WIP Exploration of Factors Influencing Job Choice of Microelectronics-Interested Engineers

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Introduction

Microelectronics is a growing field within the U.S. with great demand for highly skilled workers. Estimates for the number of engineers needed to meet the growing U.S. market demand is consistently reported as 55,000 to 77,000 engineers by 2030 [1], [2]. To meet this demand, microelectronics training and workforce development programs for elementary school through graduate level students have been established through defense, government, industry and academic partnerships. These programs have implemented courses, trainings, and K-12 interventions to increase awareness, recruit and train students for a career in the microelectronics workforce [3], [4], [5]. For translation from program participation to full-time careers, workforce development programs may need to consider how graduating students are considering their personal career goals in conjunction with microelectronics-specific career choice factors.

Choosing a job is a multifaceted decision that requires ranking multiple important and related factors. In a comprehensive systematic review, Purohit et al. [6] identified five overarching factors that influenced graduating students' job choice: internal, external, interpersonal, institutional and socio-demographic factors. Internal factors, including career interest alignment and work environment, and external factors, including job location, rank high in importance across multiple studies [6]. Additionally, interpersonal factors, such as influence from family, friends, and academic mentors, and institutional factors, such as company prestige and alignment with major, are also commonly considered when selecting a job [6]. For engineering students, Harris [7] also found that career interests and job location were ranked most important but emphasized that career decision making was "exceedingly complex" due to job availability (p.12).

To complicate a students' job decision, proximity to university and hometown play a crucial role in selecting a full-time position. Available employment opportunities can be influenced by university proximity to dense technical hubs. For example, Chow [8] found that university proximity to prestigious dense tech hubs (e.g., Silicon Valley) resulted in higher paying positions in desirable job markets compared to those at other, further universities. While microelectronics programs aim to prepare a U.S.-wide workforce, the microelectronics job market is highly localized to the western and northeastern regions of the U.S. According to Semiconductor Industry Association's U.S. semiconductor ecosystem map [9], 26 states have three or fewer semiconductors job locations, with six having no reported semiconductor industry locations in-state. Consequently, the microelectronics job market is dominated by dense microelectronics technical hubs that are located in Arizona (40 job locations), California (108 job locations), Texas (47 job locations), Massachusetts (33 job locations), and New York (20 job locations) [9], [10]. Additionally, geographic job mobility can be limited by a student's desire to be near their

hometown. Zhang et al. [11] found that when migrating from both hometown and university city, hometown plays a greater role in determining graduates' new job location. The compounding effect of fewer employment opportunities for students not in proximity to dense microelectronics hubs and the desire to stay near their hometown can greatly shape how graduating students consider the costs of full-time careers in microelectronics.

This study examines which job choice factors are most important in selecting a full-time position for alumni of SCALE (Scalable Asymmetric Lifestyle Engagement), a microelectronics workforce development program. With students' proximity to their hometown being a crucial factor, this study also examines the influence of geographic mobility on students' job choice factor ranking. The research question is: To what extent does location selectivity impact rankings of job choice factors for engineering graduates in a microelectronics workforce development program?

Methods

Data Collection

Data were collected in fall of 2024 via a Qualtrics survey administered to alumni of SCALE, a Department of War funded microelectronics workforce development program spanning academic, private and public institutions across the U.S. Geographical information was collected from the participants, including hometown, university location, and current job location. Participants were presented with a map of the U.S. split into 5 regions and asked which of the regions they had applied for post-graduation jobs (Figure 1). Participants were then asked to rank the relative importance of 10 factors that they had considered when selecting a post-graduation job: professional/career interests, promotion opportunities, compensation, working conditions, job location, family, only job available, program mentor influence, other mentor influence, and other. Most of these factors, excluding program mentor influence and other mentor influence, were derived from work by Harris et al. [7] on engineering students' motivating factors for job application. Additional factors, including program mentor influence and other mentor influence, were added to gauge the relative impact of mentor influence over job choice—as SCALE supports students in developing formalized mentorship with faculty.

Participants

Participants were 31 alumni from 10 universities who had participated in the SCALE program. In total, 32 responses were collected, but one participant reported not being an alumni of the program. After omitting that respondent, analysis was conducted with a final sample of 31 graduates, all of which were complete responses. Of the 31 alumni, 20 were men, 6 were women, and 5 did not disclose gender identity. Degrees earned by the alumni ranged from BS (n = 20) to MS (n = 9) and PhD (n = 2). Majors included mechanical engineering, manufacturing engineering, electrical engineering, systems engineering, computer engineering, computer

science, and mathematical physics. The participants had graduated from their programs within the last 3 years.

