# AC 2012-3342: A REVIEW OF NON-TENURE-TRACK, FULL-TIME FAC-ULTY AT SYSTEMS CENTRIC SYSTEMS ENGINEERING (SCSE) PRO-GRAMS

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# A Review of Full-Time Non-Tenure-Track Faculty at Systems Centric Systems Engineering (SCSE) Programs

## Abstract

The main objective of this study is to review the status of full-time non-tenure-track faculty (NTTF) at existing graduate Systems Centric Systems Engineering (SCSE) programs in the US, including an examination of hiring policies, roles, working conditions, and barriers against hiring full-time NTTF. A comprehensive survey and other sources were used to gather data from all 30 existing graduate SCSE programs nationwide. Key findings are: (1) fewer than 50% of SCSE programs hire full-time NTTF and among them, the majority of the programs (65%) have fewer than four full-time NTTF; (2) 24% of the total faculty employed by SCSE programs in 2010 are full-time NTTF and most of them (67%) spend the majority of their time teaching; (3) all respondents (65% response rate) who hire full-time NTTF identified industrial experience as the most attractive reason for hiring them; (4) close to 58% of the respondents use a formal search to hire full-time NTTF, while the rest rely on personal and institutional networks and recommendations; and (5) over 80% of the respondents apply policies in hiring and retaining full-time NTTF that are similar to those used for tenured and tenure-track faculty (TTTF) and 32% of them reported that the hiring process for full-time NTTF is decentralized, allowing it to be conducted at the department or school level. The most significant barriers to hiring full-time NTTF are the short contract length being unattractive and a lack of funding to hire them. The present study shows that institutions that started after 1995 and had 40% or more of their full-time faculty as NTTF have produced more masters degree graduates than the remaining SCSE programs that have a lower percentage of full-time NTTF.

## Introduction

The main objective of this study is to review the hiring policies, roles and working conditions of full-time non-tenure-track faculty (full-time NTTF) at the 30 existing US institutions offering Systems Centric Systems Engineering (SCSE) programs.

The engineering world and the education system that supports it are changing rapidly[1]. As engineering expands into new disciplines and the engineer of the future is expected to be more versatile, the education system needs to adapt to accommodate it[2]. The faculty that comprise the educational system need to be flexible and agile as well, which means some of the traditional methods of hiring, promoting and retaining faculty need to change[3,4,5]. Recent studies and related reports[1] have identified industry needs that call for graduates to acquire the breadth of educational experience that extends beyond just pure technical content and include skills such as communication, leadership, management, professional responsibility and public policy. However, traditional tenured and tenure-track faculty (TTTF) who lack industrial experience may lack some of these skills. According to a recent study conducted by Waltman, et al.[6], full-time NTTF often cited the opportunity to focus on teaching as a reason for choosing their job over tenure-track positions. They have often expressed high satisfaction with their teaching job and how they enjoy working with students and expressed their desire to make a difference in students' lives.

Because systems engineering (SE) education is inherently highly multidisciplinary, is constantly evolving and moves in lock step with rapid advances in technology, it influences the learning and teaching processes[7]. Recent studies conducted by INCOSE[8] and Fabrycky[9] show that there are 62 US universities that offer 110 graduate SE degrees. Thirty of these universities offer 45 Systems-Centric (SCSE) degrees; i.e., either a Master's or a Doctorate in Systems Engineering. The remaining 65 programs are Domain-Centric (DCSE); i.e., a Master's or a Doctorate in a traditional engineering discipline with a concentration in systems engineering, e.g. Biological Systems Engineering, Industrial Systems Engineering, or some other specialization. Lasfer and Pyster[10] report on the growth of SCSE programs in the US, showing rapid growth over the last decade with wide variation across institutions in that growth. The present study addresses the related question – "How do SCSE programs rely on full-time NTTF?"

