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Work in Progress: The Challenges of Evaluating ADVANCE Initiative's Effectiveness in the Progress of Women Faculty in Engineering

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Abstract

The retention and promotion of a diverse engineering faculty body play a primary role in the advancement of the field. Failure to retain engineering faculty has significant economic implications for institutions. Additionally, the availability of role models and potential mentors for women and other minorities is paramount for the continuing diversification of the field. Prior research has documented additional challenges faced by women faculty in engineering when compared to men; such evidence has resulted in significant attempts to attenuate such disparities among faculty at all ranks. Initiatives such as those requested by the NSF - Organizational Change for Gender Equity in STEM Academic Professions (ADVANCE) have the substantive goal to increase the number of women in engineering and other STEM areas and improve the quality of their experiences through the support of systemic change. However, few is known about how the cumulative positive change enacted by such initiatives manifest in the diversification of the field.

Focused on the larger goal of creating models to capture the effectiveness of ADVANCE initiatives, this work in progress presents a literature review of the different factors that have been documented to negatively affect the progress of women faculty in engineering and other STEM areas. This is presented with an iterative identification of elements through different stages of the academic career, layered with variables that are measurable, and potential approaches for future modeling given existing research and the characteristics of the ADVANCE program. The challenges of modeling such a complex system are discussed, together with potential alternatives as a first modeling approach using existing data from different sources.

Introduction

For the advancement of the engineering discipline in the U.S., it is paramount to ensure fair participation of all members of its diverse society [1]; promoting women representation at the faculty level contributes to this vision. Despite some gains in recent decades, women faculty in engineering are still underrepresented. Between 2006 and 2016, the proportion of women faculty in engineering grew from 16% to 23% at the assistant level, from 11.9% to 18.3% at the associate level, and from 3.8% to 10.6% at the full professor level [2], [3]. While the proportion of women faculty at the lower ranks has increased significantly, the limited representation of women at higher faculty ranks limits their potential for reaching leadership roles and contribution with significant decision-making to influence engineering education [4]. Although the presented gains are of value, and may already reflect the effect of multiple initiatives implemented to support the hiring and retention of women faculty in STEM areas [5], engineering is still far from gender parity at all academic levels. To promote a more diverse engineering education field, institutions need to accelerate the gains in the representation of women at all levels.

Extensive evidence exists about the additional challenges faced by women faculty in STEM areas and supports the need to study their advancement through the academic ranks [6]. Such challenges include but are not limited to: having higher teaching and service loads [7], lack of

clarity of the tenure and promotion process [8], lack of mentoring [9], isolation from informal networks [10], and issues of work-life balance [11], [12]. Institutions have used the existing qualitative evidence to inform strategies to support women faculty to overcome such challenges [13]. However, quantitative evidence evaluating how the engineering field is doing at retaining women faculty when compared to men is limited, as well as efforts to understanding the gains across organizations. A cross-organizational quantitative approach would be relevant for such exploration because it would strengthen the evidence for the value that initiatives such as ADVANCE bring to the gains in the field. Nevertheless, evaluation approaches need to be well informed by a systemic understanding of the different factors involved in the problem of interest, and the complexity of faculty paths and priorities at the level of individual organizations.

The purpose of this paper is to inform a systems-wide characterization of the issue of gender equity in engineering and other STEM academia based on existing research, identify measurable factors that can be used for assessment purposes and recognize the challenges for quantitative modeling the effectiveness of initiatives for diversifying STEM, in particular that of NSF-ADVANCE programs. In this narrative literature review, we first present the factors affecting the success of women faculty in engineering and other STEM areas that have been documented in the literature, resulting in a general three-stage approach that splits hiring, early career and late career professionals' experiences and challenges through organizational policies and support systems and Individual factors & Experiences. Then we include the evidence from existing quantitative work assessing gender differences in faculty advancement. A layer of complexity is added based on the most updated research on ADVANCE initiatives. We conclude with a discussion about the modeling challenges for program cross-organizational assessment and the future work in which we will engage towards that goal.

