the success of the students. MAP students mentioned that it was nice to know they had a voice with the apprenticeship program director and showed appreciation for the open door policy at GEA.

Company Provided Skills Training

Historically, GEA apprentices have had little access to the company provided training option during the course of their apprenticeship studies, but recently some have been invited to fill the empty slots in classes offered to journeymen when openings were available. Several apprentices reported they have had company provided training in hydraulics, mechanical drives, and thermography since given the opportunity, and many more are expected to participate in upcoming training at the MTC.

Virtual Reality training is slated to be available to GEA employees in 2020. Stoner et al. (2011) explained that electronic media for delivery of some apprentice training is necessary and inevitable because apprentices today are different than any generation before them in terms of access to technological advances and in the way students relate to the world. Robotics, programmable logics, and virtual reality courses are some ways apprentices can stay connected to evolving technology.

No apprentice reported going off site for certification training other than the certifications offered within their apprentice curriculum. The company provided training helped students complete their registered apprenticeship bucket list of hours if their rotational assignments failed to provide them in specific areas such as reliability, hydraulics, and electrical applications.

Barriers to Student Success

Current MAP students and MAP graduates echoed similar sentiments regarding work-life balance, considering school was two to three nights each week for nearly four years. Night school was difficult for many apprentices working a 40-hour schedule. The schedule was much more manageable for FAME students who worked three days and attended school the other two weekdays.

Mentor engagement was a topic of concern for apprentices in every category and for some of the graduates as well. Seniority issues and pay rates contributed to the tension that existed between mentors in the two-tier wage category and apprentices with higher GEA seniority. One FAME student noted some mentors thought apprentices learned the basics of the trade at school. The mentors did not realize some apprentices had no practical experience involved with theory learned at school. Barriers developed from apprentices not having basic expected experience or not understanding the trade lingo from journeyperson to journeyperson.

Last, the bucket system of tracking hours was difficult for students from each of the respondent categories. Accounting was required for every hour of shop floor apprentice work and designated to one of the 10 buckets. Some apprentices found it difficult to assign time to each worksheet bucket, mainly because much of the apprentice's day was in breakdown coverage on assembly lines. During line coverage apprentices and their mentors monitored lines and remained available for breakdowns and other issues. Suggestions to track apprentice learning by hours worked and tasks accomplished were made by apprentices from three different response categories. Task-based tracking was thought to be easier for apprentices to manage.

Limitations

The largest limitation to the study was the unique variance in skillsets of the subjects prior to entering the apprentice program. FAME students were typically recent high school graduates with little to no real-world experience and limited exposure to mechanical and electrical elements used in the apprentice program. MAP apprentices were incumbent employees who were usually older and had at least seven years of manufacturing experience to enter the program. Employee length of service seniority was a considering factor in MAP apprentice candidates' entry into the program. These differences affected their perceptions of the program and were evident in the interviews.

First- and second-year apprentices in this study did not have the same overall exposure to the business as the graduates and upperclassmen groups. The limited knowledge of the overall culture for each assembly plant contributed to the view of the underclassmen. Additional exposure limitations existed, as each apprentice was required to complete building and assignment rotations uniquely. One fourth-year student may have been assigned to AP3 in the first rotation year, while another may have been assigned to AP4 COE initially.

Recommendations

Program Recommendations

Five primary daily concerns from apprentice respondents included mentor engagement, management expectations, cultural differences in each plant, apprentice transportation within the facility, and proper tools for apprentices. Based on interview feedback and researcher observations, the following recommendations were offered to GEA and the apprentice program managers:

1. Scale the program back to only buildings who support it
2. Plant apprentice sponsorship
3. Leadership and communication training for mentors

4. Assign apprentices to their sponsoring building throughout the program
5. Adjust Registered Apprentice Worksheet to match each plant's needs
6. Task-based learning for apprentices with clear objectives
7. Offer a week of pre-apprentice training to include safety, tool recognition, and basic tear down and rebuild of common components
8. Address the seniority issues by having an apprentice entry date

Many apparent issues revolved around mentors and some plant leadership fully supporting the business objective of the MAP and FAME programs. A call for executive leadership was suggested as one way to garner engagement, but the best immediate solution was to reduce the number of incoming apprentices based on those buildings or plants that offered support for them. The plant cultural differences could be easily solved by plant leadership drafting apprentices to sponsor similar to the FAME draft used for companies to select FAME participants.

