

Who is the Engineering Technology Graduate and Where Do They Go?

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Abstract— Those formally educated in engineering identify themselves as engineers. How do those with degrees in engineering technology identify themselves? The lack of differentiating research between these two groups of graduates often leads to engineering technology students being taught or researched in the same manner as their engineering peers. This is problematic. As differing populations, they react to stimuli differently, as well as make different choices related to career trajectory. Those who work with both groups recognize the differences and are concerned about the engineering technology graduates as they move through their undergraduate programs and then into their post-graduation career paths. The engineering technology graduate is not often recognized as an engineer by some industries, therefore they assume different titles and career trajectories than their peers in engineering. Ultimately, when reviewed as a group, career trajectories for the engineering technology graduate are not well understood.

Research shows that those who do not self-identify with a field usually move out of that field, suggesting that community and identity are somehow interconnected. This work should provide a better understanding of that movement by the engineering technology graduate. The survey asks questions intended to explore how graduates move through their career, what changes they recommend for program seniors, and what community of practice they identify with. Engineering technology graduates often find this identifying with a community of practice difficult to foster, and the survey questions delve into some of the reasons for this issue. A survey was chosen over a generalized examination of a database because engineering technology graduates assume titles and position descriptions that vary from company to company.

The focus of this work is intended to begin identification of the engineering technology graduates career trajectory. Given the impact of global economy and world events on the job market, the researchers believe graduates from the last twenty years will be most relevant to this study. The survey used for this work addresses three areas, including demographics, experiences in the job search, and career trajectory. The alumni association sent an email to engineering technology graduates that included a link to the survey. Survey results will serve as evidence of career trajectory, networking, and issues encountered by the engineering technology graduate. It is anticipated that the results of this study will provide further direction and evidence of the need to differentiate of this unique population to practitioners.

Keywords— *engineering technology graduate, career survey, self-identity*

I. INTRODUCTION

Discussion focused on engineering technology students and graduates is often framed within the context of their engineering program counterparts, and often is focused on the Scholarship of Teaching and Learning[1]. Research is generally interested in the greater engineering population, and is most likely to relate findings to engineering technology. Practitioners with experience in both engineering and engineering technology[2] agree that these bodies of students are quite different. This author agrees and is focused on learning more about the engineering technology student and graduate, specifically achieving the following objective:

Begin to understand engineering technology graduates self-identification by discovering

- if there is a relationship to title following graduation;
- if there is a move in company or location following graduation;
- and if the graduate felt adequately compensated, equitably treated, and respected by his or her peers.

All of this information provides a greater understanding of how these graduates identify and persist in their field. Tonso[3] concludes that as engineers gain experience, they generally identify with a community of practice. The author is concerned with the ability of an engineering technology graduate to do the same, because of their inconsistent title, relationships, and experiences post-graduation. This paper will provide a basis of what those inconsistencies are and the development of future understanding of the engineering technology graduate.

The research presented in this paper informs practitioners and administration how graduates of engineering technology self-identify and furthers our understanding of their career paths. The graduates examined will consist of two groups: those referred to as early career who are 0-5 years post-graduation; and mid-career, who are 10-15 years post-graduation. Overall, these findings provide a greater understanding of potential students, and help identify which of them are most likely to be successful in an engineering technology program.

This focus on engineering technology students involves searching for graduate identification of who they are [4]. Identity research is diverse and often identifies a plethora of means to self-define [5]. While some find that awkward or inaccurate, defining identity by either the individual or one group may depend upon the answers provided by respondents in the groups studied. Based upon the data gathered in response to the provided survey, three areas are examined, including: career movement/trajectory, recommended program changes, and titles and position descriptions.

II. LITERATURE REVIEW

Engineering technology students and graduates are far less in number than those from engineering and most other STEM fields. That creates many inaccuracies in the perception of who engineering technology graduates are and where they go post-graduation. Unfortunately, engineering technology is often ignored or combined with engineering studies, promoting inaccuracies in engineering technology identity, either individual or group.