Factors affecting the success of women faculty in engineering and other STEM areas

Barriers to entry. An increasing challenge for institutions of higher education to attract and retain talented faculty is the "two-body problem," which refers to dual-career couples in which both members are highly qualified and specialized, restricting the types of jobs and locations they prefer [14]. As women are more likely to be married to professionals, their job prospects become limited, making women in dual-career couples less likely to seek tenure-track positions. Institutions have established dual-career policies to tackle this issue. However, it has been documented that such accommodations are concentrated among research universities, and doctoral-granting universities, comprehensive institutions, and liberal arts colleges were less likely to have related policies in place [15]. In addition, such policies sometimes come with the concern of stigmatization of the second hire, most often women, who are assumed underqualified or treated with less respect and support [16], despite research showing evidence that members of academic couples are as productive or more productive than non-couple hire colleagues [14] in their corresponding positions.

The teaching, research, and service balance. Once in the tenure track, the difference in time allocation between men and women faculty is extensively documented in science and engineering areas [7], [17]–[21]. A quantitative study on the gendered division of labor among STEM faculty found that the percentage of time spent in undergraduate instruction affects the average of yearly publications negatively, while time spent in graduate instruction and research

affects positively the number of yearly publications. Since women in the study reported allocating more time to undergraduate teaching, their research is the most affected [7]. To address this issue, institutions hiring faculty in tenure-track positions have been suggested to build structures where the time of the assistant professor can be protected to devote more time to research (Trower, 2012). However, such disparities in time allocation have been found to be persistent even after reaching tenure. A study of senior faculty found that women spent more time in service, teaching-related activities, and student advising, while men spent more time in research [21]. The evidence on the limitations derived from the imbalance in teaching, research, and service for women faculty might indicate that this is one of the elements influencing their departure from institutions.

Socialization challenges. Another significant aspect of the experience of faculty in the tenure track is the quality of their social interactions. Research shows that elements of the "chilly climate" [23] that women face through their undergraduate and graduate experiences persists across academic careers [10]. Such elements include a low sense of belonging as well as isolation from social networks that incentivize stimulating intellectual interactions. A study on the socialization of STEM faculty found that among faculty of both genders it was less likely they would engage in discussions about research with women faculty, and when such discussions took place, women would be rated as less competent [24]. In her work, [25] found that the low numbers of women faculty in STEM resulted in feelings of isolation, the lack of role models, and the need to work harder than male scholars to gain credibility and respect. Women faculty in engineering have also described the disadvantages of having a prevailing male administration with climate surveys identifying that they still perceived some male faculty and administrators as treating women as second-class faculty, believing that women should care for their families, judging women by elements not related to professional performance (e.g., appearance), and showing less respect to women faculty in public interactions [26]. Additional evidence shows women faculty as less likely to report being treated respectfully and more likely to report feelings of exclusion from informal networks and decision-making structures [27]. Such perceptions influence the intentions of women faculty to leave an institution significantly [28].

Mentoring. To ameliorate the disadvantage of limited socialization, institutions have adopted mentoring models to support the advancement of faculty on the tenure track and beyond [29]–[31]. While these strategies have helped all faculty, they have had a significantly positive effect on women in male-dominated fields such as science and engineering [32]. Mentoring increases job satisfaction, and higher levels of job satisfaction benefit the retention of women faculty in science and engineering as it relates to their productivity [33]. Similarly, research in mentorship has shown that mentoring favors the prospects of tenure and promotion for junior faculty [34]. In fact, mentoring is now part of the top strategies suggested for institutions to support the success of junior faculty in the tenure track and their job satisfaction [22]. There are multiple types of mentoring from which women faculty in science and engineering have benefitted from, including global mentoring, formal mentoring, informal targeted mentoring [9]; peer mentoring [35], [36], and group mentoring [37]. Extensive research has identified mentoring as an essential element influencing the success of senior women faculty in engineering [38] and among women faculty of color in STEM [39].

Work-life balance. The tenure track years tend to overlap with the biological clock of women, making childrearing a decision that competes with professional success [40]. Previous research has found that it is not uncommon among senior women faculty to plan their pre-tenure pregnancies to give birth in May, to postpone becoming pregnant until having reached tenure, or to limit the number of children they have based on the tenure-track limitations [12], [41], [42]. Confirming to the view of academia as a gendered space, since men do not experience such limitations. As a result, the new generations of Ph.D. graduates are less attracted to faculty positions. A study from the University of California system found that the proportion of graduate students wanting professor positions at research intensive institutions was reduced during their doctoral training from 45 to 36% and from 39 to 27% among men and women respectively [43] citing reasons such as not wanting "lifestyles like those of their advisers" (p. 2) and women recognizing the lack of role models that could manage work and family successfully [44]. It has been documented that this effect of "graduate school socialization" alerts women about the additional challenges they can expect to face in the tenure track [42]. To secure an increasing diversification of the faculty body in engineering, it is critical to ensure that talented women faculty opting for tenure-track positions, despite this negative outlook, are successfully retained.