## Status of full-time NTTF at US universities

### *History and definition of tenure*

The primary goal for the creation of academic tenure was to guarantee the right to academic freedom by protecting faculty when they dissent from prevailing opinion, openly disagree with administration or other authorities, or spend time conducting research on topics that may not be of primary interest to the university. Academic tenure is intended to promote new discovery and original ideas, providing scholars the intellectual autonomy to investigate problems that they are most passionate about and to report their honest conclusions[5,3,2].

In the 19th century, university professors largely worked under the control of the board of trustees of the university though a de facto tenure system existed whereby a faculty member could be dismissed only for interfering with the religious principles of a college. Courts rarely intervened in dismissals[6].

In 1940, the American Association of University Professors[3] recommended a limit of seven years – still the current norm – for the probationary period of academic tenure. It also suggested that a tenured professor could not be dismissed without adequate cause, except "under extraordinary circumstances, due to financial emergencies"[6].

In 1972, the tenure system was changed as a result of two landmark US Supreme Court cases leading to the implementation of specific tenure policy or contractual agreement in which due process requires specific procedural safeguards when a tenured faculty is to be dismissed; e.g. the right to personally appear in a hearing, the right to examine evidence and respond to accusations, and the right to have advisory counsel.

### *Decline in tenure-track faculty*

Over the past four decades, there has seen a steady decline in the percentage of tenured and tenure-track faculty (TTTF) at US colleges and universities due to increased hiring of full-time NTTF who have primarily been hired into part-time positions[2,5,11,12,13]. Statistics from the United States Department of Education[14] indicate that the combined tenured/tenure-track faculty composition was at 36% in 1975, 33% in 1995, 26% in 2007, and only 24% in 2009. However, full-time NTTF increased steadily from 10% to 15%, and part-time NTTF doubled from 24% in

1975 to 41% in 2009. These trends have occurred at all types of US institutions, both public and private[2].

Three main factors have contributed to the trends described above[11,5]:

- **Cost savings**: With increased student enrollments, colleges can staff courses with full-time NTTF who, on average, receive lower salaries and benefits than TTTF and receive limited professional support.

- **Flexibility:** As enrollments fluctuate, colleges can hire more or less full-time NTTF much more readily than TTTF.

- **Governance**: TTTF play a larger role in university governance than full-time NTTF. The decline in TTTF in universities shifts more authority to university administrations.

Additionally, both part-time and full-time NTTF have received less than equitable treatment compared to TTTF with regard to hiring, salaries, office space and equipment, opportunity for review of job performance as well as professional development and advancement as both teachers and scholars[11,5,12].

For the most part, the roles of research full-time NTTF differ from those of teaching full-time NTTF. Researchers are typically hired for funded projects or as long-term managers of research laboratories and related centers. They occasionally mentor graduate students (formally or informally)[6,5]. Such faculty members derive satisfaction from being able to conduct their own research at universities having the required resources. However, in most cases, they must generate their own sustained funding which is often the key factor for keeping their position. As reported recently by Waltman et al.[6], research full-time NTTF feel isolated from each other and from other campus groups, and they are not treated as equal to their TTTF colleagues. Lack of clear policies related to hiring, salaries, titles, and career ladders were also a concern of several researchers.

**Full-time NTTF at Graduate SCSE programs**

*__Survey Population__*

A questionnaire was developed to gather relevant data related to full-time NTTF at all 30 institutions listed in Table 1 – the US universities that offer a graduate SCSE program. Follow up interviews were conducted with some respondents. To maintain the requested confidentiality of the SCSE programs surveyed, their names are not listed in the figures and tables generated as part of data analysis.

First, the survey was sent to the department chair of each of the 30 graduate SCSE programs. Eleven programs responded. For the institutions that did not respond to the survey, other offices within each of these schools were contacted by phone and e-mail to provide the missing data. These offices included: Office of Human Resources, Office of the Provost, Dean's Office, and the Assessment Office. Responses from these offices raised the overall response rate to 83%. The response rate differed from one question to another, but was always more than 50% for each question.

