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Investigating Tenure Experiences of Foreign-Born Women Faculty in Engineering at the California State University System

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Abstract:

The number of engineering doctoral degrees awarded to foreign-born (international) students has increased in the past three decades. It has resulted in an increase in the foreign-born professoriate across the USA. To address gender parity and address the needs of a diverse student population, many universities are increasingly recruiting foreign-born women faculty. While their immigration status is their transitional identity, they do have a distinctive racial/ethnic identity. Unfortunately, issues of foreign-born faculty, especially women, are understudied. A pilot study was carried out at the California State University System to assess the needs of women faculty. A survey was administered to the engineering faculty (all identity groups) across California State University System. This paper examines the tenure navigation of foreign-born women faculty to identify their needs to attain tenure and promotion successfully. Resource satisfaction between the populations based on gender and foreign-born status are compared. Based on the evidence presented, the authors argue that foreign-born status should be considered as one of the parameters in planning retention programs and addressing intersectionality for engineering academics. Some ongoing efforts at the California State University System are also reported.

Background

In the past decade, the percentage of doctoral degrees in engineering awarded to women has increased from 21.2% to 24.1% (ASEE [1]). Simultaneously, the average percentage of women faculty in the engineering professoriate has also increased from 8.1% to 18.8% (ASEE-EDGE [2]). Most of these gains seem to be driven by the hiring of assistant professors (tenure track positions) with parallel trends in increasing associate and full professors over a 5-6-year period, indicating that these women are most likely retained. While overall trends in recruiting and retaining more women in engineering in academia are promising, demographic markers such as underrepresented minority (URM) status need to be carefully studied, especially regarding foreign-born (FB) status. ASEE [1] and NSB-NSF [3] have documented that the number of international students with doctoral degrees in engineering has been consistently increasing for almost two decades. Simultaneously, the hiring of FB women in academia has also increased. Most of these faculty are eventually naturalized and become citizens. While the immigration status of these faculty is transitional, their specific cultural and racial identity carries forward. Unfortunately, the classification of these individuals in URM/Non-URM status is complicated. Some reasons for such complexity are: 1) the URM definition used by NSF is based on underrepresentation in STEM fields relative to the overall US population, but FB faculty are drawn from the world population where the ethnic groups adversely affected by systemic inequities may or may not align with the US definitions; 2) FB faculty of Black and Hispanic backgrounds are included in URM, which raises the number of URM faculty but does not reflect an improvement in the inclusion of historically underrepresented African American and Hispanic populations in the US; 3) FB faculty of White and Asian backgrounds are not included in URM because they are not underrepresented in STEM relative to their proportion in the US, but many are still minorities in the education system and thus experience cultural isolation. Also, their experiences with bias are

obscured when combined with US-born (USB) Non-URM experiences; 4) Asian is an overly broad category that as a whole is overrepresented in STEM fields, but considering it as an aggregate masks pockets of under-represented USB minorities (e.g., Hmong, Vietnamese); and 5) White aggregates European, North African, and Middle Eastern making it difficult to distinguish the representation and experiences of these distinct groups and neglects the disparate levels of biases they face. Furthermore, the definitions of whether Asians, who form the largest pool of PhD awardees in engineering, are considered a racial minority vary between the US census bureau and NSF, creating major gaps in understanding the demographic data on faculty in the engineering professoriate. Mukherji et al. [4] have pointed out the inadequacies of the current data on URM for international students, arguing for the need for more detailed data on their cultural origins to serve these under-served students better. We propose a similar approach for understanding the URM and immigrant faculty to meet their needs better and retain them.