The difference between engineering technology and engineering is significant.[6, 7] Engineering technology graduates have been prepared for their careers by not only teaching theory, but how to apply that theory.[8] Engineering technology students are taught how to apply theory to practical applications, while engineering student focus on conceptual design using theoretical models.[6] Students that find the applied model more attractive generally follow a different mode of study and personality traits [2] than their peers in engineering. While the contrast has yet to be researched, practitioners that have taught in both fields find the contrast striking.

To further the authors' examination of engineering technology students and graduates, a survey was developed to investigate the identities of this population. While the initial data examination had a different focus, review of the data provided a different understanding of the graduates than what was expected. Although data was collected with a different goal in mind, the data on career movement, recommended programmatic changes, and titles and position description was compiled for dissemination in this venue. Further discussion of this data follows.

A. Career Movement

Most recent research asserts that career movement is best likened to a rock climbing wall [9]. Today's technical personnel work their way through a career path that may be horizontal, goes at an angle, or goes straight up. Tracking an individual's path post-graduating becomes troublesome, as they move in what may seem a random way.

It is important to carefully identify career movement in the engineering technology graduate. While Cannady, Greenwald, and Harris [10] consider all STEM fields, they suggest that using the metaphor of pipeline as part of the STEM and career movement discussion provides the allusion that there is only one way of moving through a professional

career. That supports our assertion that alignment of engineering technology graduates' career movement is not likely. Presenting the data gives the audience an opportunity to make their own conclusions, while the authors combine all that they found through the administration of the survey.

B. Recommended Program Changes

While it is not apparent through a great deal of searching that this has been researched, it is evident through publications such as the one published by Hart Research Associates [11] that new graduates have not satisfied many employers' requirements. While this is an issue, redesigning of curriculum and programmatic requirements has been successful.[12] Graduates see the things that would have benefited them upon graduation, with differing views as they move further into their careers. Results of the survey may provide a great deal of insight into student need, providing impetus for change in engineering technology programs.

C. Titles and Position Description

Engineering graduates most often begin their professional career in an engineering position, with an engineering title, working with other engineers. Some of these graduates belong to professional engineering organizations, such as IEEE[13], and work for companies that recognize them as engineers. This is not always the case for engineering technology graduates, causing issues with those researching identity. The lack of differentiation, particularly in the case of identity, creates a dichotomy and misrepresentation of engineering graduates regarding self-identification. While engineering graduates have titles that contain the word engineer, the population divide between that population and engineering technology graduates is wide, often confusing our understanding of their career movement.

These three areas provide a unique means to identify the engineering technology graduates and their career movement. To understand the data and input from the engineering technology graduates, a theoretical framework known as the Identity-Trajectory Theory[14, 15] will be used to review survey findings. Many theoretical frameworks have been used to determine the identity of study populations.

D. Theoretical Framework

The Identity-Trajectory Theory is a theoretical framework that is used further to understand academics in various stages of career development.[16, 17] However, with a slight adjustment, it was used to interpret findings of our survey focusing on career trajectory. There are three sections in this framework: networking, intellectual pursuits, and institutional culture. The first and third sections are easily found in available references. However, the second section is not mentioned in references consistently. To use this framework, researchers consider sources of information from intellectual artifacts to surveys or other means to learn how an individual identifies in their role. It is this portion of the theory that is most applicable to the understanding of the data collected from the engineering technology graduates.

The artifacts used in this study of engineering technology graduates are the result of a survey developed for furthering our understanding of this population. The study is divided into three sections using questions arising from the use of constructs in networking, intellectual pursuits, and institutional culture. The first section focuses on the graduates, where they live, came from, and moved through their post-graduate years. The second area reviews how graduates identify as they relate to their titles, and other aspects related to promotion and corporate positioning. The last area begins our understanding of how these graduates fit their corporate identity, thus providing a sense of how they fit in the organization, relate to their peers, and supervision.

Individual identity is often developed because of belonging to or working in an organization.[3] Then, through contact with the cultural composition of the organization, they develop their identity. Albert and Whetten [16] and others [5, 17] assert that individual identity is central to the cultural composition of an organization. Use of this theory also will provide a better understanding of how the individuals are impacted by the various aspects of their workplace.

