

Fermilab

Critical parameters in the faculty application process: A data-driven analysis

FERMILAB-PUB-23-0917-SQMS

DOI: 10.1557/s43577-023-00573-w

This manuscript has been authored by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the U.S. Department of Energy, Office of Science, Office of High Energy Physics.

Critical parameters in the faculty application process – A data-driven analysis

Katherine A. Mazzio^{1,2,*}, Iman Sengupta³, Akshay Murthy⁴, Zachary D. Hood⁵, Diana Lutz⁶, and Babak Anasori^{7,8}

¹ Insitut für Chemie, Humboldt Universität zu Berlin, 12489 Berlin, Germany

² Joint research group Operando Battery Analysis, Helmholtz Zentrum Berlin für Materialien und Energie, GmbH, 14109 Berlin, Germany

³ Department of Metallurgical Engineering and Materials Science, Indian Institute of Technology Bombay, Mumbai – 400076, India

⁴ Superconducting Quantum Materials and Systems Division, Fermi National Accelerator Laboratory (FNAL), Batavia, IL 60510 USA

⁵ Applied Materials Division, Argonne National Laboratory, Lemont, IL 60439 USA

⁶ Ion Storage Systems, Beltsville, MD 20705

⁷ Mechanical and Energy Engineering, Indiana University–Purdue University Indianapolis, IN 46202, USA

⁸ School of Materials Engineering, Purdue University, West Lafayette, IN 47907, USA

*corresponding author: katherine.mazzio@hu-berlin.de

Abstract:

For many aspiring academics, the faculty hiring process has remained shrouded in a veil of mystery, with its obscure criteria and decision-making process often leaving many feeling bewildered and uncertain. Crafting a strong application package and navigating a highly subjective review process with unclear expectations can be daunting. This study presents a comprehensive data-driven analysis of critical parameters in the faculty application process that was conducted using a large dataset of applicant/search committee questionnaires from a diverse range of academic institutions. Here, the MRS Early Career Professionals Subcommittee presents their data-driven analysis of the faculty application process from the survey, including the demographics of respondents and their findings on the application package, cover letter, and CV, as well as the research, teaching, and diversity statements. The analysis identifies areas where there are mismatches in expectations between applicants and hiring committees and provides valuable insights into the critical components of the application package. The findings of this study provide valuable insights for both applicants and institutions seeking to improve the effectiveness and fairness of the faculty application process.

Introduction:

The process of applying for faculty positions requires a significant time investment for both the applicant and hiring committees. Applicants face the daunting task of sifting through a seemingly endless amount of information related to crafting their application packages in preparation for a review process that is inherently highly subjective. Furthermore, while scientific supervisors are often the most valuable

resource during this stage of career development, it may have been many years since they have gone through this process themselves, and it is important to note that they may not have experience with recent developments in the application process. Since expectations and job responsibilities of new faculty members are rapidly evolving, certain guidelines are often not clearly specified, and it is therefore becoming difficult for applicants to most effectively prepare their application documents. Without access to adequate information and assistance, early career researchers can be placed at a significant disadvantage in the hiring process. There are several recent articles that have been designed to help prospective applicants in the materials sciences land a faculty position,¹⁻³ but there is nevertheless a clear need for clarification on expectations for different aspects of the faculty application materials.

As members of the Early Career Professionals Subcommittee (ECPSC) of the Materials Research Society (MRS), we are committed to providing resources to help improve the outcomes of early career professionals in the materials science community. While we aim to develop programs and support early career researchers across all career trajectories, there is a particularly strong interest from our audience pursuing academic career paths. Due to this interest, the ECPSC has developed a variety of programming related to academic career paths, including webinars (“How to Land a Faculty Position - From Application to Interview,” “Learn from the Early Career Faculty,” and “The Road to Mid-Career: Advancement for Early Career Professionals in Materials Science”), broader impacts symposia at MRS meetings (Fall 2020, Fall 2022), articles,⁴ and annual poster sessions at Fall MRS Meetings beginning in 2019 (“Meet the New Faculty Candidates Poster Session”). These efforts have afforded us with unique access to both faculty members and early career scientists, which can otherwise be difficult to bring together through traditional channels. In this contribution, we leverage our diverse network by performing a comparative analysis of parallel surveys in order to help faculty applicants better understand the application review process while simultaneously helping to focus their efforts on the most critical aspects.

We surveyed faculty members who have chaired and/or served as members on hiring committees to gain insight into their views regarding the hiring process, including expectations and details about the core components of the application package: the cover letter, CV, and research, teaching, and diversity statements. At the same time, we provided a parallel survey to a pool of faculty applicants to gain insight into their views on the application process. By comparing and contrasting the survey results, we were able to identify areas where there exist mismatches in terms of expectations between each party. While we acknowledge that our study may not cover all opinions and perspectives, we expect that this report, which represents the first data-driven analysis of parameters one should consider when applying for a faculty position in the materials sciences, will serve as a valuable tool for future faculty applicants. In this article, we will present the findings from our survey, including the demographics of respondents and their thoughts on the application package as it relates to the CV, cover letter, and research, teaching, and diversity statements.