Knowledge gaps: Terms such as international, foreign-born, foreign-trained, and diaspora have been used in the past to describe individuals not born in the United States. However, Akulli [5] reported that the term foreign-born, i.e., individuals born outside of the United States, was broadly acceptable for faculty in STEM fields. Thus, Foreign-Born (FB) will be used in this paper. Most studies focused on gender in engineering do not consider the FB status of the faculty, while those that study trajectories of FB faculty do not focus on gendered experience, resulting in FB women faculty being overlooked and understudied. A small number of researchers (e.g., Wells [6], Foote et al. [7], Akulli [5], Rita, and Karides [8]) have studied the issues related to FB faculty in STEM. While data on international students are publicly available (e.g., ASEE [1], NSB-NSF [3]), collecting the data for faculty is very difficult because of privacy issues and rapid changes in residency status. The California State University System as an employer only tracks the FB status of the faculty for visa purposes, not linking it to any internal assessments as they do with gender and URM status. Therefore, collecting more granular data that goes beyond simple demographics is needed. Past studies have indicated that gender is an influential factor (e.g., Akulli [5]) for FB faculty. Additionally, Foote et al. [7] and Rita and Karides [8] point out that feeling isolated is one of the most traumatic work environment experiences, especially for FB women. These studies also indicate that while gender biases and isolation are common for all women faculty, the severity varies for FB faculty. Lawrence et al. [9] studied the intention to stay among Asian faculty, who form the largest group among international faculty, and found that the FB faculty are more productive in research but less productive in teaching and that dissatisfaction with the work environment may not necessarily lead to resignations or departures. Similar observations were recorded by Mamiseishvili [10] [11] with respect to FB faculty. The study by Akulli [5] showed that FB women expressed the greatest dissatisfaction with the work environment in academia. The sporadic studies on FB faculty were conducted mostly at research (R1 and R2 Carnegie classification) institutions, thus focusing on research productivity as a success metric. Unfortunately, there are no similar studies on resource satisfaction in teaching and service-intensive universities such as the California State University System, nor does the system share/publish internal data to understand workplace satisfaction. This led us to undertake a preliminary study i) to understand trends in demographics and ii) to investigate and compare tenure success, faculty preparation, and satisfaction with resources among engineering faculty in the California State University System using an intersectional approach considering FB status

and gender. In the following sections, we present the methods and descriptive statistics of the participants, a detailed analysis of the data, results, and discussion, followed by the conclusion and future directions for the study.

Methods and Descriptive Statistics

To understand the current demographics of the engineering faculty along with their intersectionality with subgroups (gender, tenure status, FB status) and to measure their satisfaction with respect to various resources, a survey was sent to all engineering faculty in the California State University system in 2018. The survey questions were divided into five categories: demographic information, employment information, tenure experiences, networking and collaborative experiences, and satisfaction with resources. More information about these categories may be found in Oka et al. [12]. In addition to the survey questions highlighted in Oka et al. [12], the survey asked faculty whether they were born in the United States, the years during which they were hired, received tenure, promoted to Associate Professor, and/or promoted to Full Professor, number of publications prior to receiving tenure (for tenured faculty) or number of publications since date of hire (for untenured faculty). Survey respondents included fifty-two (52) tenured or tenure track engineering faculty employed at ten different campuses in the California State University System. Comparisons of statistical differences in the surveyed population based on gender and FB status were measured using standard statistical methods.

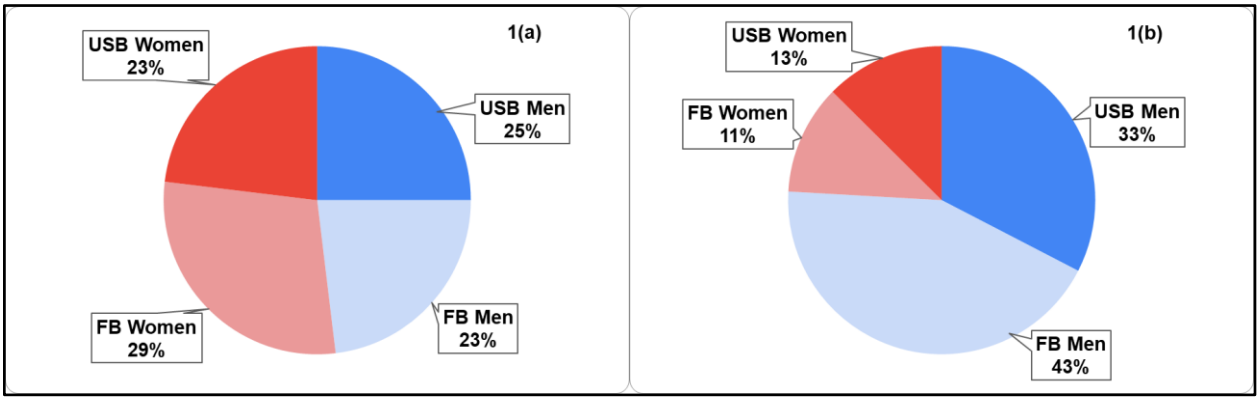

Figure 1: Distributions based on gender and FB status: (1a) In the current study; (1b) Engineering doctoral degrees awarded in the US (ASEE [1])