Family-friendly policies. A variety of family-friendly institutional policies, such as available high-quality childcare services, dual hiring, and the possibility to stop the tenure clock, have been documented to have a positive effect on the retention and promotion of women faculty from assistant to associate professor [11], [45], [46]. Other initiatives, such as half-time tenure, in which faculty with any type of caregiving responsibilities can reduce their load to half in all aspects of tenure, and consequently splitting the value of one year into two [47] have been less widespread, but the potential of such part-time tenure-track (PTTT) positions has been argued to enhance faculty satisfaction, success and retention [48]. Parental leaves and stop-the-clock policies, which aim to decrease the burden of overlapping between the tenure-track and the early stages of childrearing, are available at many institutions. However, research has shown that women faculty are less likely to take full advantage of such policies because of a variety of reasons. One example is "flexibility stigma," which describes sanctions experienced by workers that appear to violate the "ideal-worker" scheme through the request of accommodations [49]. Research has shown that flexibility stigma is a factor deterring both men and women faculty in STEM from taking time off for caregiving purposes [50]. This evidence deserves questioning the efficacy of such initiatives. If faculty does not feel inclined to use family-friendly policies despite their broad availability, institutions need to explore the factors deterring faculty from using such accommodations, particularly in the context of the effect that these tradeoffs have in their retention of faculty.

Challenges to promotion to full professor. Evidence has also been provided against the commonly held belief that increasing the number of women at the junior levels will eventually result in women reaching the higher levels of the academic path [51], [52]. In their study of the stories of associate women faculty, Stout and colleagues [53] found that participants were exposed to gender discrimination in a variety of experiences including those involving students (e.g. through teaching evaluations) as well as colleagues (e.g. being suggested to "wait" until other male colleagues also apply for promotion). Faculty in this study also identified the lack of clarity of the promotion process as a main barrier for their advancement. Their experiences often resulted in feelings of resignation, leaving them to question if the promotion process was worth it

at all. Additional exploration of the lack of clarity in the promotion to full process has shown that women were more likely to be suggested to "withdraw" their application for promotion before it went through the evaluation process, making it more likely for them to do so [54]. This was particularly salient for women that studied non-traditional research areas, such as those focused on issues of women in STEM [54]. The evidence that research done in non-traditional areas and research performed by women tend to be discredited has kept growing [55]. While efforts have been done to close the achievement gap at the senior level, these efforts and their success have been documented at very few institutions [29], [56].

Socialization of senior women faculty. While a lot has been done to ensure barriers for women advancement are reduced, there is qualitative evidence that a gendered culture might be perpetuated by women faculty themselves. A study found that gendered expectations and norms were used by 30 STEM women faculty to distance themselves from women that they perceived as deviating from such expectations and norms [57]. The faculty in the study "distanced" themselves from other women faculty in different ways, including avoiding women faculty that were "emotional" and keeping themselves from conveying "typically" feminine behaviors. In addition, they distanced themselves from other women by denying the problem of gender equality. A study exploring the experiences of 102 associate and full professors in science, engineering and math disciplines found that women were likely to "minimize or deny gender's importance in interactions" [58]. During their experiences with colleague interactions, organizational structures, and the workplace culture, gender never came up as a salient characteristic unless it was explicitly brought in by others. This might be an indicator of a socialization effect, where women faculty's identity as researchers (within a male-dominated paradigm) is more salient, and therefore other dimensions of their experiences are not given similar weight. If that is the case, it would have significant implications for the new generations of women faculty. For while the numbers of women faculty at higher ranks might increase, the ability and/or willingness of senior women faculty to support junior women faculty might be compromised by limited views on the role of gender in faculty advancement.

