The Career Pathways of Non-tenure-track Full-time Engineering Faculty

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I. Introduction and Literature Review

A significant and growing portion of faculty members who teach in universities in the United States are in appointments that do not offer tenure. These appointments are sometimes referred to as contingent or non-tenure-track appointments. Using data from the Integrated Postsecondary Education Data System (IPEDS), the Government Accounting Office (GAO) estimates that in 2015 the percentage of all faculty members teaching at four-year institutions in the U.S., including part-time, in non-tenure-track appointments was 61% [1]. Considering only full-time positions at four-year universities, the percentage of non-tenure-track appointments was 34%. Data from the 2014 ASEE survey of engineering programs in the United States shows that the percentage of non-tenure-track appointments in engineering departments is 8.9%.

Non-tenure-track appointments are growing much faster than tenure-track appointments. From 1995 to 2011, the number of tenure-track positions increased by 9.6% while the number of non-tenure-track full-time positions increased by 109.2% [1]. The reasons for this increase in non-tenure-track faculty include budget constraints, the need for additional flexibility in scheduling, and the ability to include faculty members with specific knowledge or expertise for specific courses [1][2], factors which are not likely to abate.

As the number of non-tenure-track faculty increases, concerns about the impact of this change on student learning and as an attack on the tenure system have emerged. As Levin and Shaker note, “full-time non-tenure-track faculty are deemed accomplices, albeit unwitting, to the erosion of the academic profession, faculty power, and undergraduate education” [3]. Early quantitative studies supported this notion, using large national datasets to show that non-tenure-track faculty, especially part-time faculty, are less likely to engage students, spend less time preparing for courses, are less likely to use active and engaging teaching techniques, had lower academic expectations for their students, and were less productive in both teaching and research [4][5]. At that time, it was not clear whether the effects were caused by the non-tenure-track faculty themselves or the structure in which the non-tenure-track faculty operate.

Kezar and Sam [6] suggested that new theoretical models are necessary to understand non-tenure-track faculty and proposed that some earlier studies had used theoretical models that did not fit non-tenure-track faculty and were derived from a deficit model based on the preconceived notions of the researchers [6]. For example, in a study of non-tenure-track effectiveness, one measured aspect of non-class student-faculty interaction was how many hours per week faculty spent supervising undergraduate student research. Supervising research is an activity that tenure-track faculty are likely to perform but is not in the job description of most non-tenure-track faculty. In that study, the list of measured faculty activities was generated by examining the daily work of tenure-track faculty. Activities that are typically performed by non-tenure-track faculty alone would not have made it onto the list of measurements. Levin and Shaker noted that the study of non-tenure-track faculty often does not include the perspective of the non-tenure-track faculty themselves, leading to an incomplete understanding of the professional identity of non-tenure-track faculty and perpetuating a misunderstanding of faculty life [3]. It is important to hear from non-tenure-track faculty themselves, to find out what the non-tenure-track faculty want and what job issues they perceive to be the most important [2]. This study explores the experience of engineering faculty while most studies have included faculty from a broad range of disciplines, noting that faculty from engineering and business programs are likely to have a different experience because of their professional careers.

The varied career and academic experience of non-tenure-track faculty increases the diversity of engineering programs by providing perspectives and values that may be different from those of the tenure-track faculty. The ASEE statement on diversity asserts that:

> *ASEE strongly believes that all must be provided with equality of opportunity to pursue and advance in engineering careers and that no individual should experience marginalization or non-inclusiveness of their contributions or talents because of visible or invisible differences [14].*

Non-tenure-track faculty have "invisible differences" in their career and academic experience when comparted to their tenure-track counterparts. These invisible differences contribute to their marginalization and exclusion and subject them to policies that are explicitly biased against them [13]. This marginalization and exclusion impedes the ability of non-tenure-track faculty to perform in their teaching roles [7].

This study explores the experience of non-tenure-track engineering faculty by listening to the faculty themselves. We explore the previous career and academic experience of each participant. We explore the hiring process to see if it is formal and tailored to the needs of the program. A formal hiring process can increase the effectiveness of the faculty member and improve student outcomes [7]. We explore the motivation of each participant to teach to see if engineering non-tenure-track faculty share the same motivations found in prior research which are a desire to work with students and to achieve a better work/life balance [2][8].