Engineering technology graduates regularly pursue different employment situations than engineering graduates. The most differentiating factor is their ability to incorporate theory into authentic situations more readily than their engineering counterparts. The application of findings from studies done on engineering graduates to engineering technology graduates is inaccurate, due to the distinction of experiential knowledge and career movement encountered by both groups. This raises the questions:

How do early (0-5 year) and mid-career (10-15 year) engineering technology graduates traverse the engineering field? What titles do they hold, and what recommendations do they have related to career movement for program improvement?

By furthering our understanding of the engineering technology graduate, we learn more about how this population develops its identity. Most importantly, we understand what they are doing post-graduation, their work culture, and other characteristics that contribute to their identity.[16, 17]

III. METHODS

A survey was created using tools supporting survey development [18-20]. These resources provided guidance in the elaboration of a survey grounded in literature and focused on identity characterization of the subject population.[21] The survey questions are listed by area in the results section of this paper.

The survey distributed to engineering technology graduates belonging to Purdue's alumni association included 4,821 email addresses. The authors wanted to maximize the number of respondents; these graduates are perceived as those most likely to respond. The click-through rate on this survey was 4.3% when most surveys are 3%-5%. [22] Emails were sent

twice as the first email went out just before a national holiday, resulting in an increase of respondents of nearly 35%.

The data was cleaned and sorted, because of the entries into free-response questions. Respondents varied their methods of entry by using different date formats in their graduation year, as well as other responses requiring a date. All of the data from the years 2010-2015, and 2000-2005 could be used and sorted once the dates were corrected; all were clear as to the intent of the response. The findings of these evaluations are in the following narrative.

Using Identity Trajectory Theory as the framework for analyzing the survey results, and breaking the results into the areas employed in the framework, we further our understanding of engineering technology graduates. The first area is career movement to further our knowledge of post-graduation assimilation or persistence, the second is recommended program changes, and the final is titles and position descriptions. All of this data was compared, categorized, and counted to determine similarities and differences in the findings, providing us with a better understanding of the graduates, where they are going and career related experiences as engineering technology graduates.

IV. RESULTS

After sorting the data for graduates of the years 2010-2015 and 200-2005, the questions are presented and then under appropriate headings the data is summarized by area.

The questions related to career movement are:

- When you moved into your first position after graduating - did your co-workers respect you?
- When you moved into your first position after graduating - did your superiors treat you in the same way as others?
- When you moved into your first position after graduating was everyone that started with you compensated equitably?
- Are you still working for the same organization that you began working with after graduation?
 - If not, when did you leave?
 - If you are, are you in the same position? Why?
- What are your prospects for the future?
- When you began studying at the university, what was your home state and country?
- What do you consider your current hometown? Please specify hometown and country.

The question related to recommended program changes is:

- Based upon what you know today, what would you recommend be done to guide current and incoming students in the first position following graduation?

Finally, titles and position descriptions are extracted by asking:

- Upon graduation, what was your title?

The data for each of these areas is summarized and presented in the tables below.

A. Career Movement

Table 1 provides a summary of answers to the questions regarding co-workers, superiors, and equitable compensation.

TABLE 1. RESPECT, AND EQUITABLE COMPENSATION

	0-5 years		10-15 years	
N	24		35	
	Y	N	Y	N
Coworker	22	2	35	0
Superior	22	2	32*	2
Compensation	18	6	28	7

Respondents were asked if they had moved to another company and why they chose to move, or if they hadn't moved, why not? The total responses are shown in Table 2, with a summary of comments provided in Table 3 and 4.

TABLE 2. MOVED TO A NEW COMPANY

	0-5 years		10-15 years	
N	24		35	
	Y	N	Y	N
Moved	17	7	9	26

TABLE 3. MOVEMENT TO ANOTHER COMPANY (0-5 YEARS)

	0-5 years
N	24
Moved	Higher Pay
	More Responsibility
	Not Enough Design
	Too Much Project Management
Stayed	Promotion
	Promotional Opportunities
	Loyalty
	Company Top in Field
	Just Started
	"I Love My Job"

TABLE 4. MOVEMENT TO ANOTHER COMPANY (10-15 YEARS)

	10-15 years
N	35
Moved	Lack of Upward Mobility
	Move to Non-Family Owned Company
	Larger Company
	Restructuring of Company
	Wanted Increased Responsibility
Stayed	Movement in Same Company Possible
	Challenging and Well Compensated
	Pay Above Average
	Supervisory Position in Engineering

The last three questions that support the career movement part of the analysis are summarized in Tables 5, 6, 7, 8, and 9.