Several response concerns could be resolved by plant sponsorship. If a plant sponsors an apprentice, plant leadership should be assured the apprentice would work for the sponsoring plant at program completion. This idea gives ownership to building managers and mentors who question training apprentices who are going to work in a different plant.

The sponsor model also would solve the issue of transportation and proper access to tools needed by apprentices in a specific plant. Maintenance leaders are more likely to provide tools and transportation items to apprentices who stay in sponsoring buildings. The idea also would offer apprentices the opportunity to build rapport with a smaller group of tradespersons and to build trust at a faster rate. One concern with dividing apprentices into sponsoring buildings is the way in which the Registered Apprentice Worksheet would fit with the individual buildings. The worksheets could be adjusted based on the needs of the sponsoring buildings.

Whether the first two recommendations are adopted, mentor leadership and communication training is vital. Apprentice communication classes have helped students cope with the different aspects of the maintenance environment, and mentors also can benefit from the classes. GEA should sponsor training to help mentors communicate more effectively with apprentices and others.

Task-based apprentice tracking was recommended. If an apprentice is given a list of necessary tasks for each of the 10 buckets, the student can learn on a more specific level when working with mentors. Mentors also would have a better understanding of how to train apprentices if a formal task book could be kept by the apprentice. In a task book, each task has a detailed procedure with diagrams and safety completion guidelines. Each task requires a mentor, a supervisor, and the apprentice to sign off when a task is completed satisfactorily. This model was used at Ford Motor Company when the primary researcher served an electrical apprenticeship.

Finally, the biggest barrier to mentor-apprentice relations involved the issue of MAP apprentice seniority. The seniority issues were cited by respondents as the cause for apprentices with higher GEA seniority to be treated differently by low senior tradesmen. The apprentice respondent consensus was that journeymen were concerned that apprentices could displace journeymen to an off shift when the apprentice completes the program.

The recommendation for addressing the seniority issue was simple. GEA should institute an entry date for apprentices entering the MAP program. With an entry date to maintenance, the apprentice could keep GEA seniority for vacation and personal day concerns; the shift and pay rate would be equal with someone who hired into GEA maintenance from external paths. For example, if someone with January 1, 2000, GEA seniority entered the MAP program on January 1, 2020, the maintenance seniority date would be January 1, 2020, but the GEA date would remain at January 1, 2000. At the end of their apprenticeship, the MAP apprentice would have seniority on only journeypersons who were hired after the apprentice entered the program.

This solution would address some mentor concerns of apprentices who did not seem to be fully invested in the program. The MAP apprentice would need to decide whether the program was worth giving up the seniority regarding shift selection.

Recommendations for Mentors

- Work with apprentices to track tasks and sign off on the tasks completed correctly
- Participate in communications and leadership classes

Education Provider Recommendations

- Replace current electives with advanced technical and reliability training

Company Provided Skills Training Recommendations for Apprentices

- Enhance PLC training, to include GE Proficy, Allen-Bradley, and Siemens
- Enhance follow-up robotic training
- Offer reliability training to all apprentices
- Offer deeper electrical training to include wiring and electrical troubleshooting
- Add an in-depth autopsy class to dissect and repair motors, pumps, chains, etc.

Implications for Further Study

Further information should be collected through interviews with plant maintenance leadership and mentors from each of the GEA plants to obtain a more comprehensive view of both the GEA MAP and FAME programs. Additional data could be collected from organizations that sponsor apprentice programs, like GEA's general trades programs, and from companies that sponsor specific trade apprenticeships at their facilities to determine whether some of the same perceptions exist. If the recommendations offered in this GEA apprentice study are implemented, an additional study might be conducted within the next two years to determine whether apprentice perceptions have improved.