Our research questions are:

1. What are some career pathways to becoming a full-time non-tenure-track engineering faculty member?
2. What factors, if any, do non-tenure-track faculty in our sample believe motivate them to teach?

A. Definition of Terms

In this study, faculty members who are in appointments that offer tenure are referred to as tenure-track whether they are tenured or pre-tenure. Faculty who are in appointments that do not offer tenure are labeled non-tenure-track. The label non-tenure-track, when used alone, denotes faculty members who are either part-time or full-time and are not graduate students. Whether full-time or part-time, the faculty member's primary responsibility is teaching, which excludes faculty members whose primary responsibility is research. The label full-time is used to describe faculty members who are considered full-time employees by their institution. The criteria for being considered full-time varies by institution. The label part-time refers to faculty members who are not considered full-time by their institution. In this study, the term adjunct is a synonym for part-time non-tenure-track faculty.

Engineers who perform engineering work outside academia, usually for corporations or governmental agencies, are referred to as "practicing engineers" or "engineering professionals". These labels are not intended to imply that engineers working in academia are neither professional nor non-practicing.

II. Methodology

This study is a general qualitative study using a criteria-based sampling strategy and a semi-structured interview for data collection [9].

A. Sampling

For this study, we are interested in the experiences of typical non-tenure-track engineering faculty members and so we designed our sampling criteria to select typical cases [9]. We first used the American Society of Engineering Education data mining tool to determine the national average of full-time non-tenure-track faculty members as a percentage of all full-time faculty members [10]. We wanted participants in the study to be typical non-tenure-track full-time engineering faculty working in US research universities. Our sample set began with engineering programs at universities with a R1 Carnegie rating. From that set, we selected electrical engineering programs that had at least ten full-time faculty members. We chose electrical engineering departments because every engineering college that matched our criteria has an electrical engineering department and the author who conducted the interviews (Fitzmorris) is an electrical engineer and thus could more completely interpret the nuances of the responses in discipline-specific discussions. We sorted the programs using the percentage of full-time faculty that are non-tenure-track. From that sorted list, we selected universities whose percentage of non-tenure-track faculty was near the national average.

Ten members of this population were included in an earlier study on the career goals of non-tenure-track engineering faculty members, so we attempted to recruit the same ten participants. Seven of the ten agreed to participate in this study. We recruited the remaining three participants by selecting two additional engineering departments that fit our sampling criteria and sending recruitment emails to all faculty members in those departments with the words instructor, lecturer, teaching, or practice in their titles. Overall, we sent nineteen recruitment emails and enrolled ten participants from eight universities.

B. Data Collection

We collected data using a semi-structured interview of seventeen questions. The interview was intended to last forty-five minutes although the participants were encouraged to elucidate their answers and the use of probing questions added to the interview times [11]. The shortest interview was thirty-five minutes and the longest interview was fifty-eight minutes. We provided the participants with the interview questions several days in advance to allow them to reflect upon the questions.

C. Data Analysis

The interviews were audio-only, conducted via telephone, and recorded for later analysis. The audio data were coded directly without transcription using qualitative analysis software (NVivo 11) with an initial code set that had been developed from the research questions and the interview questions. The code set contained twenty-two codes with four codes added as emergent codes during the coding process. One author (Fitzmorris) conducted the interviews and coded the interview data. Once the data were coded, all three authors listened to selected interview segments, discussed the initial findings, and evaluated emergent codes. Collaboration between the three authors during data analysis improves the reliability of this study by providing a diversity of perspectives. One author is a non-tenure-track faculty member, one author is a tenured faculty member, and the third author is a tenured faculty in an administrative position.

Nine of our participants are male and one is female. This gender imbalance is typical of electrical engineering faculty. While qualitative research methods sometimes generate meaning from a single case, the research team did not feel that this single participant's perspective was sufficiently interesting to address the role of gender in the lived experiences of non-tenure-track faculty. This is unsurprising since analyzing the role of gender in non-tenure-track faculty was not a research goal of this study and no questions were asked that related to gender.

Direct quotes from the interviews appear later in this paper and appear in italics. Interview data that appear within square brackets [ ] are clarifying remarks made by the authors. Interview data that appears within curly braces { } are details that have been removed to protect the identity of the participant.