Figure (1a) shows the distribution based on gender and FB status of the faculty participants in this study. Figure 1(b) shows the current proportions of the potential pool of candidates based on doctoral degrees awarded (ASEE [1]). Based on FB status, the overall percentages of USB and FB in both samples are similar (52% of FB faculty in the current study versus 55% FB individuals in the national level PhD awardees group). The institutional data indicated that approximately 22% of the engineering faculty are women (approximately 194 out of 882 faculty), This is similar to the national average of 24%. However, women faculty in both categories of USB and FB are overrepresented in our survey. In contrast, the vast majority of the respondents completed their PhDs in the 2000s or 2010s. During these decades, the proportion of nonresident engineering PhD graduates in the US (the closest available comparison to foreign-born status) remained in

the 50% - 56% range, with the exception of an all-time high of 62% in 2006-07 (ASEE [13] and ASEE [1]). Thus, the comparisons of survey respondents based on FB status do not significantly differ from the candidate pool of PhDs generated over the previous two decades and can be considered representative of national trends.

Figure 2 shows the number of tenure track and tenured faculty disaggregated by USB/FB and women/men engineering faculty who participated in the survey. Tenure track faculty were more represented than tenured faculty for all demographics except USB men. Among tenure track faculty, FB faculty respondents outnumbered USB faculty respondents. This observation is reflective of the current trend of higher percentages of doctoral degrees being awarded to FB individuals and newer tenure track positions being offered to them.

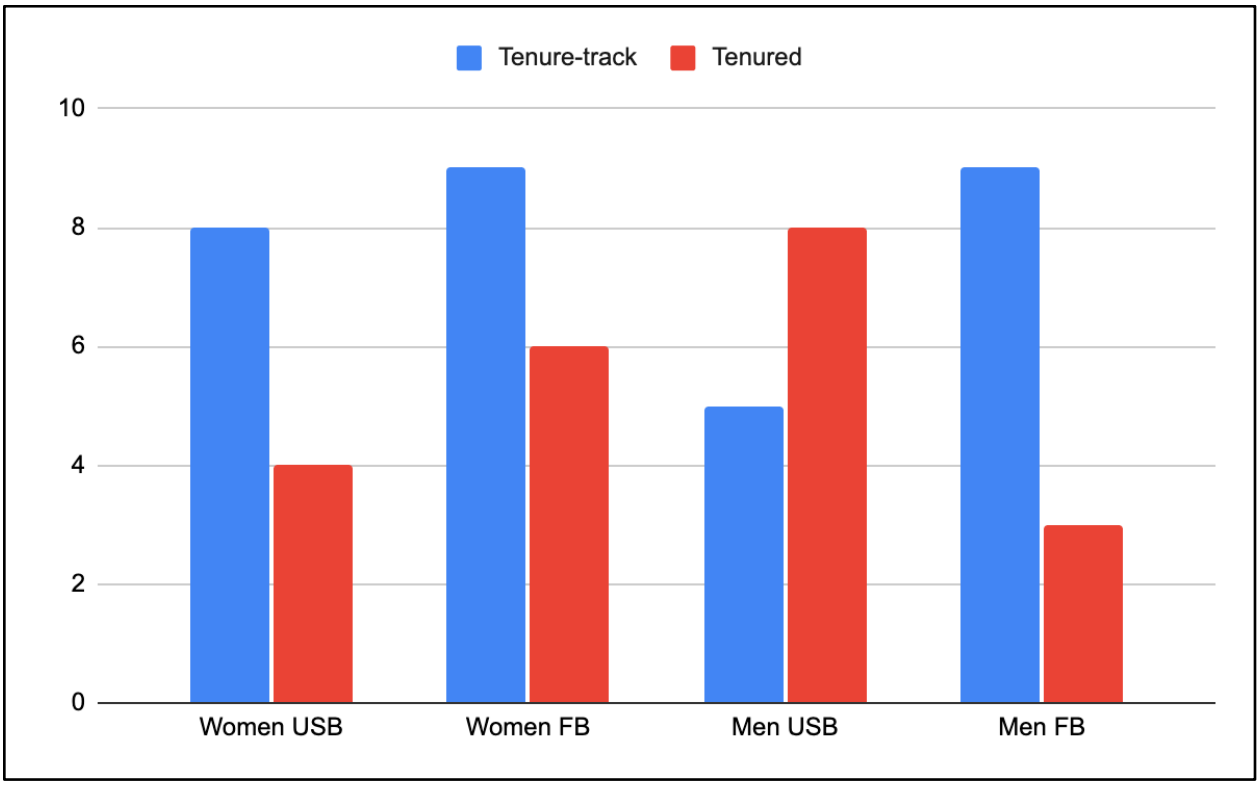

Figure 2: Demographics of the participants based on the tenure track and tenured status