Results:

We polled applicants and faculty from a variety of disciplines within the materials science community. The demographics of our respondents are summarized in Figure 1 and the complete set of questions and anonymized responses for both polls can be found in the Supporting Information. While most responses came from those located at R1 universities in the US (doctoral universities – very high research activity), we also received responses from individuals at R2 universities in the US (doctoral universities – high research activity), PUIs in the US (primarily undergraduate institutions), as well as responses from colleagues internationally. The applicants and search committee members alike come from a variety of career stages. 62% of applicant respondents have experience from applying to positions during one or more hiring cycles. Meanwhile, 82% of the search committee respondents have served on three or more

search committees, with 56% having served on at least six, which provides credibility to our study and demonstrates the broad-reaching interest of the results.

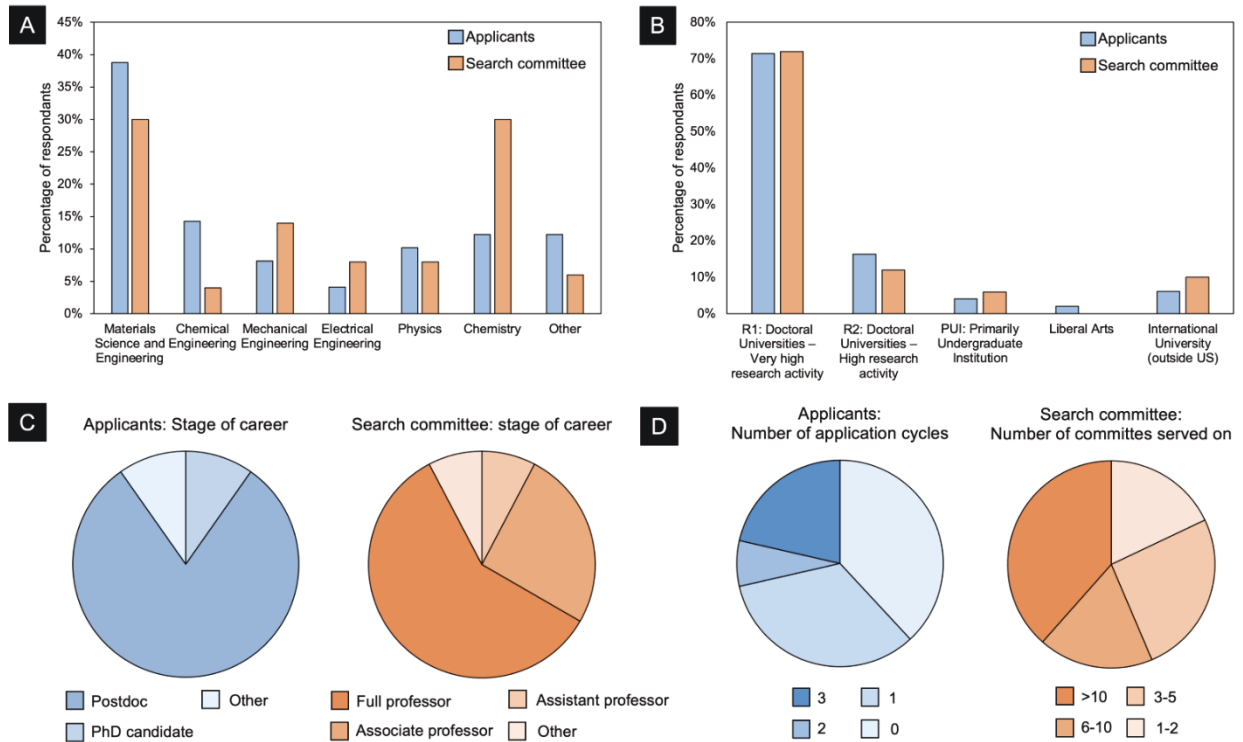


Figure 1. Demographics of applicants and search committee members by A) current educational program, B) current institutions, C) stage of career, and D) participation in application cycles or search committees.

We polled both groups about their thoughts on the relative importance of the different application documents (the CV, cover letter, and research, teaching, and diversity statements) and expectations on the amount of time that would be taken to review each. In general, there was a deep misunderstanding by the applicants about the amount of time that is spent reviewing each document in the application package, as in all cases this was severely underestimated by the applicants. Figures 2 and 3 present a summary of these results. In the following, we analyze the responses and compare results from the prospective faculty applicants (also referred to throughout as candidates) and the current faculty members that sit on hiring committees.