Conclusions

This study examined the history of apprenticeship programs, the need for apprentices in the workplace, and the types of apprenticeship programs existing throughout the world. The primary focus was skilled trade apprenticeship programs and how they helped companies in dealing with a shortage of skilled labor. Due to a shortage of available, qualified, skilled tradespersons, the GEA apprentice programs are relied upon to help offset or eliminate the impact of this shortage.

GEA's MAP and FAME apprentice programs were examined in an ethnographic study of the GEA apprenticeship culture. Apprentice interviews and observations were conducted that focused on perceived problems with the GEA programs. The problem was the perception that some of the graduating apprentices were not prepared to move immediately into journeyman roles. The research questions examined program impact on the individual student and factors contributing to student success.

Program positives were outlined in the findings, along with potential opportunities to improve each of GEA's apprentice initiatives. The study found several areas of potential improvement and offered recommendations that could be considered by GEA program leadership. Overall, the program appeared to be properly preparing apprentices for future roles as GEA maintenance journeypersons. Recommendations for program structure, mentor engagement, and future training were significant talking points in this study.

Key recommendations for apprentice program improvement are as follows:

- Assembly plant sponsorship of apprentices
- Task-based tracking of apprentice hours
- Seniority entry date for apprentices

The transfer of knowledge that exists in apprenticeship programs is a good indicator companies want to invest in individuals, and skilled tradespersons want people capable of maintaining the business when they leave. The key to success for a program of this nature is for the program manager to ensure all the necessary stakeholders and components are present within the program, and the program is current and relevant with the needs of the business and the current climate. This study gauged buy-in of the apprentices of GEA to the goals of GEA leadership by examining their willingness to offer helpful suggestions to the overall program.

Stakeholders can use the findings of this study to determine the resources that are most effective in the success of the program. If gaps exist regarding mentorship, additional training could be conducted to improve the process. If deficiencies are discovered with related instruction aspects of the program, stakeholders may choose to create a cross-functional team with KCTCS to address the needs. The apprentice manager can use the data to make overall structural changes to the program for any improvements that are necessary. Findings indicate that further research is necessary for a more comprehensive evaluation of the GEA program structure. Results of this research will serve as a guide to deeper future studies of GEA apprentice programs.

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APPENDIX A: IRB APPROVAL LETTER

INFORMED CONSENT DOCUMENT

Project Title: Apprenticeship Participation at GE Appliances: An Insider's Ethnographic Study of Apprentice Participation and Factors Contributing to Apprentice Success

Investigator: Berschel Robert Hunt, Department of Educational Leadership, In-Person contact

You are being asked to participate in a project conducted through Western Kentucky University. The University requires that you give your signed agreement to participate in this project.

You must be 18 years old or older to participate in this research study.

The investigator will explain to you in detail the purpose of the project, the procedures to be used, and the potential benefits and possible risks of participation. You may ask any questions you have to help you understand the project. A basic explanation of the project is written below. Please read this explanation and discuss with the researcher any questions you may have.
If you then decide to participate in the project, please sign this form in the presence of the person who explained the project to you. You should be given a copy of this form to keep.

1. **Nature and Purpose of the Project:** The purpose of this research study is to provide insight into the perceptions and insights of GEA apprentices regarding factors that promote success in the program and barriers that could limit those successes.

2. **Explanation of Procedures:** It is designed to collect data from apprentices through interview questions and observations. The interview session per participant is designed to not to exceed one hour. With your permission, I will audiotape and take notes during the interview. The recording is to accurately record the information you provide and will be used for transcription purposes only. All recordings will be erased once transcribed. If you choose not to be audiotaped, I will take notes instead. If you agree to taping but feel uncomfortable at any time during the interview, I can turn off the tape at your request and continue the interview. You further have the right to stop the interview at any time.