TABLE 5. FUTURE PLANS

	0-5 years	10-15 years
N	23	35
Promoted	8	12
Move On	11	7
Happy	4	14

TABLE 6. SUMMARY OF FUTURE PLAN COMMENTS (0-5 YEARS)

	0-5 years
N	23
Move On	Pursuing Higher Degree (PhD)
	Move Closer to Family
	Learned Loyalty is not Advantageous
	Higher Pay
	Mass Layoffs at Company
	Don't Like Location
	Limited Opportunities
	No Friends
Happy	Was promoted Last Year
	Fair Compensation
	Company Promotes Growth

TABLE 7. SUMMARY OF FUTURE PLANS (10-15 YEARS)

	10-15 years
N	35
Move On	Will move when done with additional course work
	Lifestyle Choices With Family
	Relocation
	More managerial
Happy	"Love my current job."
	Great position and expect to stay 20 years
	Current position top in field
	Enjoy holding several positions in small company

TABLE 8. ORIGINAL AND CURRENT HOMETOWN (0-5 YEARS)

	Original	Current	No Change
N	23	23	
Indiana	17	7	9
Illinois	2	2	1
US - Further	3	13	0
International	1	1	1

TABLE 9. ORIGINAL AND CURRENT HOMETOWN (10-15 YEARS)

	Original	Current	No Change
N	33	33	
Indiana	26	16	9
Illinois	2	2	1
US - Further	3	14	1
International	2	1	0

B. Recommended Program Changes

The recommendations made by graduates in the last 5 years can be summed up by saying that internships are highly recommended, a class should be developed strictly for job skills and interview preparation, skills outside the core curriculum should be learned, full-year final design projects should be required, and attendance at conferences and job fairs should be required. While the graduates of 10-15 years suggested the creation of a database of companies that have hired engineering technology grads in the past, teaching graduates how to market themselves, offering internships, class or sessions for job search preparation, encouraging leadership in campus organizations, and presenting job opportunities throughout the world, and providing career guidance after graduation.

C. Titles and Position Descriptions

Tables 10 and 11 summarize the titles provided by respondents in the early and mid-career groups.

TABLE 10. FIRST PROFESSIONAL TITLE (0-5 YEARS)

	Discipline	Associate	Technician	Other
Engineer	6	2	1	9
Supervisor	0	0	0	2
Other	0	0	0	3

Titles that this group of graduates provided that were not engineering related were: software developer and researcher. It was noted that researcher was a title of lower stature with biologist and chemist.

TABLE 11. FIRST PROFESSIONAL TITLE (10-15 YEARS)

	Discipline	Associate	Technician	Other
Engineer	5	3	0	12
Supervisor	0	1	0	0
Other	0	0	4	8

This group of graduates had many different titles, as is evidenced by the number of titles indicated on the right side of Table 11. These titles included inspector, glassblower, CAD detailer/drafter, and designer.

V. DISCUSSION

Review of the data through the lens of the Identity – Trajectory Theory[14] provides a distinct contrast between the two different groups of respondents. However, the reviewer must be reminded that the respondents in the mid-career group graduated during the time frame of the events of September 11, 2001. This impacted the job availability and corporate ability to project their employment needs, making the job search and initial employment situation tenuous for these graduates.[18]

These responses support the data shown in Table 4, where the mid-career graduates are generally happy or have had a promotion, encouraging them to stay with their current employer. The early career graduates are considering a move, while almost as many have been promoted and a few are happy in the positions they currently hold.