**Table 1. List of SCSE Programs Selected for the Study**

| | |
|---|---|
| 1. Air Force Institute of Technology | 16. Rochester Institute of Technology |
| 2. Boston University | 17. Stevens Institute of Technology |
| 3. Case Western Reserve University | 18. Southern Methodist University |
| 4. Cornell University | 19. Southern Polytechnic State University |
| 5. George Mason University | 20. University of Alabama – Huntsville |
| 6. George Washington University | 21. University of Arizona |
| 7. Iowa State University | 22. University of Houston - Clear Lake |
| 8. Johns Hopkins University | 23. University of Idaho |
| 9. Lehigh University | 24. University of Pennsylvania |
| 10. Massachusetts Institute of Technology | 25. University of Maryland |
| 11. Missouri university of Science and Technology | 26. University of Southern California |
| 12. Naval Postgraduate School | 27. University of Texas – Arlington |
| 13. Polytechnic University – Farmingdale | 28. University of Virginia |
| 14. Penn State at Great Valley | 29. Virginia Tech |
| 15. Portland State University | 30. Washington University |

### *Non-Tenure-Track Faculty ( full-time NTTF) position titles*

The most common titles assigned to full-time NTTF at various levels include: visiting professor, lecturer, senior lecturer, distinguished lecturer, instructor, research (assistant, associate, and professor), distinguished research professor, and distinguished service professor. Staff titles are frequently qualified with such terms as "distinguished", "eminent", "emeritus", university", and "research". Policies regarding these titles vary from one institution to another. Some appointments are given through the department head, some through the dean or provost or even the university president. Among all the responses, 32% indicated that the hiring process for full-time NTTF is decentralized, allowing departments and other administrative units smaller than the entire university to hire full-time NTTF.

### *Data analysis*

The survey data was compiled and analyzed for each question as follows.

## 1. SCSE full-time NTTF population and duties

Among the SE programs surveyed, only 47% (14 programs) had full-time NTTF in 2010 (Figure 1.). Other results as illustrated in Figure 1 and Table 2 are summarized as follows:

- 24% of the total faculty employed in all 30 programs in 2010 are full-time NTTF

- 13% (4 programs) had ten or more full-time NTTF

- 3% (1 program) had between 5 and 9

- 30% (9 programs) had between 1 and 4 full-time NTTF

- Six of the SCSE graduate programs that started after 1995 have 40% or more full-time NTTF

- 67% of all full-time NTTF were hired for teaching positions

- 100% of the respondents identified industry experience as one of the main reasons for hiring full-time NTTF. Other reasons for hiring full-time NTTF are listed in Table 2.
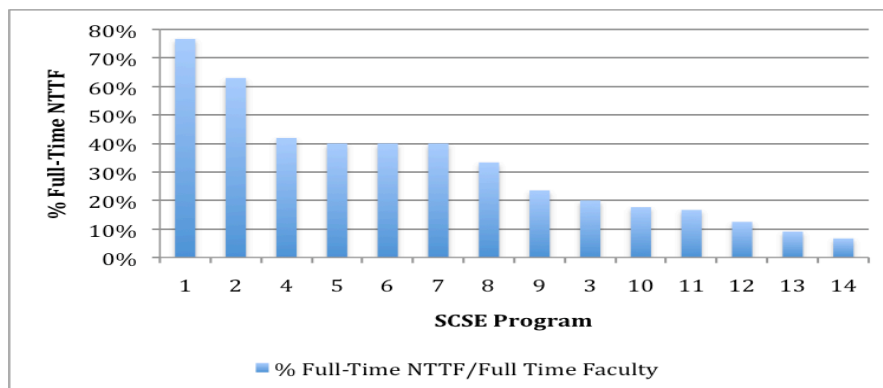