3. **Discomfort and Risks:** This study places me at little to no risk. The probability of harm anticipated is no greater than I would encounter in everyday life.

4. **Benefits:** The benefits gained from your participation may provide the opportunity to improve your apprentice program for current and future apprentices.

5. **Confidentiality:** Absolute confidentiality cannot be guaranteed; however, data will be held in confidence to the extent permitted by law. Records will be viewed, stored, and maintained in private, secure files only accessible by the P.I. and supervising faculty for three years following the study, after which time they will be destroyed.

6. **Refusal/Withdrawal:** Refusal to participate in this study will have no effect on any future services you may be entitled to from the University. Anyone who agrees to participate in this study is free to withdraw from the study at any time with no penalty.

You understand also that it is not possible to identify all potential risks in an experimental procedure, and you believe that reasonable safeguards have been taken to minimize both the known and potential but unknown risks.

____ ________________

Signature of Participant Date

____ ________________

Witness Date

- I agree to the audio/video recording of the research. **(Initial here)________**

THE DATED APPROVAL ON THIS CONSENT FORM INDICATES THAT
THIS PROJECT HAS BEEN REVIEWED AND APPROVED BY
THE WESTERN KENTUCKY UNIVERSITY INSTITUTIONAL REVIEW BOARD
Robin Pyles, Human Protections Administrator
TELEPHONE: (270) 745 3360

WKU IRB# 20-172
Approved: 1/15/2020
End Date: 3/01/2020
EXPEDITED
Original: 1/15/2020

APPENDIX B: INTERVIEW GUIDE

1. In which program are you currently enrolled? MAP or FAME
2. Describe your experience in the program:
    a. What do you value the most?
    b. What are/were the greatest challenges?
3. How have your relationships with program mentors progressed through the program?
4. Describe how related technical instruction is incorporated into the workday.
5. Where would you like to see added focus within the program?
6. Are there any parts of the program that seem to be irrelevant to your success as a maintenance journeyman?
7. (for graduates only) Describe opportunities provided to you after the program to continue to hone your skills.
8. What would you like to see offered?
9. Were there any barriers you would consider detrimental to student success in the program?
10. How has the program impacted you, either positively or negatively?

APPENDIX C: GEA APPRENTICE WORK PROCESS SHEET

WORK PROCESS
MAINTENANCE REPAIRER-FACTORY
O*NET/SOC CODE: 49-9042.00 RAPIDS CODE: 0311

Description: Installs, maintains, and repairs machinery, equipment, physical structures and pipe and electrical systems in industrial, factory environment. Follows specifications, blueprints, manuals and schematic drawing. Uses hand tools, power tools, hoists, cranes, and measuring and testing instruments. Visually inspects and tests machinery and equipment to detect malfunction and discusses machine operation variations with supervisors or other maintenance workers to diagnose problem or repair machine. Dismantles defective machines and equipment and installs new or repaired parts, following specifications and blueprints, using precision measuring instruments and hand tools. Cleans and lubricates shafts, bearings, gears, and other parts of machinery using rags, brushes and lubricating tools. Installs and repairs electrical apparatus such as transformers, wiring, and electrical and electronic components of machinery and equipment. Lays out, assembles, installs, and maintains pipe systems and related hydraulic and pneumatic equipment. Repairs and replaces gauges, valves, pressure regulators, and related equipment. May repair and maintain the physical structure of the buildings and grounds of the establishment. May install machinery and equipment according to blueprints and other specifications. Sets up and operates machine tools such as lathes, grinders, drills, or milling machine to repair or fabricate machine parts, jigs, fixtures and tools. Operates cutting torch and welding equipment to cut or join metal parts. May fabricate counters, benches, partitions, and other wooden structures. Will work with predictive technology tools to determine machine reliability. May install, maintain and operate robot systems and perform troubleshooting with programmable logic controllers.