D. Subjectivity Statement

The author who performed the interviews and data analysis is a non-tenure-track electrical engineering faculty member and so was able to understand the nuances of the participants' responses without needing to clarify technical details about particular courses or career experience described by the participant. While conducting the interview, he attempted to maintain a neutral posture but his background may have influenced the probing questions that he chose to ask and the topics that he chose to clarify. During data analysis, he was especially careful not to project his personal feelings onto the data and to accurately portray the views of the participants to the best of his abilities. Once the data were coded, all three authors met to listen to the coded audio data, identify emergent codes, and to discuss the findings. The three authors have different academic roles (non-tenure-track faculty, tenured faculty, and administration) which strengthened the data analysis.

III. Results

The interviews with each participant discussed their pathway leading into the full-time non-tenure-track faculty position Interviews also asked participants to reflect on their motivations and expectations for this career track.

A. Significant Professional Experience

Our first research question explores the career pathways that our participants experienced on their way to becoming full-time non-tenure-track engineering faculty. One aspect of that pathway is prior professional experience.

We found that seven of our participants had significant professional experience as shown in the following list:

Alan: 7 years engineering

Brandon: No engineering experience

Cody: 40 years engineering

Darrell: 10 years engineering

Ethan: 35 years engineering and military

Frank: 7 years engineering

Greg: 21 years engineering

Henry: No professional experience

James: No engineering experience

Kimberly: 8 years, engineering

Four of the participants rose to positions of influence in their organizations before leaving to become faculty members. Alan was the senior engineering manager, reporting directly to the CEO of his company. Cody was a senior developer in charge of overseeing the team of engineers on his projects. Ethan was a division manager at a prestigious laboratory after completing his career in the military. Greg was the director of engineering at his company before retiring.

Henry began his teaching career immediately after earning his master's degree in computer science. James had a particularly unique path, working in non-engineering related fields before earning his engineering degree, working in a research lab, and finally transitioning to a full-time teaching position. After earning his MS in electrical engineering, Brandon postponed his engineering career for professional athletics.

Most of these participants have significant experience in the practice of engineering, half of them with engineering management experience.

B. Diversity of Academic Experience

Another aspect of our first research question exploring career pathways is the academic experience of our participants. We found a remarkable diversity of academic experience.

All ten of our participants earned master's degrees in electrical engineering or computer science. Eight of the participants earned their master's degrees while attending university full-time. Darrell and Greg earned their master's degrees while working in industry. Five participants have doctoral degrees in engineering: Cody, Darrell, Ethan, Greg, and Kimberly. Darrell, Ethan, and Kimberly earned their degree while attending university full-time while Cody and Greg earned their degree while working at engineering firms. Both Darrell and Ethan began teaching at the same institution immediately after earning their doctoral degree, Kimberly earned her doctoral degree, then worked for eight years at a national laboratory before returning to the university to teach full-time. The five participants who have doctoral degrees also have the most extensive engineering experience.

Five participants, Alan, Brandon, Ethan, Henry, and Kimberly, who had received a degree from the department in which they teach, described how some of the faculty members in their department seemed at times to consider them as graduate students or as subordinate faculty. This was not usually overt, but was communicated in subtle ways. The participant who struggled with this issue the most was Henry, who began teaching as a graduate teaching assistant and then transitioned into a full-time teaching position. While he is widely regarded by the students and other faculty as an excellent teacher, he describes his status in the department as in a gray area between a graduate student and faculty and has had to take steps to be recognized as a faculty member within the department.

> *I: Once you started teaching full-time in Spring/Fall, how was it determined what you'd be teaching and did you have the resources you needed to teach those courses?*
>
> *P: The first couple of semesters I was full time were annoying because I was treated as a Graduate Teaching Assistant (GTA), even though I wasn't. My hiring was done through the GTA program coordinator rather than being hired by the department chair like the other lecturers. During that time I was also teaching an intro-level class which is a class that is exclusively taught by GTAs. It was very second-class for a while. After I started teaching more regular, required classes in the Fall/Spring, it still took a year or two before I started getting hired through the department chair and stopped being treated like a GTA.*
>
> *I: So that took some time. Do you know why that shift happened?*
>
> *P: I complained about it. I have a good relationship with the graduate program coordinator and I told her that I didn't understand why I was being hired through her, I'm not a GTA. That led to them acknowledging that I needed to be treated like the other lecturers.*

Cody, Darrell, Frank, and Greg had significant industry experience and did not receive a degree from the department in which they taught said this was not a significant issue. While they may not have the same status in the department as the tenure-track faculty, they are considered part of the faculty.