Figure 1 summarizes the elements described by the presented literature separating the organizational policies and support systems implemented to counteract individual factors and experiences that have been documented to affect women faculty success in STEM. Within this structure, the hiring stage denotes dimensions that are considered challenging to attract women to faculty positions in STEM, early career denotes the tenure-track stage of assistant professor or any non-permanent hiring arrangement, followed by Late career of tenured associate or full professor or any alternative permanent hiring arrangement. The challenges listed are specific to each stage, but also have some relationships that need to be explored further. For example, the need to understand how the documented gendered socialization of late career women faculty would affect the quality of the mentoring experiences of early career faculty.

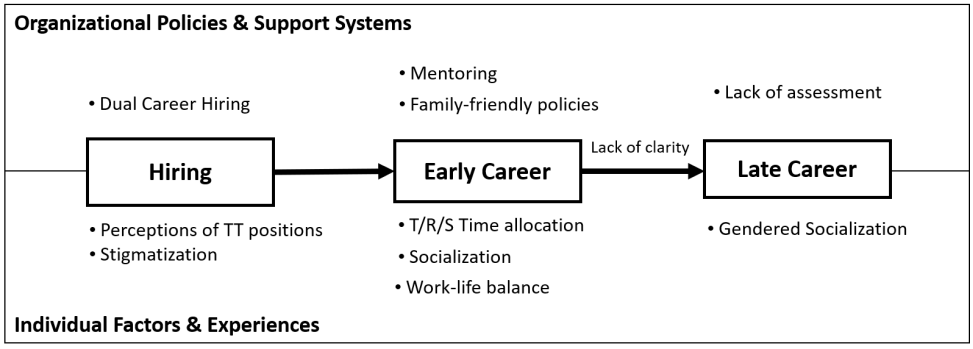

Figure 1. *The three stages of advancement through academic positions and the factors documented in literature affecting the success of women in STEM faculty careers*

In the next section we present a synthesis of research that has focused on the specific analysis of retention and promotion of faculty in STEM and how the explored variables fit and expands the systems representation shown in Figure 1.

Research on *Individual Factors & Experiences*

Quantitative studies analyzing the factors influencing faculty departures from institutions have identified factors such as research productivity, salary, and job security [59], [60]; perceived work-life satisfaction, issues related with professional development, and the amount of service activities required [25]; career and organizational satisfaction [61] and tenure status [25], [60], [61] as influencing the probability of departure of faculty in STEM. In many of these studies, the effect of those factors was stronger for women faculty [25], [60]. On the other hand, qualitative studies have identified professional relationships, the heavy focus in research, and available resources among the most important factors influencing the perception of faculty considering departure [62].

Initiatives to study institutional faculty retention have grown in the last few decades mainly motivated by the increasing interest in understanding the disadvantages faced by women and faculty of color in obtaining tenure [63]. Such is the case of the Collaborative on Academic Careers in Higher Education (COACHE), a research-practice partnership based at the Harvard School of Education that is focused on systematic data collection through faculty surveys that allow the rigorous study of faculty satisfaction and their advancement [64]. Research in STEM areas using data from COACHE and other faculty surveys have shown that the causes of departure for faculty differ across areas of science. In her study of faculty attrition in STEM disciplines, Xu [65] found that departures among faculty in the social and health sciences were influenced by personal characteristics, but faculty in engineering were most influenced by perceived research pressure and organizational support levels. This supports the need to study the phenomenon of faculty retention within specific disciplines.

Research on *Organizational Policies and Support Systems*

The second approach that the research in faculty retention and promotion has taken is that of evaluating the effect of policies that have existed or have been recently implemented. Each institution of higher education establishes their own policies regulating the tenure and promotion (T&P) process (e.g., “Purdue University Policies -

I.B.2" [Purdue University, 2015]); however, different policies have different effects on faculty retention. For example, O'Meara [67] studied the effect of an institutional policy requiring faculty to obtain external offers for comparable positions in order to get a salary raise. She found that the need to find such offers would push faculty "half-way-out" of the institution, making them more likely to leave once such offers were obtained. Faculty leaving, faculty remaining, and administrators at the studied institution all recognized that such a policy "decreased loyalty to the institution by fostering resentment" (p. 292), which decreased organizational commitment and resulted in the loss of productive and promising early career faculty. In a follow-up study [68], it was also identified that men were more likely to secure outside offers than women.