**Figure 1. Ratio of SCSE full-time NTTF to All Full Time Faculty at Existing SCSE Programs**

**Table 2. Motivation to hire SCSE full-time NTTF**

| Reasons for Hiring full-time NTTF | Response Rate |
|---|---|
| **Industry experience** | **100%** |
| Managerial experience | 30% |
| Teaching effectiveness | 30% |
| Flexibility to meet short-term needs | 10% |
| Provide release time to TTTF to conduct their research | 30% |
| Other: domain knowledge in non-traditional areas (creativity, social networks, etc.) | 10% |

The total number of full-time NTTF represents approximately one fourth (24%) of the total number of full-time faculty within the 30 SCSE programs in the US. Fewer than 50% of SCSE programs hire full-time NTTF and among them, the majority of the programs (64%) have four or fewer full-time NTTF, representing a much smaller percentage of the total faculty than at US universities at large. Anecdotal data from the survey indicated it was relatively difficult for SCSE programs to find qualified full-time NTTF to hire, which could explain the difference between SCSE programs and other university programs. All respondents agreed that the most attractive reason for hiring full-time NTTF is industrial experience. This finding is in agreement with the well-documented need for SE programs to expose their students to practical industrial training as an essential component of SE education. Also, the majority of full-time NTTF (67%) at SCSE programs spend most of their time teaching.

Some institutions that started their SCSE programs after 2001 and produced a high number of SE master's degree graduates[10] also employ a higher number of full-time NTTF. However, there is no correlation between SCSE programs that started before 2001 that produced a high number of master's graduates and the number of full-time and part-time full-time NTTF. This may reflect the fact that most of the growth in master's graduates in the US occurred in SCSE programs that began after 2001. Those programs would have the greatest need to hire additional faculty and would be more likely to reach out to full-time NTTF.
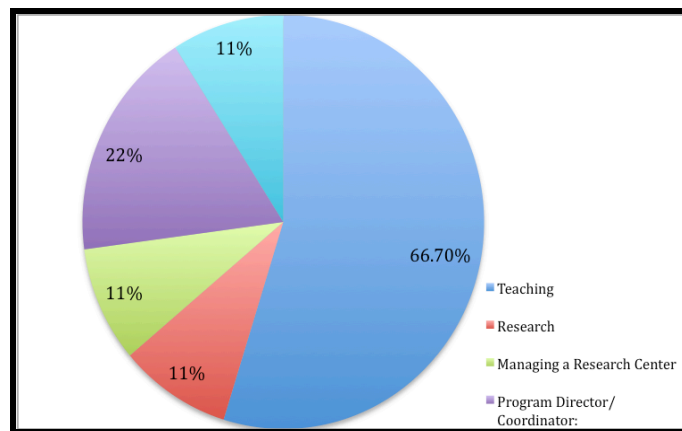


**Figure 2. Main duties of SCSE full-time NTTF**

## 2. Comparison of the roles of SCSE full-time NTTF and TTTF

Among the 14 institutions that hire full-time full-time NTTF, 12 of them (85% response rate) provided the data needed to compare roles of SCSE TTTF and full-time NTTF within the last 5 years. The comparison is summarized as follows:

- 75% of full-time faculty at responding SCSE programs are TTTF, which is much higher than the corresponding percentage overall in US universities.

- In 100% of the SCSE programs, TTTF are generally more active than full-time NTTF in research publications and research funding, reflecting the primary role full-time NTTF have supporting teaching.

- 70% indicated that TTTF received higher teacher effectiveness ratings from students than full-time NTTF. Considering that full-time NTTF are hired mainly for teaching and for their industrial experience, this is a somewhat surprising result. Perhaps this reflects the fact that full-time NTTF have spent most of their careers outside the classroom and may have not honed their lecturing skills.

- There is not a large difference in teaching load between full-time NTTF and TTTF.