Two participants expressed frustration regarding the need to pursue a doctoral degree in engineering in order to advance in their academic career. Alan noted that he is interested in pursuing a doctoral degree in engineering education, but that degree is not offered at his university and pursuing a degree in education would not suffice for promotion in his department.

> *I would argue that maybe it is appropriate that you need a PhD for that level, but let's clarify that. A PhD in [specific technical field] which is what my Master's degree in, is not going to help me in any way. That should not count towards the promotion. But something along the lines of educational psychology or engineering education, one of those PhDs where the focus of the research is improving pedagogy. That has merit, but in my department, that PhD would be counted as less valuable than a more technical degree.*

Henry is interested in engineering education but is absolutely not interested in pursuing a doctoral degree in computer science saying "Doing research would take me out of the classroom and away from students, why would I want to do that?"

C. Finding the Position

A third aspect of exploring the career pathways of full-time non-tenure-track engineering faculty is the process by which the participants found their first teaching assignment. Kezar found that a formal hiring process in which candidates are recruited based on the needs of the department has a positive effect on student learning [7]. Most of our participants were not recruited in that manner.

By far, the most common way our participants found their teaching position was by encountering a member of the administration, usually a department head, who had their eye out for a non-tenure-track faculty member. Seven participants found their position in this manner. We did not interview members of the administration so we don't know how long they had been looking or what criteria were used to choose the faculty, but we do know the process was informal and did not involve other faculty members in the department. Alan, Darrell, Ethan, and Henry were all offered full-time positions immediately following their thesis or dissertation defenses. Brandon was invited to give a talk on leadership and motivation which was attended by a dean who offered him a full-time position. Cody and Greg were interested in retiring from their industry positions and teaching full-time, inquired about full-time positions, and were directly hired by the department head.

Greg describes his experience:

> *P: I went down to the university because they are always looking for researchers. I had my PhD but didn't know much about different academic positions.*
>
> *I: So they were looking for tenure-track faculty?*
>
> *P: Right, they were looking for tenure-track people with the ability to get money from grants and all that. The guy they directed me to who was in charge of the first-level of hiring there at that time was a little bit of a jokester. He pointed to a stack of resumes that was about three feet tall and said, "Those are the qualified people. You are not."*
>
> *I: Oh! Wow! [Both laugh]*

P: And then he said, "But if you want to teach, that's not a problem". What they wanted for teaching was someone to take over Senior Design, their Capstone course. They looked at my resume and saw twenty-five years of manufacturing experience which was real-life experience compared to the tenure-track people they had who had spent their lives in academia. They thought it fit extremely well and so I was offered a position on the spot.

Only two participants found their position as part of a search process. Frank was looking for a full-time teaching position and responded to nation-wide job listing. Kimberly was hired as part of a formal search process.

Eight of our ten participants found full-time teaching careers in the city where they lived. Frank and James relocated.

We found that the hiring process for most of our participants was informal, the decision was quick, and the people who made the decision were the department head and dean. Most of our participants found their teaching position in the city where they lived and worked.

D. Salary Determination

A fourth aspect of our first research question, exploring the career pathways into non-tenure-track engineering faculty position, is the process by which the salary was determined for these participants. Prior research has indicated the department head plays a critical role in the life of non-tenure-track faculty because the department head has significant influence in decisions regarding contract renewal, departmental responsibilities, and salary [12]. We found that as predicted, the department head had the largest role in determining starting salary.

Two participants, Cody and Darrell, negotiated their initial salary with the department head. Darrell described his experience as typical of a salary negotiation that he experienced in industry. The other participant who negotiated, Cody, made a single counter-offer that was 25% higher and the counteroffer was accepted by the department head. Eight of the participants did not negotiate their starting salary. Alan, Ethan, Henry, and James did not have the option to negotiate because the salary was set by the institution for that position. Brandon, Frank, Greg, and Kimberly chose not to negotiate because the salary offered by the department was acceptable to them. Five of the participants, Alan, Cody, Ethan, Greg, and Kimberly reported that they took a substantial pay cut when moving from industry to the teaching position, but that salary was not the primary motivator in their career switch.