The survey instruments in the current study were designed to investigate and compare the factors that are typically considered as measures of success in the tenure trajectory. Therefore, in addition to demographics (gender, race/ethnicity, USB/FB, rank), the survey collected the data on the level of satisfaction of engineering faculty with the available resources. The comparative analysis presented in the following sections was carried out to identify whether there are any significant differences based on the combination of gender and USB/FB status in satisfaction with available resources for teaching, research, and service.

Limitations of the current study: The results of this study are based on a very small sample size of 52 out of 880 faculty, and more granular data will be required to generalize results for the entire

population. However, comparisons within the group of surveyed populations are possible and provide important indicators of the level of satisfaction among the engineering faculty in the California State University System and highlight areas that should be investigated in more depth in future studies.

Results and Discussion

Analysis of time to tenure: This study analyzed time to tenure for engineering faculty across the California State University System campuses and compared results based on both gender and USB/FB identities. Data collected from associate and full professors documented that all faculty earned tenure within 4-7 years, with the largest proportion (50%) earning tenure at 6 years. However, the survey results indicated that FB faculty achieved tenure significantly earlier (P=0.066) (5.4 years compared to 6.1 years for USB faculty). Time to tenure for FB faculty also varied more, with a standard deviation of 1.3 years for FB faculty compared to 0.57 for the USB faculty. In particular, when this data was disaggregated by FB status and gender, as shown in Table 1, it became clear that only FB men had achieved tenure earlier, while the differences between the other three demographic groups were not statistically significant. It should be noted that the statistically significant (P=0.015) shorter time to tenure for FB men is based on a small sample size, and it may or may not be representative of the corresponding population in the California State University System. This survey did not collect the data on service credit received at the time of hire, so it is not possible to distinguish whether shorter times to tenure reflect disproportionate receipt of early tenure or are merely a result of service credit received. Although, the study did not control for a particular campus or engineering discipline, it is indicative of possible differences in tenure experiences in the groups and future studies can be planned accordingly.

Table 1. Tenure metrics for Associate and Full Professors surveyed

	FB Women	USB Women	FB Men	USB Men
Mean time to tenure (years)	5.8	6.0	4.7	6.1
Mean pre-tenure publications per year	1.1	2.3	5.9	1.2

Although research and funding expectations for tenure are lower in the California State University System compared to research-intensive institutions, this study demonstrates that the timing of faculty tenure appears to be correlated with publishing rates. Figure 3 charts the time to tenure for FB tenured respondents against their pre-tenure publication rates, and Table 1 summarizes the mean values of pre-tenure publication rates arranged by gender and FB status as their cross-sectional identities. The following observations were drawn from this data:

- The pre-tenure publishing rate for FB men was significantly (P=0.005) higher than for the other demographic groups. This higher mean publication rate among FB men aligns with their shorter mean time to tenure.

- The majority of FB tenured faculty (81%) had pre-tenure publication rates between 0.33 and 1.6 papers per year.
- Earning tenure earlier than the standard six-year timeline was only achieved by faculty with pre-tenure publication rates of 1.6 or above.
- Time to tenure for FB faculty was moderately correlated with publication rate (R^2 = 0.68).