- TTTF consistently have a higher administrative load than full-time NTTF.

### 3. Treatment of SCSE full-time NTTF

#### Full-time NTTF treatment policies

Among the 30 schools surveyed, 22 responded to the question related to the policies applied to hire and retain SCSE full-time NTTF (73% response rate). 58% of the respondents use a formal search to hire full-time NTTF. The remainder relied on personal and institutional networks. In 60% of SCSE programs, the program director or department head does not have the authority to hire full-time NTTF. The decision for hiring is usually made at the provost's office.

It has been widely recognized[2] that at US colleges and universities at large, full-time NTTF have received less than equitable treatment compared to their tenure-track colleagues with regard to hiring, salaries, office space and equipment, as well as opportunity for review of job performance and professional development and advancement as both teachers and scholars. However, full-time NTTF treatment at SCSE programs appears to be different. At most SCSE programs, full-time NTTF receive treatment for hiring and retention similar to that for TTTF:

- Nearly all SE full-time NTTF participate in course and curriculum development. They are not just handed course material from which to teach.

- Nearly all programs allow SE full-time NTTF to participate in governance at the program, department, or higher level in the institution.

- 76% of the programs allow SE full-time NTTF to be considered for a switch to a TTTF position.

- Nearly all programs offer SE full-time NTTF the same benefits as SE TTTF.

- 73% of the programs allow SE full-time NTTF to participate on PhD dissertation committees, even if they cannot be a PhD advisor.

- Nearly all programs allow SE full-time NTTF to lead research projects.

#### Barriers against hiring and retaining SCSE full-time NTTF

Based on the responses from 22 schools among the 30 that were surveyed (73% response rate), the barriers against hiring full-time NTTF are:

- Limited budget to hire full-time NTTF

- Full-time NTTF are viewed by some TTTF as an attempt to eliminate tenure

- Year-to-year contracts, sometimes with limited opportunity to renew beyond 3 to 5 years

- Policies limiting the number of full-time NTTF allowed

- Requirements for full-time NTTF to be self-funding, having to get their own grants

- Pressure to build research programs via traditional TTTF hiring

**Conclusions and Recommendations**

At doctoral and research universities in the U.S., full-time NTTF represent 48 percent of the entire faculty and 68 percent at all US degree-granting institutions[3]. Yet, at the 30 existing graduate SCSE programs, full-time NTTF represent only about a fourth of the total faculty. Historically, full-time NTTF are hired in many schools generally to increase their department's flexibility "to meet short-term needs for special staffing and expertise"[14,15]. In the case of graduate SE programs, special staffing and expertise is often reflected in extensive industrial experience. The present study shows that institutions that started after 1995 and had 40% or more of their full-time faculty as full-time NTTF, graduated a higher number of masters degree students than the remaining programs that have a lower ratio of full-time NTTF.The majority of full-time NTTF at SCSE programs spend most of their time teaching, although some  full-time NTTF have active research roles. Close to 58% of the respondents use a formal search to hire full-time NTTF. Unlike the trends observed broadly at US colleges and universities where  full-time NTTF received lesser treatment compared to their TTTF colleagues, at SCSE programs over 80% of the institutions apply equitable policies in hiring and retaining TTTF. Primary barriers against hiring full-time NTTF are short contract length and a lack of available budget for hiring.

The present study reveals that five of the SCSE graduate programs that started after 2000 employ a larger percentage of full time NTTF. These five programs have produced the largest growth in number of master's degree graduates during the period from 2001 to 2010 (Lasfer and Pyster[10]). As part of the present study, based on discussions held with SCSE department chairs, new programs could benefit from hiring full-time NTTF to teach graduate professional students whose experience matches the needs of their employers. The professional experience that full-time NTTF bring to a program should allow them to teach and conduct research in their domain expertise. This could require adjustments in policies and practices to make it attractive for qualified professionals from industry and government to seek employment in SE graduate programs.

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