Ethan and James were unhappy with how the salary determination was handled. James felt his current department had unethically gained information about his previous salary. Ethan describes a different frustration with his salary determination:

I: How did the department decide, and who decided, what your salary would be?

P: There was a range that they had established for these three positions. These were all PhD lecturer positions and the only consideration in changing the salary was time-since-PhD. I talked with the chair at the time and said, "You know, I have thirty-five years engineering experience and that doesn't count for anything." He agreed that the only thing the university would consider was time-since-PhD. I'm not in it for the money, but that rankles me a little bit.

We found that as would be expected, the department head is the most important person in the non-tenure-track faculty's salary determination. Many of our participants took a significant cut in salary when accepting

their teaching position. We found one departmental policy that was biased against faculty members whose career paths included substantial professional experience, which undoubtedly improved their engineering practice, before earning their doctoral degree.

E. Resources and Responsibilities

One aspect of a departmental culture that encourages the success of all faculty members, including non-tenure-track faculty members, is having the resources necessary to perform their duties adequately [7]. We asked our participants whether they felt the resources provided by their organization were sufficient.

The process of getting an office, the resources needed to teach their classes, and staff support were satisfactory to all ten participants. It was widely reported to be similar to the resources provided to other new faculty in their department. Adjunct faculty often do not receive this same level of support, so it is interesting that full-time non-tenure-track faculty do. Seven of the ten participants Alan, Brandon, Cody, Darrell, Ethan, Henry, and Kimberly, already knew faculty members or the department head before joining the department, so they had contacts in the department that could help them obtain the resources that they needed to get started.

Most of the participants taught three courses per semester which is considered a full load for teaching faculty at their university. Darrell teaches one course only but is responsible for developing and maintaining the laboratory course material that is a component of several lecture courses. Kimberly teaches two courses but has the additional responsibility of mentoring senior design teams.

We found that our participants had the resources they needed to do their jobs, which has been shown to improve student outcomes [7].

F. Value of Career Diversity and Industry Experience

Five participants, Alan, Ethan, Greg, James, and Kimberly, teach capstone or senior design courses and they believe their industry experience and contacts have been invaluable. Alan says that he strives to make his capstone course as similar to his industry experience as possible. Alan, Ethan, and Greg were in engineering management before starting their teaching career and feel especially well prepared to teach the communication and project management skills that are a component of those courses.

Five of the participants, Cody, Darrell, Ethan, James, and Kimberly, reported that when they teach a course that is related to their industry experience, the practical examples and stories from their career about the topic are especially effective teaching tools and they get positive feedback on their student evaluations about that technique.

Ethan described his use of examples and stories in the classroom:

> *When I teach, what I try to do is to say "Why is this important, where would you use this concept?" and having had many opportunities at {prestigious laboratory} to apply a lot of the things I teach and also in the {military branch}, I can give them a lot of real-life, why-you-should-care examples about the topic. They seem to like that.*

Darrell explains how his industry career helps inform his teaching:

> *[Career experience] is invaluable for the classes that it applies to. So when I teach a subject that I have industry experience in, I can make absolutely exceptional examples and tell stories about why you need to learn this stuff. Students latch onto that. Examples*

> *from the field, personal experience, are way more convincing than general examples. It's just a better story.*

Frank contributes to his program by developing a course and a lab for a specific technology that did not previously exist in the curriculum. He reported that local industry has found the course valuable and he believes the new course is uniquely preparing his students for careers in that branch of engineering.

Greg had a career in manufacturing and brings advanced manufacturing techniques into the department, allowing students to build systems that were not previously possible and collaborating with researchers in the department.

Capstone and introductory courses seem to be particularly well-suited for teaching faculty. Capstone is a particularly good fit for participants like Alan and Greg who had engineering management experience and so could model the type of design processes and skills that are necessary in a product development career. Alan explained how his experience in engineering management helps his senior design course:

> *I treat senior design almost exactly like I treated my employees when I was in industry. I run senior design as if it was a company. I'm the project manager for the company and each team is working on a separate project for the company. I don't think that's a particularly unique approach, but with that mindset, I can use everything that I had successfully developed in industry. The reporting is for the most part the same with a few tweaks for the educational environment. Honestly, it's not something I had to sit down and put a lot of thought into, it was just a natural fit.*

Communication, budgeting, scheduling, and project management skills that participants developed in industry are especially valuable in capstone courses that use industry-sponsored projects. Their contacts and experience in industry help them locate new projects and determine whether those projects are the right scope for the capstone course. Capstone or senior design courses seem to be a good fit for teaching faculty with engineering management experience.