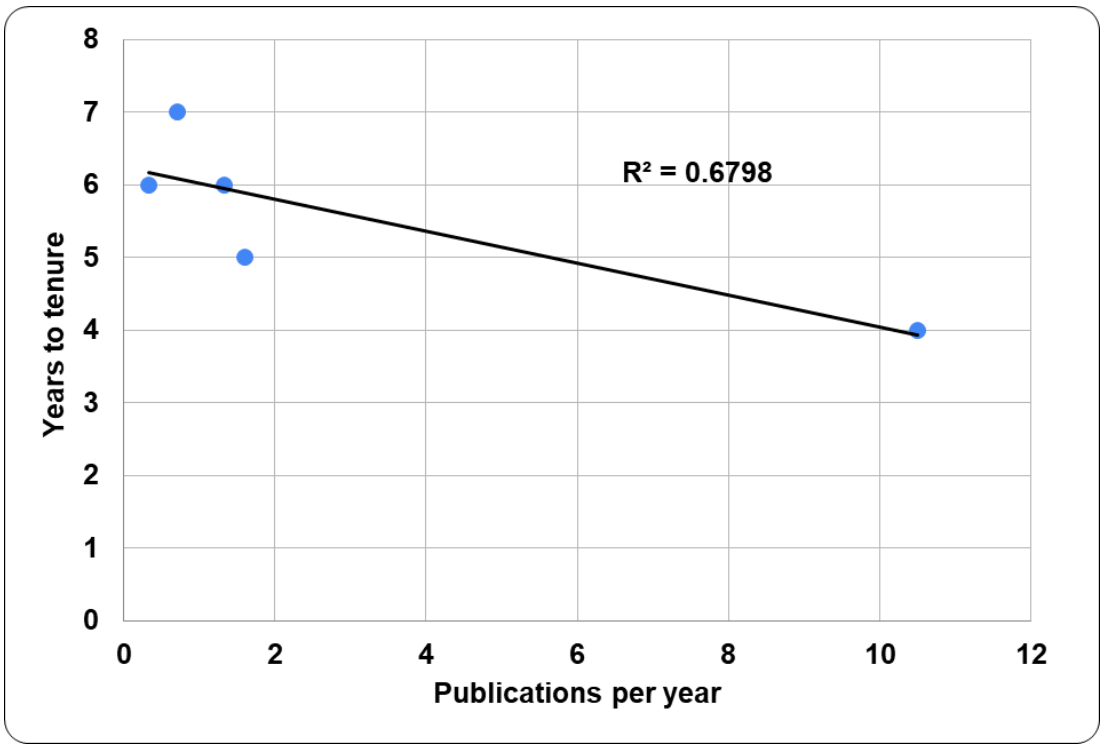

Figure 3. Time to Tenure against Pre-tenure publication rates for FB Associate and Full Professor respondents

The remainder of the results will focus primarily on tenure track faculty. This demographic is of particular interest because 1) tenure track faculty were all hired within a 6-year period, and thus factors that change over time, such as university priorities, funding, and workplace climates, have less effect on their data compared to tenured faculty; 2) tenure track faculty data better captures the full distribution of faculty performance and experiences because the sample includes faculty who may not meet tenure expectations; and 3) retention of tenure track faculty is of particular concern.

Analysis of tenure track faculty trends: Table 2 summarizes the analysis of key metrics from tenure track faculty responses. Since one FB woman reporting 25 publications per year was considered an outlier, analyses using this data were completed with and without the outlier, and findings are reported below:

- Tenure track FB faculty reported a significantly higher (P = 0.047 including the outlier and P = 0.008 excluding the outlier) rate of publications per year than USB faculty (3.7

papers/year including the outlier and 2.4 papers/year excluding the outlier compared to 0.9).

- Assistant Professor responses indicated USB men were publishing at a higher rate than women (P = 0.062), but no statistically significant difference was observed among FB faculty of both genders (P = 0.224 with the outlier and P = 0.388 without it).
- FB faculty reported spending significantly more hours per week on research (P = 0.023) and fewer hours on teaching (P = 0.046) than USB faculty, but no statistically significant difference was found between men and women (P = .150).
- Higher publishing rates of FB faculty appear to be associated with the higher mean number of hours per week spent on research, although no statistically significant correlation was found between hours spent on research and publication rates.
- No statistically significant differences were found in the number of hours spent on service or total weekly hours worked based on gender or FB status.

Table 2. Summary of Research, Scholarship, and Activities for Assistant Professors

	FB Women	**USB Women**	**FB Men**	**USB Men**
Mean years as Assistant Professor at time of survey	3.2	2.4	3	2.4
Mean publications per year	4.7 (2.2*)	0.7	2.5	1.2
Median publications per year	2.0	1.0	2.0	1.5
Mean hours per week spent on research	15	9	19	9
Mean hours per week spent on teaching	24	34	29	37
Mean hours per week spent on service	9	10	10	6
Mean total hours per week (research, teaching, and service)	48	52	58	52

*Analysis repeated omitting outliers.