On the other hand, research has also shown limited positive effects of policies designed with the intention to support faculty advancement. The study conducted by Brockopp and colleagues [11] analyzed the perceived effectiveness of 35 university-based activities designed to improve recruitment and retention of women faculty in science and engineering. Women faculty in the study identified the institutional efforts to change the culture to be very valuable; however, they still perceived barriers to use family-friendly policies due to cultural stigma and pitfalls in the established mentoring structures. It is important to keep assessing which institutional efforts result in real advancement of women faculty, as well as which established practices keep limiting the efforts of retaining valuable faculty and need to be modified.

Figure 2 presents the additional presented evidence around the identified individual factors and experiences in the STEM tenure track that represent a challenge to generate complete representations of the elements influencing the various stages of faculty advancement. The research in both the organizational and individual levels explores things that work and things that have proven not to work or to work against the final objective of faculty advancement. For the purpose of measurement, it is important to identify that both elements are equally relevant, still the data collection techniques would be significantly different. For example, while the existence of policies could be extracted from existing institutional documentation, the actual practices of policies could only be assessed by exploring the experiences of those using them.

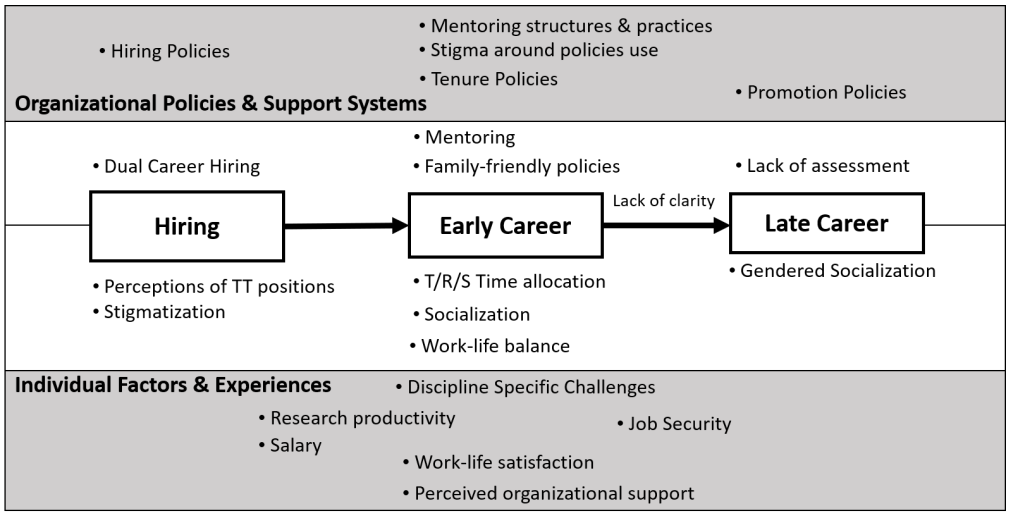

Figure 2. *Iteration of the systems' representation from Figure 1, including the evidence of research around institutional diversity*

Large-scale studies in the advancement of women in STEM

Large scale quantitative studies have helped generate multi-institutional assessments of the racial and gender disparities in faculty advancement documented by small-scale studies. These studies have focused on measurements of retention and promotion. Kaminski and Geisler [69] conducted the first multi-institutional study of faculty retention in the areas of science and engineering. Their study describes the length of stay of 2,966 assistant professors in science and engineering across 14 U.S. institutions and only found gender differences in the area of mathematics with women leaving earlier than men (4.45 vs 7.33 yrs respectively). An extension of this work [70] evaluated faculty retention and promotion disparities in the social sciences. Their results did not show any significant effect of gender in the faculty retention time, but they did find that men were more likely to be promoted to associate professor than women. Another work used a limited sample of four land grant institutions to analyze differences in retention and promotion across gender and also across race in STEM fields, the authors found that women in engineering were more likely to leave without tenure than men [71]. Their analysis of time to promotion to full professor, found similar median times to promotion between men and women in engineering and the mathematical and physical sciences, but not in the agricultural, biological, and biomedical sciences, where women took two years longer to reach such promotion. Nevertheless, none of these studies included the institutional characteristics or policies to control for the effects in retention and promotion.