Participants had hometowns in all 5 regions of the U.S., with 7 from the Northeast, 8 from the Midwest, three from the West, four from the Southeast, and 9 from the Southwest (Table 1). Of the 31 participants, 16 attended university in the Midwest region. The workforce development program that students participated in is based at a large, Midwestern research university, which explains the higher number of study participants attending university in the Midwest region compared to the other regions. Of the 31 participants, 20 had attended university in the same region as their hometown.

Table 1

Hometown and university region demographics with sample size from each hometown region.

		University Region				
Hometown Region	*n*	NE	MW	W	SE	SW
NE	7	3	4	0	0	0
MW	8	0	8	0	0	0
W	3	0	1	0	0	2
SE	4	0	2	0	2	0
SW	9	0	1	0	1	7

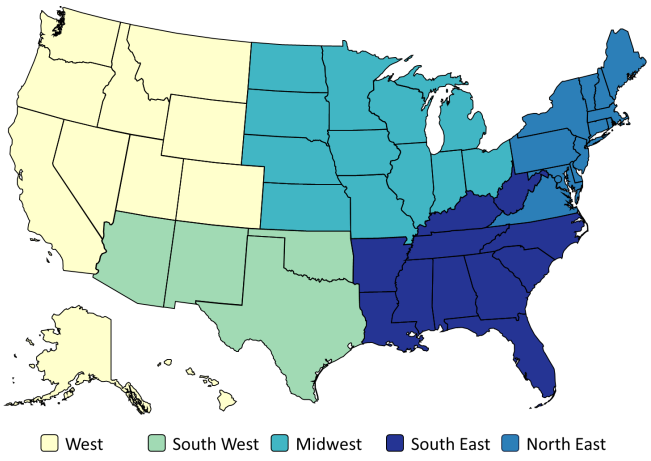

Figure 1. Map of US divided into 5 regions.

Analysis

Descriptive Analysis

Initial descriptive analyses were done in Excel and RStudio. Relationships between hometown region, university region, target job region and actual job region were evaluated with comparison tables. Responses were grouped based on geographic mobility, where "stayers" were those whose jobs were in their hometown or university region and "goers" were those whose jobs were outside of their hometown or university region. When performing data analysis, profiles started to emerge with three types of stayers and two types of goers. Type I stayers are those whose hometown, university, and job were in the same region. Type II stayers are those whose hometown and job were in the same region, but their university was not in that same region. Type III stayers are those whose university and job are in the same region, but not in their hometown region. Type I goers attended university in their hometown region but went to a different region for their job. Type II goers are those whose hometown, university, and job are all in different regions.

Ranked Analysis

Ranked-choice data were analyzed using the Plackett-Luce model in RStudio using the *PlackettLuce* package [12]. Plackett-Luce models are a probabilistic model for preference data and are valuable for analyzing ordinal data where averages are unable to accurately capture statistically meaningful differences [12]. The relative worth of each factor is estimated by the model which indicates the likelihood of the factor being chosen over other factors. The estimate output by the model indicates the log-worth value with positive values correlating with higher preference relative to other factors. A base model was used to fit the data initially, pooling all responses. This model showed good fit with the data with AIC of 728.41. A model incorporating geographic mobility as a covariate was also fit to examine differences in rankings for stayers vs. goers. The model with geographic mobility had an AIC of 712.48, indicating better fit for the data compared with the base model.

Results

Regional Preference Results

When selecting target job region, participants were able to select more than one region (Figure 2). The median number and most frequently selected number of regions (mode) was two regions. The West, Southeast, and Southwest were the most popular regions, with 17 participants indicating interest in applying for jobs in those regions, followed closely by the Northeast with 16 participants indicating interest (Table 2). The least popular region was the Southeast with 14 participants indicating applying for jobs in that region.

The actual job region reflects similar trends seen with the target job region (Table 2). One participant whose hometown was in the Midwest reported getting a remote job, so no information was provided for actual job region. Nine participants got jobs in the Southwest region, making it the most common. The Northeast and West were the next most common with 7 participants getting jobs in each region, followed closely by the Midwest with 6 participants.

Only one participant got a job in the Southeast region, which reflects the relative popularity of that region as a target job region.

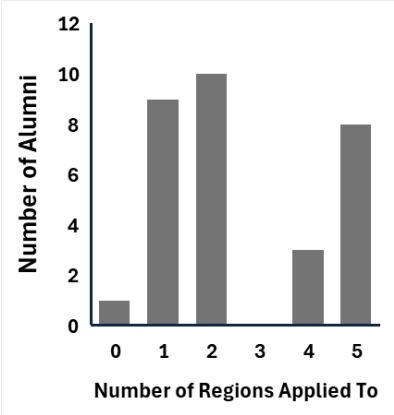

Figure 2. Number of regions applied to by alumni.