Analysis of faculty preparation: Figure 4 summarizes years of engineering teaching, industry, and research experience prior to hiring into their current faculty position for engineering faculty for tenure track (i.e., Assistant Professors) and tenured (i.e., Associate and Full Professors) USB and FB faculty. The tenure track FB faculty in this study had significantly higher engineering industry and research experience prior to hiring (P = 0.013 and P = 0.002) than tenure track USB, while differences in teaching experience were not significant. When gender and FB status were considered together, the largest differences in pre-hire experiences were between FB and USB

women. FB women reported a mean of 6.2 years of industry experience and 5.6 years of research experience, whereas USB women reported a mean of 0.75 years of industry experience and 3.0 years of research experience. In fact, only 25% of USB women compared to 89% of FB women reported any engineering industry experience. For Associate and Full Professor respondents, there was no statistically significant difference between the years of previous teaching, industry, or research experience.

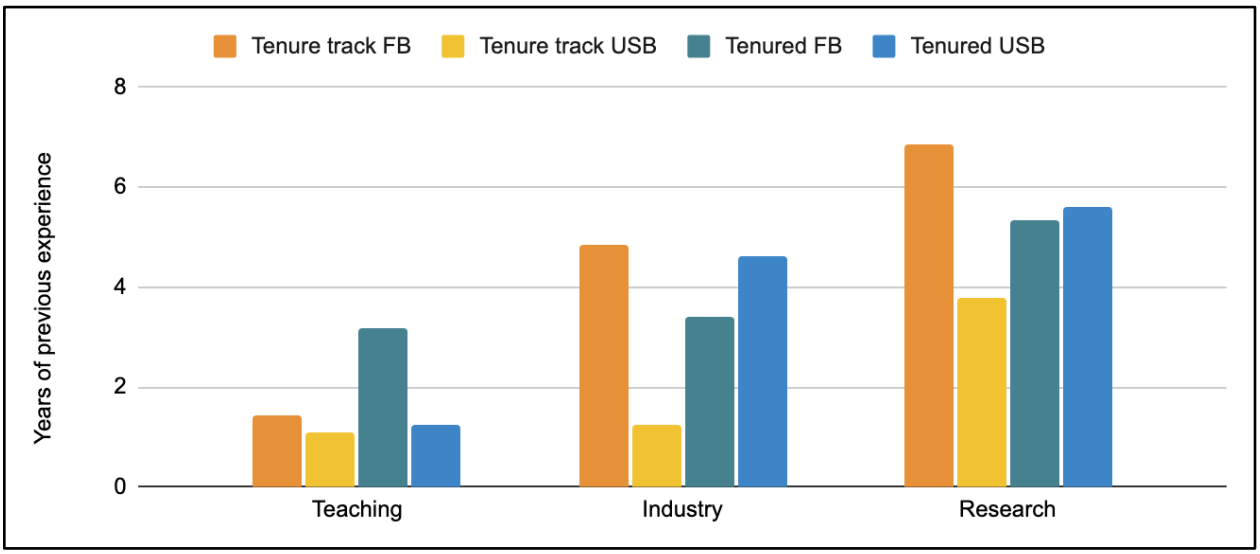

Figure 4. Pre-hire experience of engineering faculty disaggregated by tenure and FB status

To complement experience as a quantitative measure of preparation, respondents were asked how well their PhD prepared them for their faculty position. Table 3 summarizes the results. A significantly higher proportion of FB compared to USB tenure track faculty indicated that their PhD prepared them very well or extremely well for teaching (P=0.099) and research (P = 0.005). When responses of men and women were considered without consideration of FB status, no significant differences in perceptions of preparation between genders were observed. However, when gender was considered as an intersectional identity with FB status, differences were observed. 86% of FB men reported feeling very or extremely well prepared for teaching by their PhD, which was significantly higher than FB women (P = 0.009), of whom only 44% reported feeling very or extremely well prepared for teaching. Meanwhile, although USB women reported feeling very or extremely well prepared for teaching by their PhDs compared to USB men, the difference was not statistically significant. In contrast, a higher proportion of both FB men and FB women reported feeling more prepared for research during their PhD studies than their USB counterparts. Unfortunately, the difference was only statistically significant for women (P = 0.008 vs. P = 0.164). No significant differences were observed between genders, FB status, or intersections of these identities for tenured faculty. The trends observed in these findings illustrate three key points: 1) Considering USB vs FB status when interpreting faculty data may illuminate disparate trends between these groups; 2) opposing trends in genders and FB status (e.g., FB women and USB men) among engineering faculty can offset each other to obscure gender differences; and 3) a comparison of FB and USB faculty without consideration of gender can mask differences between women and men faculty.