In an effort to combine data from the individual and institutional levels, [72] presents the only engineering-specific quantitative analysis of faculty retention and promotion to this date. Using data between 2000 and 2017 her event history models analyzed the retention and promotion times of 2,675 engineering faculty across 20 institutions including their field and the institutional characteristics as covariates. One of the covariates was the presence or absence of an ADVANCE program at the 20 institutions where the faculty were hired. Once controlled by the engineering field, and the presence of a women leader, the effect of an ADVANCE initiative was not significant in increasing the odds of getting tenured. However, it was significant for lowering the odds of being promoted to full professor among faculty of both genders that were hired as assistant but not among those hired as associate professor. Nevertheless, this effect needs to be interpreted with caution since it does not capture the temporality of the adoption of the ADVANCE program in an institution. Considering that the adoption of ADVANCE programs at institutions are supported by documented issues in faculty advancement, the effect of ADVANCE programs need to capture the before and after nature of their adoption.

Research in Program effectiveness

ADVANCE was not the first initiative to support the advancement of women in STEM. Between 1997 and 2000 the Professional Opportunities for Women in Research and Education (POWRE) program adjudicated grants to help the career development of individual outstanding women scientists and engineers [73]. Nevertheless, influential work spearheaded by MIT initiated a chain reaction for recognizing that addressing gender issues in science and engineering required

institutional-level efforts for cultural change [13]. In a shift from the individual to the institutional, the NSF in 2001 started the ADVANCE program, which aims to foster gender equity "through a focus on the identification and elimination of organizational barriers that impede the full participation and advancement of all women faculty in academic institutions" [74].

While the benefits of support programs have been documented, the remaining challenges have also been assessed. In a study analyzing the perception of continuing issues for academic women in science and engineering, Rosser [75] found that women awardees of the POWRE program between 1997 and 2000 identified that work-life balance remained an issue for women faculty even after a decade of initiatives to ameliorate such problems. Overt discrimination and harassment has not been reduced significantly during the observed decade, although issues with stereotyping were reduced, most likely due to the increasing presence of women in science and engineering fields (Rosser, 2013). These assessments incentivize other inquiries about the effectiveness of initiatives targeting the advancement of women faculty. Questioning if the gains in gender equity for faculty are derived from the established programs and the increasing critical mass of women in these fields [7] will help inform which areas require further attention in order to support the advancement of women academics in science and engineering.

Effectiveness of ADVANCE initiatives

Supported by existing research on the challenges of women faculty, such as those described in previous sections, ADVANCE goals include increasing the representation and advancement of women academics in STEM through systemic approaches, promoting gender equity in STEM in innovative and systemic ways, and contributing to the creation of knowledge around equity across gender and other identities of STEM academics. To reach its goals, ADVANCE sponsors initiatives to conduct projects of institutional transformation as well as those related with adaptation of practices and sustaining change [76]. Between 2001 and 2018, ADVANCE funded initiatives at 177 different institutions of higher education spread across 47 states, including 40 minority serving institutions and 13 professional or research organizations in STEM, totaling more than $270M [76]. The empirical research produced by ADVANCE initiatives is extensive, providing evidence of the benefits of the different elements of the initiatives, including recruitment and mentoring programs [4], [5], [30], [77], [78].

Limited literature has evaluated the effectiveness of ADVANCE programs using different approaches. A study analyzing the gains of University of California, Irvine, one of the earliest grantees of the ADVANCE institutional transformation which initiatives focused on increasing female participation in Tenure Track faculty positions, [79] found that while their program was successful in increasing the number of women hired in STEM areas compared to other institutions in the UC system, retention was not greatly influenced. The study in [80] used the websites of 37 funded ADVANCE initiatives to explore the aspects of the activities envisioned by each initiative that were aligned with harnessing institutional transformation using the lens of gendered organizations. They found elements that addressed both the horizontal and vertical gendered composition of the institutions, as well as aspects of culture and climate and cognitive racial schemas; aspects of access to networks and mentoring, work-life policies and procedures as well as transparency and coordination of policies. However, their assessment only explored

the extent of intention and not the actual achievement of the goals set by the initiatives under analysis.