Geographic Mobility Results

The majority of participants were stayers (19/31), meaning they took a job in either their hometown or university region following graduation (Table 3). Of the stayers, 11 were classified as Type I meaning their hometown, university, and job were all in the same region. Four participants were classified as each Type II and Type III stayers meaning their job was in the same region as their hometown, but not their university (Type II), or their job was in the same region as their university, but not their hometown (Type III). Of the 12 goers, 9 were classified as Type I, meaning they attended university in their hometown region but took a job in a different region. Type II goers were the least common with only 3 participants whose hometown, university, and job were all in different regions.

Table 2

Target job region and actual job region demographics parsed by hometown region.

		Target Job Region					**Actual Job Region**				
Hometown Region	*n*	NE	MW	W	SE	SW	NE	MW	W	SE	SW
NE	7	6	4	3	3	4	4	2	0	0	1
MW	8	3	6	5	4	3	1	3	3	0	0
W	3	1	1	0	1	1	0	0	1	0	2
SE	4	3	3	3	4	2	1	1	1	1	0
SW	9	3	3	6	2	7	1	0	2	0	6

Table 3

Frequency table of Stayers and Goers by type and hometown region.

		Stayers			**Goers**	
Hometown Region	***n***	*Type I*	*Type II*	*Type III*	*Type I*	*Type II*
NE	7	3	1	2	0	1
MW	8	3	0	0	5	0
W	3	0	1	2	0	0
SE	4	0	1	0	2	1
SW	9	5	1	0	2	1
			Total Stayers	19	**Total Goers**	12

Factor Ranked-Choice Results

Of the 10 factors, professional/career interest, compensation, and job location were the most highly ranked (Table 4). Of the 31 participants, professional/career interest was ranked most commonly with 16 participants ranking it first, 5 ranking it second, and 5 ranking it third, putting it in the top 3 for 26 participants. Compensation was ranked second most common with 5 participants ranking it first, 5 ranking it second, and 7 ranking it third. Job location was ranked the third most common, and it was in the top 3 most important factors for 16 participants. While working conditions was not ranked first by anyone, it was in the top 3 for 14 participants, putting it at the fourth most common ranking. Beyond these four factors, promotion opportunities, family, only job available, program mentor influence, and other mentor influence were selected as top three most important less commonly with notable exceptions that only job available was rated as highly important (top three) for seven participants. The option for other was ranked ninth or tenth for 27 of the 31 participants, indicating most participants did not have other significant factors contributing to their decision making. Two participants that ranked other in their top three factors cited “good fit” and “aligned with goals” as the factors. The other participant that ranked it first did not provide information for what the factor was.

The Plackett-Luce base model somewhat aligns with the frequency of ranking in the top three most important factors (Table 5). Positive estimate values indicate factors consistently ranked above the sample average while negative estimate values indicate factors consistently ranked below the sample average. Professional/career interest was ranked most important on average followed by compensation and job location. The base model showed significance for the rankings of all factors except for family. Based on the way the Plackett-Luce model was

performed, all estimates are relative to zero. Thus, family, with an estimate near zero, was not significantly greater or lower than the average. While the value is not significant, it can be interpreted relative to its nearest neighbors based on the estimate (i.e., level of importance); however, claims on the relative importance of family on job selection cannot be stated with certainty.

Table 4

Number of participants that ranked each factor from first to third most important.

Factor	**1**	**2**	**3**
Professional/Career Interest	16	5	5
Compensation	5	5	7
Job location	5	3	8
Working conditions	0	8	6
Promotion opportunities	1	2	3
Family	0	3	0
Only job available	2	3	2
Program mentor influence	0	1	0
Other mentor influence	0	0	0
Other	2	1	0

The model with geographic mobility as a covariate—that is, being a stayer or a goer—showed significance for the only job available factor. The estimate for only job available was -2.52 with a ratio greater than 2 indicating significance. These results indicate that goers were more likely to rank only job available significantly lower than stayers. No other factors were significantly differently ranked between the stayers and the goers.

Table 5

Plackett-Luce rankings with the base model (relative to zero) and a second model with geographic mobility as a covariate.