Table 3. Proportions of tenure track faculty reporting well or extremely well preparation due to pre-hire experiences

	Women	Men	FB	USB	FB Women	USB Women	FB Men	USB Men
Teaching	47%	58%	63%	38%	44%	50%	86%	20%
Research	76%	77%	94%	54%	100%	50%	88%	60%

Analysis of satisfaction of USB and FB women tenure track engineering faculty: Oka et al. [12] previously determined that the five areas of lowest satisfaction (with fewer than 50% indicating moderately or extremely satisfied) in their survey of tenure track women engineering faculty were related to resources for research equipment, professional networking, industry collaborations, work-life balance, and overcoming bias. The current study further segregated the data by USB and FB identities. As shown in Figure 5, each demographic group showed varying levels of satisfaction in the five aspects studied by Oka et al. [12]. The intersectional analysis performed in this study led to the following observations:

- USB women in engineering tenure track positions expressed low satisfaction (i.e., lower than 50% moderately or extremely satisfied) in only one category (research equipment resources), while FB women expressed low satisfaction in six of the nine categories surveyed.
- There were no statistically significant differences between USB and FB faculty regarding satisfaction with research equipment or professional development resources.
- For FB women, the areas of least satisfaction were industry collaborations (11%) and overcoming bias (22%). The satisfaction of FB women in these areas was found to be significantly lower ($P = 0.03$ and $P = 0.02$, respectively) compared to USB women, of whom 60% and 71% reported moderate or extreme satisfaction with resources for industry collaborations and overcoming bias, respectively. The FB women were also significantly less satisfied in the above two areas when compared to FB men ($P = 0.04$ and 0.01, respectively), of whom 50% and 83% reported moderate or extreme satisfaction with these resources.
- While women as a whole were significantly more satisfied with work-life balance resources than men ($P = 0.045$), disaggregating by FB status indicated that the difference between genders was only statistically significant for FB faculty ($P = 0.074$). This follows a similar trend to the total number of weekly hours worked shown previously in Table 2, where USB men and USB women reported the same mean number of hours, but FB men reported more hours than FB women. Both FB women and FB men expressed lower satisfaction with work-life balance resources when compared to their respective USB counterparts, but the difference was not statistically significant.
- In Oka et al. [12], satisfaction with career and professional development was not indicated as a category of low satisfaction for women. However, when we disaggregated the responses by FB status, we found that while 86% of USB women expressed moderate or extreme satisfaction in this area, only 44% of FB women did, which was statistically significantly lower ($P = 0.5$). Some studies in the past (e.g., Wells [6], Mamiseishvili [10])

have reported similar observations. The current study again highlights the importance of analyzing data of FB faculty separate from USB faculty to assess their career experience and satisfaction.