In their presentation of factors that help evaluating the effectiveness of ADVANCE initiatives and similar ongoing programs in the UK, [81] evaluation experts argue how relevant is to have high quality data, appropriate leadership committed with the system change proposed, and have clarity in the implementation and sustainability efforts necessary. In terms of data quality, they deem paramount to count with high-quality data, disaggregated, clean and complete with quantitative and qualitative metrics, in addition to having definitions understood across the collaborative team, and baseline data for benchmark of all interventions.

An analysis of ADVANCE programs announcements and solicitations [82] found that the ADVANCE program evolved through the stages of (1) refocus from individuals to institutionally-based solutions; (2) privilege the position of women who were already active in STEM; (3) include policies that denoted the inequalities experienced by underrepresented women without exclusively addressing them, and (4) require the use of approaches reliant on data collection and literature to justify the proposed applications. With such evolution ADVANCE was able to move from a space that benefitted principally white women and to one that addresses the intersectional nature of gender inequity. However, the effectiveness of such last moves has not been explored. In a more recent literature review [78] summarizing the past, present and future of ADVANCE initiatives reinstate that the effectiveness of ADVANCE should be evaluated by more than gains in numbers of faculty hired, retain and promoted, and should consider elements structures that were successfully changed and the academic and workplace climates that were improved which confirms the need to keep a focus on quantitative and qualitative data. In addition, the different evolving tracks of the ADVANCE initiatives, which include some that have persisted, such as the *Institutional Transformation* track, as well as those that evolved such as the *Leadership* and *PAID* tracks, and the now-extinct *Fellows* track, and the younger, *Adaptation* and *Partnerships* tracks, denotes the need for a deeper understanding of the goals and needs for each institution with a particular type of initiative in order to assess its gains properly.

Figure 3 denotes the complexity of the elements added by focusing on ADVANCE initiatives. The need for a thorough understanding at the institutional level represents the main limitation to multi-institutional evaluation endeavors. The implementation level and its stated priorities and approaches based on the type of track of the initiative would also pose additional complexity. The evolution of the ADVANCE program to requiring the inclusion of intersectional approaches to institutional change also poses a challenge for evaluation and assessment.