Introductory courses are also a good fit for teaching faculty. Cody and Henry teach large introductory courses. They feel that they are particularly good at teaching those courses because they are intrinsically motivated to teach, like working with the students, and feel that they have a natural ability to explain complicated subjects in an accessible way. Cody explains how his industry experience helps him relate to students in his large introduction to programming course:

> *I've been doing this as a career for a long time, so I've made all the mistakes that they make. I know how it feels to make those mistakes and I know how it feels to get something working. It's been a huge exercise in drawing on my own personal experience. It gives me a lot of credibility in the classroom with the students. I get innumerable students say on their course feedback at the end of the semester, "{Cody} is a powerful professor because he has so much experience to draw on."*

Three participants, Cody, Ethan, and Kimberly, described how their experience in industry allows them to bring stories and examples into the course. They describe how the examples demonstrate the importance of the topic and increase the students' motivation to learn the material.

Participants who worked as product development engineers were a good fit for upper-level courses in subjects that they were proficient in during their industry career. Kimberly worked for eight years as an engineer at a prestigious laboratory and is especially well suited to teach upper-level courses in electronics.

Frank worked as a radio-frequency design engineer for ten years and is especially well-suited for teaching upper-level radio frequency and communication courses. Departments could use teaching faculty with significant development experience to quickly bolster their program in areas where more courses are needed but more research faculty are not.

We found that the diverse career experience among our participants was an asset to their departments and they believe their experience provides unique perspectives and experience that enrich their courses.

G. Self-Reported Motivation to Teach

Our second research question explores the factors that non-tenure-track engineering faculty believe motivate them to teach. Studies of non-tenure-track faculty from all disciplines have shown that non-tenure-track faculty are motivated to teach by interaction with students, the classroom environment, and the ability to strike a satisfactory balance between work and personal responsibilities. We asked our participants what motivated them to pursue a teaching career.

Eight of the ten participants, Alan, Brandon, Cody, Darrell, Ethan, Frank, Greg, and Henry said that they were looking forward to interacting with the students and to be able to focus on teaching without competing priorities. Darrell, who had worked in a corporate R&D organization for ten years, explained how he was looking forward to teaching and interacting with the students:

> *I've done a lot of R&D, research and development, and I wasn't that excited about having to chase grants and work on research-oriented projects. I wanted to be with the students. That's the number one thing I was looking forward to, primarily a teaching position versus research responsibilities.*

Alan, Cody, and Henry felt that they have a natural talent for teaching, for breaking down complex topics and explaining them and so teaching engineering was the career that fit them best. Henry enjoys the process of teaching and feels that he is good at it:

> *I enjoy explaining things and that follows me outside of the classroom. I just intrinsically enjoy explaining things and helping people understand things.*

Greg felt that his career as an engineering director at a manufacturing firm had become too removed from the hands-on engineering work that he loved and a teaching position would allow him the creative freedom to build hardware and to teach students to do the same.

> *This job allows me to explore. If I wanted to build a project with a processor, I can just do it. There's enough time for me to actually build stuff. My office has wonderful resources in terms of equipment to put things together, I've got enough funding for parts. Now I've got the time to actually build things and the things I build for fun end up attracting students because it's always blinking or moving.*

One participant had been in an industry position that required extensive travel and was becoming increasingly busy. A teaching position provides a balance between work and family that the participant found more suitable.

We found that engineering non-tenure-track faculty are motivated by the same factors that motivate non-tenure-track faculty from other disciplines: the opportunity to teach, work with students, and to find a satisfactory balance between work and personal life [1][2][8].

H. Career Satisfaction and Dissatisfaction

Studies of non-tenure-track faculty of all disciplines have shown a high level of career satisfaction [1][8]. We asked our participants if they had considered leaving teaching and if so, where they would go.