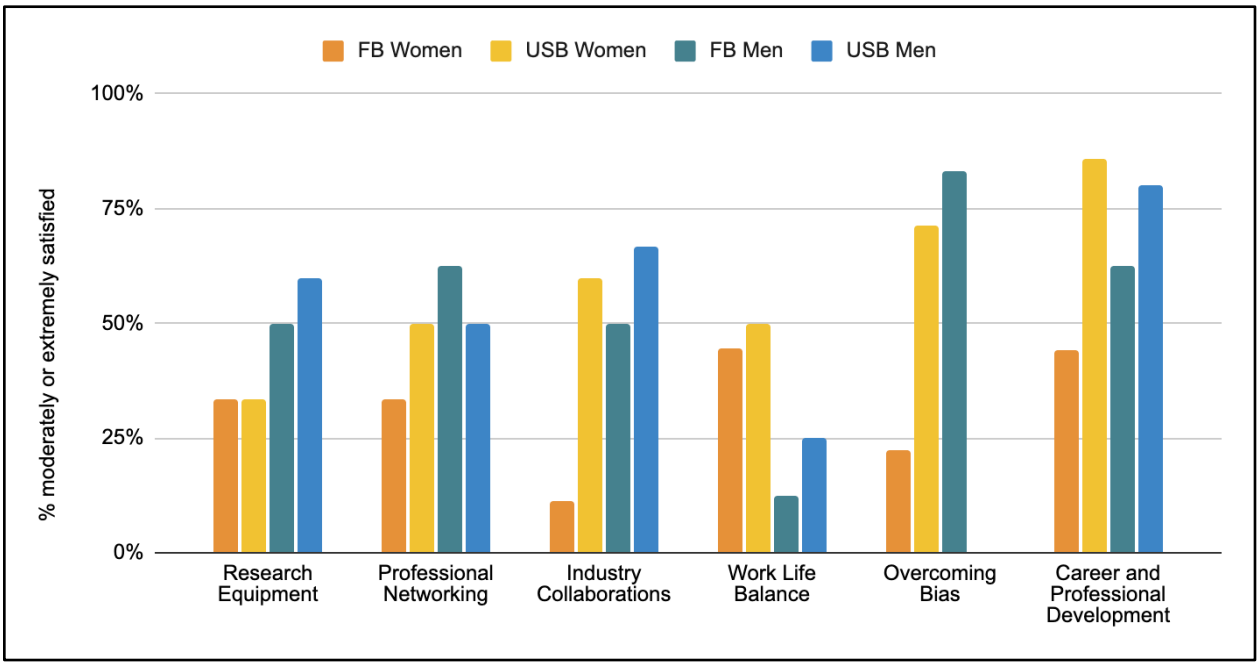

Figure 5. Proportions of tenure track faculty reporting moderate or extreme satisfaction with select areas of resources disaggregated by gender and FB status

Proposed Work

In 2021, four campuses in the California State University System received an NSF-ADVANCE partnership grant titled Kindling Inter-university Networks for Diverse (KIND) Engineering Faculty Advancement in the California State University System. The grant's main focus is increasing the representation of women, especially URM women, at California State University campuses. The project will also study the intersectionality between gender, race, and foreign-born/foreign-trained (FB/FT) status to create support systems for fostering a diverse and inclusive working environment for successful faculty development. The proposed work focuses on three activities. The first one is to create a faculty dashboard conceptually based on ASEE-EDGE [2]. The dashboard is expected to provide data on hiring, retention, and promotion/tenure practices across the California State University System. The data collection instruments are being developed with careful consideration to facilitate data-driven decisions with respect to gender, URM, and FB/FT status. The data will be used to inform the existing practices and suggest modifications wherever necessary. We anticipate that the data limitations of the current study can be overcome with the NSF funding by creating an institutionalized system-wide mechanism on a large scale. We expect that dashboard creation will help the individual campuses in formulating and tracking issues such as parental leave, extending the tenure clock, and child care responsibilities which have been found to be most detrimental to women's progress during the COVID-19 pandemic (NAP Report [14]). The second activity of the grant is to form cross-campus and cross-discipline research

groups to increase the grant opportunities as well as successful proposals for women in the California State University System. The third and final activity focuses on mentoring. Many women, including those in the FB/FT category, do not have access to mentors at higher levels. Thus, by providing mentors who have already navigated the arena, we hope to give targeted help to all women faculty. The last two activities (i.e., forming research alliances and mentoring networks) were derived from the past study detailed in Oka et al. [12].

Conclusions

In sum, the primary focus of this paper is an exploration of some of the issues that arise in the retention of FB women engineering faculty. An initial discussion in the paper centers on why low satisfaction with resources among FB women faculty in engineering constitutes a retention concern. This is specifically illustrated by comparing data on mean pre-tenure publications per year and mean time to tenure for the FB women engineering faculty with that of USB women engineering faculty as well as with the USB and FB men engineering faculty. The analysis of tenure track faculty preparation and satisfaction is performed by summarizing key metrics from tenure track faculty responses. Further research is needed to improve our understanding of the low levels of satisfaction among the FB women faculty observed in this study, including causes and the extent to which it contributes to faculty departures. Next, the paper briefly examines the questions of equity versus representation among engineering faculty. While the lower representation of FB at the tenured ranks compared to tenure track ranks was not significant, it does further highlight the importance of monitoring retention and tenure success rates of women to ensure there aren't disparities in these metrics that contribute to dissatisfaction and departures, ultimately leading to an overall reduced representation of FB faculty among tenured ranks. Finally, tenure track FB women were found to have significantly more pre-hire engineering industry and research experience than their USB peers. Although the reasons for these disparities could not be answered with the data from this study, this trend could indicate a bias against FB women in either the faculty hiring process or the PhD admissions process that expects them to be more qualified than their peers in order to be perceived as equally competent. Many researchers (e.g., Jacobs et al. [15]) have discussed such issues of cultural taxation for URMs and faculty of color. The trends observed in the study's analysis demonstrate that intersectionality between FB status and gender should be considered in analyzing engineering faculty data for improved retention and diversity, equity, and inclusion planning.

Acknowledgments

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