While research is not pervasive in the area of technical personnel moving due to job, personal, or family desire, to understand the identity, the relocation, or lack of relocation must be understood. Tables 6 and 7 summarize the movement of both the early and mid-career respondents. Not all of the respondents answered these questions, however 23 and 33 did in the early and mid-career groups respectively. More of the mid-career respondents stayed in or are currently very near to their original hometown, while over half of the early career respondents originally living in Indiana moved out of the state. A much larger percentage of mid-career respondents have

moved further away than Indiana or Illinois. In the case of the early career graduates, one international graduate did not move away from their home country upon graduation, while both international graduates moved away from their home country.

Based upon the survey data, there appears to be a desire to remain or move closer to home later in life. Other than that, both groups are relatively the same with regard to moving or moving back/staying within a close proximity of their hometown upon matriculation.

While reviewing the comments provided in response to recommended program changes, a few issues appeared multiple times in both graduate groups. Teaching and promoting learning of life and job search skills are paramount to both groups. The recommendations include:

- Internships
- Develop a Class or Workshop Series Teaching Skills in Job Search – Resume, Interview, Search
- Compile and Make Available a List of Companies that Have Hired Engineering Technology Graduates
- Promote Leadership in Campus Organizations

Finally, the titles given in the graduates first post-graduation position show a difference in how engineering technology degrees are viewed, or at least how the companies that the graduates have gone to view them. The mid-career group, as evidenced by Table 11, shows that many of the titles were something other than a discipline-specific engineering title. The titles were those that normally indicate a lower pay grade and stature within the company, supporting these graduates' desire and eventual move into positions in which they are happy and have no desire to move, while those in the early graduate group have more titles related to engineering and other positions more closely aligned with engineering technology.

VI. CONCLUSION

Based on the data gathered, it has become clearer that the engineering technology graduate is distinct from the engineering graduate, if in title only. The differentiation, while not overtly obvious, appears most prominently in the mid-career data, as noted by the titles that include things such as inspector, drafter, and designer. While these titles do not appear in the early career responses, we do see that a few titles were given and noted as not being at par with their engineering counterparts. Therefore, based upon the title and comments provided, it becomes evident that engineering technology graduates see some differentiation from their peers in engineering. This is of interest because most graduates indicated that their co-workers and supervisors respected them.

When considering the identity issue, the data provided on movement and location stability shows that those in the mid-career group have been more mobile. Until further research is completed, we cannot be sure if this is because of the effects

of the events of 2001 or because of their entry-level position and their not feeling a part of the organization. Some of the graduates indicated that they felt a part of the organization, didn't want to leave due to a great position, good compensation, and in a couple of cases loyalty, which was dispelled by a couple of graduates in the mid-career group.

We may find identity a difficult concept to secure in the engineering technology graduate due to the variation in titles and career movement, particularly in contrast to engineering graduates. Suggested improvements for current students included pursuing an internship, having leadership positions in campus organizations, and providing a greater resource specific to engineering technology students. Considering these aspects, it is important to note that these graduates find value in practical experience and soft skills such as those required of a successful leader. Comments provided to these questions often have a terse tone, indicating that the graduates providing their opinion had an experience or need for those things they suggest.

We see that due to factors with students or employers there may be a relationship to title post-graduation. There is some impact on graduates within the first ten years following graduation, as many of the mid-career graduates have established a relationship with their employer and have settled into a position they are pleased with, while early career graduates are deciding what to do. Finally, the survey results suggest that most graduates in both categories felt adequately compensated, but those with non-engineering titles and positions on the fringe of careers in engineering have issues with compensation, and relationships.

To answer the research questions, the findings support the need for required internships, and courses/workshops supporting job search activities. Review of engineering technology programs indicate that there are inconsistencies in program requirements[19], thus supporting the lack of consistency in career paths of the responding engineering technology graduates.

VII. FUTURE RESEARCH

Survey questions asked of the engineering technology graduates include those that provide information regarding job movement, titles, if they work for the same company they joined upon graduation, prospects for the future and any related comments that they made. While this information is limited to the population studied, it provides an understanding of how these program graduates fare as they traverse their career and how identity is formed. This information is anticipated to guide further investigation in larger study populations as well as a more diverse population regionally and/or nationwide.

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