All ten of the participants are satisfied with their teaching career. Six of the participants, Brandon, Darrell, Ethan, Greg, Henry, James, and Kimberly reported that they have had no serious thoughts about leaving their teaching career. Alan, Frank, and James have thought about changing at times but have no immediate plans. Cody was in the process of transitioning from a non-tenure-track teaching position to a non-tenure-track research position because he would like to travel more than the university class schedule permits. Of the six participants who have not considered leaving their teaching position, two participants gave the reason that their non-tenure-track position allowed them to focus on teaching while still affording them the option of doing research or consulting to the extent that they choose. Another two of the six participants who have not considered leaving feel like teaching is the career option that fits them best and there are no other career paths that they would enjoy more. The final two had long, successful careers in industry and although there are opportunities to return to industry, they enjoy interacting with the students and the university environment.

The three participants who have considered leaving would return to industry. One participant who is generally satisfied with his position does sometimes think about leaving when he is dissatisfied with his status in the department.

> *I was the program manager and built an entire microelectronics division for a company, and from that to upper-level management for a consulting company. I reported to the president and had many subordinates. Now, I'm the lowest guy here and there's no real chance for advancement or promotion, that's not entirely true, but the promotions are pretty minor. So am I going to spend the rest of my career as the lackey when I started my career as "the guy"? That's a little hard on the ego.*

Several participants described aspects of what Kezar calls a "learning culture" in which the departmental culture encourages the faculty member to improve the program, using their skills and expertise to create new learning experiences for students [7]. Frank developed a lab and course based on his experience in designing radio frequency circuits which he considered the most valuable and satisfying contribution to his department. James developed an electric vehicle competition team which was based on his career experience and was an extremely satisfying part of his career. Greg used his years of manufacturing experience to develop the manufacturing capability of his department, allowing the students to build systems using 3D printing, cabling, and circuit boards that they could not have built before. Aligning the responsibilities of teaching faculty with their career experience and giving them the resources necessary to make changes to the curriculum and the facilities leads to greater satisfaction for the faculty member and enriches the undergraduate student experience.

IV. Discussion of results

A. The Diversity of Non-Tenure-Track Career Paths

Our first research question is "What was the pathway for these participants in becoming full-time non-tenure-track engineering faculty members?" We found a remarkably diverse set of pathways that provided our participants with a rich set of skills, perspectives, and experiences that they believe enrich their classes. Some participants started teaching right away, some after years or decades of industry experience. Some participants earned a doctoral degree early in their career, some much later, some do not plan on earning a doctoral degree at all. This breadth of pathways is important when considering recruitment and career

advancement policies. A “one size fits all” approach to recruitment, especially if that approach is modeled on the tenure-track recruitment criteria, will result in policies that exclude some candidates whose perspectives and experiences would be an asset to the program. There was no career pathway that could be described as “typical” among these ten participants.

We found that our participants were hired with an informal process, most of them serendipitously. Of the ten participants in this study, seven found their initial teaching position by knowing the department head or faculty members in the department where they began teaching. There are positive aspects to this approach in that the department is hiring a person whose capabilities and strengths are known and who already have a set of contacts within the department who can help them become integrated into the department in their new role. There are negative consequences to informal hiring processes that should be considered. If the pool of candidates for a position is limited to the people known by the department head or the faculty, then many qualified and motivated people who may be more suitable for the position are not being considered. Performing a wide and methodical search for non-tenure-track candidates would encourage departments to consider exactly what the role of the new faculty member would be in the department and then search for a candidate who possesses the skills to be successful in that role. In other words, it would be beneficial to see the same attention and effort applied to hiring non-tenure-track faculty that is applied to tenure-track faculty.

B. Self-reported motivation to teach

Our second research question explored the participants’ motivation to teach. Our findings regarding motivation confirm prior research on full-time non-tenure-track faculty in other disciplines. Our participants were motivated to teach because they enjoy interaction with students and the ability to forge a satisfactory balance between work and personal responsibilities [1][8].

These participants felt most satisfied with their work when they were engaged with students, teaching them skills and knowledge about the topics in which they had significant experience which is expected [2][8]. Participants find satisfaction in developing new courses, new laboratories, and new manufacturing capabilities.

We found a high level of career satisfaction among our participants, consistent with the satisfaction levels of non-tenure-track faculty of other disciplines. Nine of the ten participants have no plans to leave teaching. Three of those nine have considered leaving, not because of the teaching itself but because they are dissatisfied with their status and opportunities for advancement.