Approximate hours

I. Safety

600 Hours

A. Adhere to plant safety rules at all times. Complete all required EHS training for maintenance related activities.

II. Preventive Maintenance

1000 Hours

A. Clean/lubricate equipment and check fluid levels
B. Performance tolerances
C. Read blueprints and apply layout and precision measurement skills to prepare work
D. Correct deficiencies

III. Corrective Maintenance
2200 Hours

A. Mechanical
   a. Clean, inspect and disassemble pumps, machinery and equipment
   b. Evaluate work and broken components to determine the feasibility of repairs, rework and replacement
   c. Reassemble using new gaskets, and repaired, remanufactured, or new parts as needed
   d. Test reassembled devices to determine conformance with manufacturers specifications
   e. Adjust as needed for optimum performance
   f. Repair/Replace belts, pulleys, bearings, gears, couplings, and shafts

IV. Electrical
900 Hours

1. Test and troubleshoot electrical circuitry using appropriate test equipment
2. Analyze problems and correct deficiencies as indicated
3. Perform PLC and Robotic troubleshooting and recovery techniques where required

V. Plumbing
300 Hours

1. Test and repair plumbing systems and piping for steam, water, waste, and process fluids
2. Replace parts as needed
3. Test for proper operation and integrity
4. Boiler Maintenance

VI. Pneumatics and Hydraulics
800 Hours

1. Test and repair compressed air and vacuum systems and devices as needed
2. Replace or repair defective components and reassemble system
3. Test and adjust for correct operation
4. Troubleshoot and repair hydraulic systems

VII. Press Maintenance
600 Hours

1. Conduct preventive maintenance of Press equipment
2. Perform corrective maintenance as needed
3. Repair and replace parts as needed

VIII. Welding
400 Hours

1. Weld machinery components and/or structural members as needed using:
    a. Oxy-acetylene
    b. Electric Arc
    c. Tig Welding
    d. Mig Welding

IX. Predictive Maintenance

400 Hours

1. Troubleshoot using Infrared Technologies
2. Troubleshoot using Vibration Analysis
3. Troubleshoot using Ultrasonic Technologies
4. Diagnose Oil and other lubricants for potential breakdown

X. Maintenance Line Coverage

800 Hours

TOTAL HOURS

8000

APPENDIX D: RELATED THEORETICAL INSTRUCTION (RTI)

RELATED THEORETICAL TRAINING

MAINTENANCE REPAIRER-FACTORY

O*NET/SOC CODE: 49-9042.00 RAPIDS CODE: 0311

The following related training outline identifies subject matter which must be mastered by the apprentice in order to successfully complete the program:

General Education Classes	Credit Hours
Written Communication	3
Oral Communication	3
Technical Mathematics OR Technical Algebra & Trigonometry	3
Social/Behavioral Sciences	3
Natural Sciences	3
Heritage/Humanities	3
Total General Education Credit Hours	18
Technical Core Classes	**Credit Hours**
Basic Blueprint Reading	3
Fundamentals Machine Tools	3
Electrical Motor Controls I w/lab	5
Electrical Motor Controls II w/lab	4
Programmable Logic Controllers w/lab	4
Fluid Power w/lab	5
Safety Culture	1
5S	1
Total Production System Maintenance	1
Problem Solving	1
Maintenance Reliability	1
Welding for Maintenance w/lab	5
Industrial Maintenance Electrical Principals w/lab	5
Maintaining Industrial Equipment w/lab	5
Practicum	2
Industrial Robotics & Robotics Maintenance	4
Industrial Maintenance Technology Capstone	1
Total Credit Hours	**71**

APPENDIX E: GEA INTERVIEW PERMISSION LETTER

Western Kentucky University
Institutional Review Board
Office of Research Integrity
301 Wetherby Administration Building
Bowling Green, KY 42101

Attention Robin Pyles,

Doctoral student Bob Hunt is hereby granted permission to conduct interviews of GE Appliance's maintenance apprentices for his ethnographic study of the impact of student success.

Please contact me should you have any questions.

Warm regards,

James Atkinson
GE Appliances
Maintenance Apprenticeship Program Manager
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