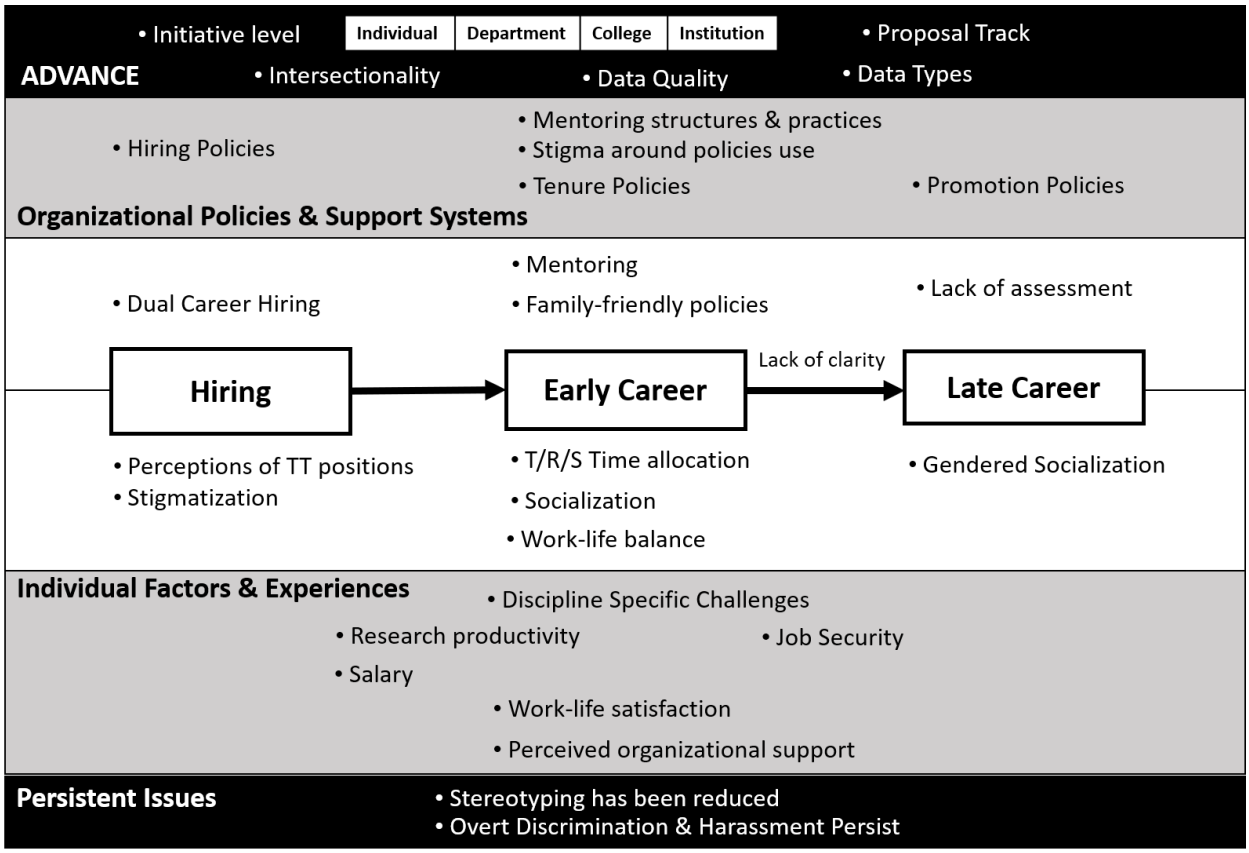

Figure 3*. Final iteration including the challenges of assessment infused by the complexity of ADVANCE programs and persistent issues*

Discussion and Future Work

This work in progress aims to discuss the challenges for evaluating institutional change derived from ADVANCE initiatives, as a first step towards proposing modeling approaches for such purpose. From the reviewed literature is clear that a multitude of factors can be measured to evaluate career advancement and satisfaction of women faculty in STEM at different stages. In fact, these same elements could also be used for the actual identification of the need for ADVANCE initiatives. However, a lot less is known about such needs' assessment. While institutions that received ADVANCE initiatives are aware of the issues they want to address, it is not known if institutions without ADVANCE initiatives have any valuable approaches that make the need of such initiatives less evident or, on the other hand, lack assessment systems to illustrate the need for change. As the goal of initiatives like ADVANCE is to general cultural change it would be valuable to also explore comparisons among those with and without ADVANCE to evaluate the climate differences obtained at both groups of institutions. Only one work in our literature captures the effect of ADVANCE initiatives among a group of 20 institutions, and it does not account for the effect of the adaptation of the initiatives as time-dependent effect [71].

While valuable data collection instruments have been derived from the space of institutional assessment, such as the COACHE survey [63] it is important to ensure that tools capture the different levels of institutional engagement in efforts to advance women faculty. Capturing the intentionality at the Institution, College, Department or Individual level of the different initiatives executed by ADVANCE programs would be paramount to identify the expected outputs to evaluate their effectiveness. In this same aspect, there are challenges related to using individual level and data from other institutional levels in the same assessment models. Survey data represents the gold standard to collect faculty experiences, however the availability and description of specific policies, as of now, has to be collected from varied sources in different formats. The intersection of faculty experiences and policy implementation should be explored further through suitable data collection efforts.

In addition, a large proportion of the existing literature relies in small qualitative evidence. At the same time, the handful of studies using large scale quantitative data limits their approaches to targeted measures such as retention and promotion, most of them leaving out institutional factors. As suggested by [80] it is important to strive for the inclusion of quantitative and qualitative evidence, and thorough assessments would balance the use of both in the success of initiatives. Evaluation models can include qualitative evidence in a variety of ways, ranging from infusing the analysis of subgroups based on certain perceptions, to translation into quantitative scales after a thorough recoding guided by theory backed and critical research methods.

Finally, there is a lack of theoretical approaches accompanying existing evaluations. Among the works identified in the literature as performing any type of assessment of faculty advancement in STEM only those presented in [71], [79] and [81] use a theoretical framing to understand the issues under analysis. In [71] and [79] the authors use the theory of gendered organizations and incongruent bureaucracies, while [81] presents an intersectional critique for the evolution of ADVANCE. The current recognition of the need of intersectional approaches for proposals

The next steps in this research involve the mapping of existing data related to multiple measures across institutions based on the work presented in [69-72] coupled with the mapping of policies available at the involved institutions, as well as the design of new data collection tools using an intersectional framework.

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