V. Conclusion

Non-tenure-track faculty are an increasingly large part of the faculty population at institutions of higher education. The factors that have led to the increase in the non-tenure-track faculty ranks are widespread and unlikely to change in the coming years. Increasing the understanding of non-tenure-track engineering faculty careers and motivations can help institutions learn how to use this valuable new resource to make their educational programs improve.

We found a remarkable career path diversity among our participants. This diversity is a strength, bringing new perspectives, skills, and experience into engineering programs.

This remarkable diversity has two significant implications for departmental policies, one regarding recruitment and one regarding career advancement.

A. Latent Danger in Formalizing the Search Process

Previous research has shown that the recruitment of full-time non-tenure-track faculty should be undertaken with care, ensuring that the skills and perspectives that the new faculty member brings to the department complement the existing faculty [7]. This careful hiring did not happen for most of our participants. Nine of the ten were hired without a search committee and without formal criteria. Most were hired serendipitously and previous research would predict suboptimal outcomes, such as dissatisfied faculty, and faculty that are not well suited for their appointments. This is not, however, what we found. We found participants who were quite satisfied in their work and who were not only a good fit for their appointments but brought experience and skills that made them a clear asset to their departments. It seems that the lack of a formal hiring process has allowed these participants to enter easily into a teaching career. There is a danger here, then, in formalizing the hiring process. When search committees are formed to hire non-tenure-track faculty members, who will serve on those committees? By what criteria will the candidates be judged? The department must be careful to not take a deficit-view of non-tenure-track faculty, holding the tenure-track criteria up as ideal with deviations considered negative. Ironically, the call to formalize faculty searches could result in the creation of criterion that inadvertently exclude a rich, dynamic, diverse group of candidates.

As an example, suppose the search criteria included the requirement that candidates hold a terminal degree in their field, a common requirement for tenure-track searches. That requirement would have eliminated half of our participants. Alan, who was the engineering manager of a corporation, reporting to the CEO, would not make the cut. Frank, who went on to develop a RF course and laboratory, providing students in his department a valuable skill set, would not make the cut.

As another example, a search committee may place significant value on research capability or require a research statement, a common requirement for tenure-track searches. Most of the participants would be at a serious disadvantage when competing against post-doctoral students who had performed research in university labs. Most practicing engineers do not write research papers as part of their work, they develop products and processes and any research they do is often proprietary and therefore not published.

If the composition and criteria of the search committee are not carefully designed, the department will miss the remarkable diversity available and could instead recruit candidates that would be better suited for a tenure-track career. This diversity will certainly be missed if the department uses non-tenure-track appointments as a “holding pattern” while the institution waits for a tenure-track position to come open.

This is an important, urgent, area for programs to consider and for future research.

B. Criteria for Career Advancement

If engineering programs continue to recruit full-time non-tenure-track faculty members with diverse backgrounds, another important matter is to examine the criteria for career advancement. In a previous study [13], we found that some participants could not advance in their careers because they did not possess a terminal degree in their field and a degree in education which they perceived as more germane to their work would not suffice. Prior career experience and educational research should contribute to career advancement.

We see a clear injustice in the case of Ethan whose decades-long engineering career in the military and later at a prestigious laboratory was not counted towards his career advancement because he did not at the time have a doctoral degree. This might make sense for a tenure-track pathway in which every candidate earns a

doctoral degree before beginning their career, but does not make sense for non-tenure-track faculty who may have had careers that did not require or reward doctoral degrees.

To create a culture where non-tenure-track faculty with diverse backgrounds are valued and respected, career advancement policies need to be reviewed and carefully designed to encourage this rich, diversity of career paths. The temptation to hold up the tenure-track career advancement criteria must be resisted, many non-tenure-track faculty will not be interested in pursuing a terminal degree in their field and will not be interested in performing research, even educational research. It is possible to create a viable career path that relies on teaching skills, the development of new courses, of new laboratory capabilities and spaces, and contributions to departmental educational goals.

We have uncovered an important and beneficial dimension of full-time non-tenure-track engineering faculty. By carefully designing recruitment and advancement policies, engineering departments can tap into the remarkable diversity of non-tenure-track candidates, enriching their programs and improving student outcomes.

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