	Base Model			Model with Covariate		
Factor	Estimate	Std. error	p	Estimate	Std. Error	Ratio
Professional/Career Interest	2.10	0.24	**<0.001**	2.27	1.24	1.83
Compensation	1.19	0.21	**<0.001**	-0.35	0.92	-0.38
Job location	1.08	0.21	**<0.001**	-0.41	0.87	-0.46
Working conditions	0.99	0.21	**<0.001**	-0.64	0.86	-0.75

Promotion opportunities	0.62	0.20	**0.002**	-0.35	0.88	-0.40
Family	-0.10	0.20	0.62	-0.98	0.87	-1.12
Only job available	-1.10	0.25	**<0.001**	**-2.52**	**0.82**	**-3.09**
Program mentor influence	-1.03	0.22	**<0.001**	-1.45	0.82	-1.76
Other mentor influence	-1.23	0.22	**<0.001**	-0.57	0.79	-0.71
Other	-2.52	0.30	**<0.001**	-0.60	0.76	-0.79

Discussion

Microelectronics engineering graduates ranked job choice factors similarly to other engineers. Similar to findings by Harris et al. [7], professional/career interest and job location ranked highly in job choice importance. These findings illustrate the importance of job location as a part of the study and are crucial for future discussion of students' mobility. While Harris et al. [7] found "only job available" as also highly ranked, it was also found to be polarizing, where students either ranked it very high or very low relative to other factors. When adding geographic mobility as a covariate, "only job available" became statistically significant. Participants who relocated had ranked only job available as less important than those who stayed in the same region indicating that geographic mobility is a contributing factor to the jobs available to recent graduates.

When examining participants by their geographic mobility, most graduates stayed in their hometown region for their full-time positions. A majority (74%) of participants reported applying for jobs in their hometown region, and 61% of participants were stayers. Most stayers were Type I or II, with 15 participants taking jobs in their hometown region, and only 4 participants were Type III stayers taking jobs in their university but not hometown region. Zhang et al. [11] similarly found that hometown plays a greater role in job mobility than university region. Our findings also highlight an interesting relationship between Type I stayers and SIA's U.S. semiconductor ecosystem map [9]: students located in the Southwest and West region were the most likely to be stayers potentially due to the highest concentration of semiconductor job locations. The converse is also true, that all students with hometowns in the Midwest and Southeast—a geographic location with relatively low semiconductor job locations—indicated they sought employment outside of their hometowns (goers), finding positions in regions such as the West and Northeast.

Job availability was impacted by being a stayer, and the degree of the impact depends on the region. For stayers in regions with high semiconductor job activity, being a stayer is less limiting on job availability. These findings highlight findings from Chow [8] that found that university proximity to dense technical hubs was influential in job mobility towards selective markets. With the greatest number of semiconductor job locations in the Southwest and West, it is unsurprising that students from these regions interested in engineering and participating in a microelectronics

workforce development program would find themselves staying in their hometown region for university and their full-time position.

Limitations

This study looked at broadly defined geographic regions of the US, which limited information collected on specific states and cities of interest for microelectronics interested engineers. There are states that have very little to no semiconductor industry locations within the same region as states with very high industry activity (e.g., California and Montana). Future work could investigate interest in more specific regional bounds like states or cities rather than the broad geographic regions used here. Additionally, for job choice factor ranking, the responses were limited to a specific set of predetermined job choice factors. While this provides an overall look into how these engineers prioritize factors, it is limited by the lack of information about the individual and complex process of choosing a job. The study is also limited by a small sample size and survey response rate, as well as the sampled population which was alumni from a microelectronics workforce development program. Future work should include analysis of more responses from a more diverse population.

Conclusion

While workforce demands for engineers trained in microelectronics are growing, engineering graduates interested in careers in microelectronics face unique challenges related to regional availability of microelectronics jobs. By examining job choice factor rankings and job-related geographic mobility, we demonstrated that location/proximity may play a crucial role in the job placement behaviors of microelectronics-interested engineering graduates. Our results show that microelectronics-interested engineering graduates rank career interest, compensation and job location as the most important factors when selecting a job, and when constrained by location, job availability (i.e., only position available) becomes a highly important factor. When considering these results with the geographic mobility of microelectronics-interested graduates, graduates primarily remain in their hometown region for both university and employment which may influence their job availability, especially for those in regions without a large microelectronics sector.

This study provides a unique contribution to understanding how job factors, including location and proximity to hometown and university region, influence microelectronics-interested students target placement and actual placement in full-time positions. As microelectronics-related workforce development programs, initiatives and degree programs are developed, we encourage faculty, administrators and researchers to develop robust industry connections with microelectronics-related companies in the geographic regions of the university and students' hometowns to support students in their career search. For regions of the U.S. without strong microelectronics-related sectors, we encourage faculty, administrators and researchers to support students in finding internships outside of the geographic region and/or supporting students in

translating/aligning their microelectronics career interests to similar, geographically available sectors. Future work will examine the job choice factors of current undergraduate students in a microelectronics related workforce development program.

Acknowledgements
We acknowledge support from SCALE: U.S. Department of Defense Contract No. W52P1J-22-9-3009. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Department of War.

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