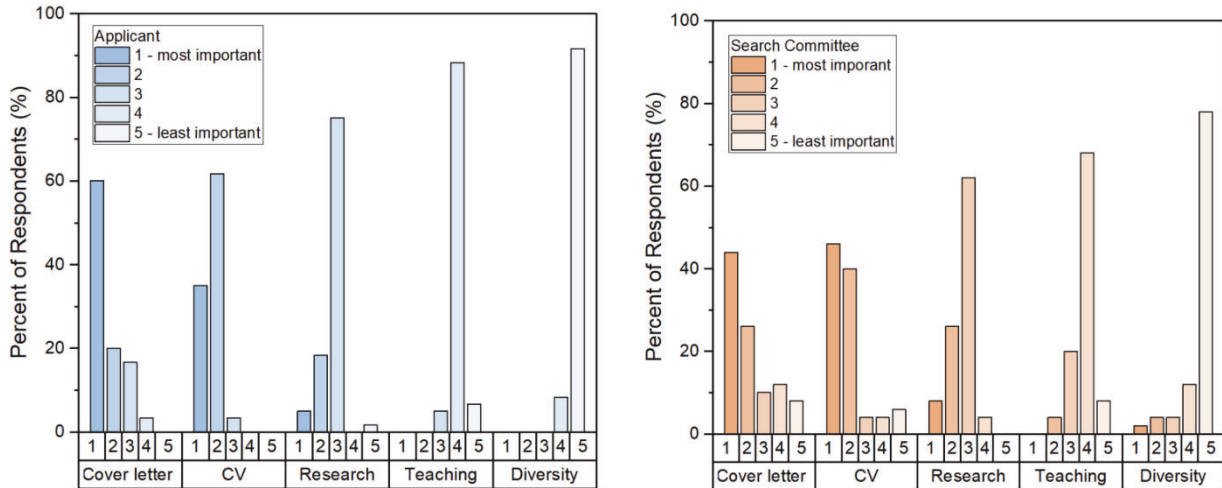


Figure 2. Importance of each application component ranked by applicants (blue) and search committee members (red).

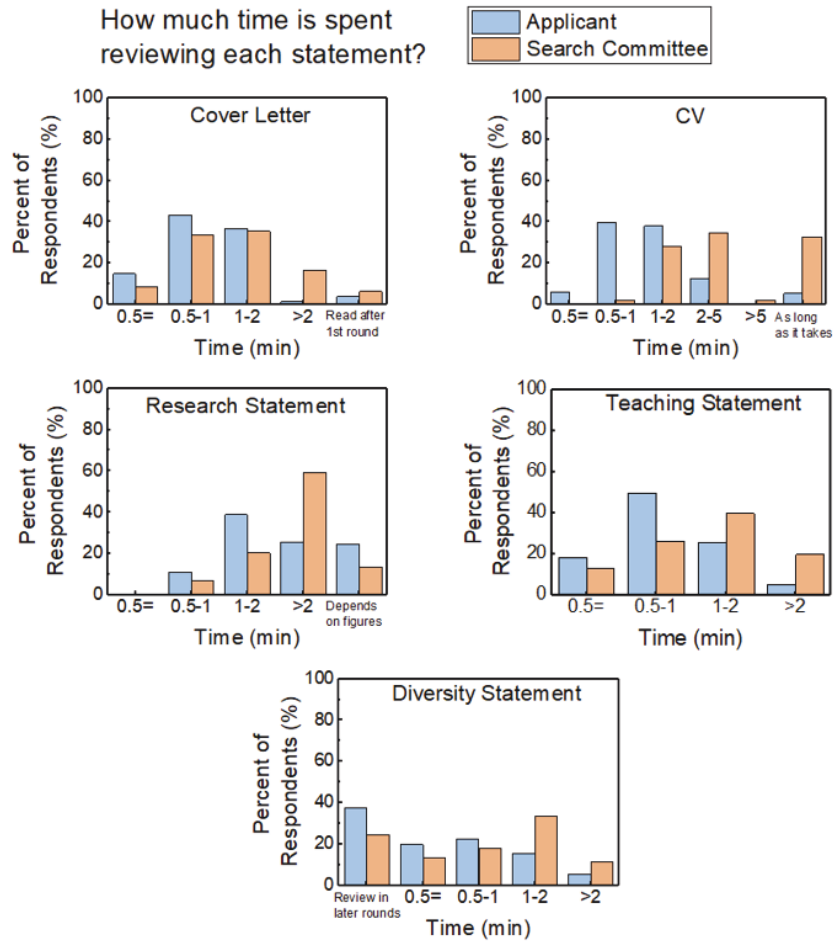


Figure 3. Applicant (blue) and search committee member (red) responses to how long each piece of the application is read: cover letter, CV, research statement, teaching statement, and diversity statement.

Cover Letter:

The cover letter is the opening of most job applications. It serves as an introduction of the applicant to the search committee and it is standard to include aspects of all subsequent parts of the application. It emphasizes what unique skills and experiences the applicant can bring to the prospective department and summarizes why one is applying for the specific position. It must give concise background on who the applicant is, why they want to become a professor at the specific university to which they are applying, what the applicant has done in their previous research, what the focus of their research group will be in the future, and even a potential mention of prior teaching, mentoring, leadership, and diversity experience. There is a lot of ground to cover in a very concise way, and based on the survey results, crafting an authentic and targeted cover letter is critical for making it to the next rounds.

We found that the faculty applicants and the search committee members were mainly on the same page concerning the importance of the cover letter. About half of both the applicants (60%) and the search committees (44%) indicated that the cover letter is the first part to be read in one's application package. The next largest group, 35% of applicants and 46% of search committees, indicated the CV as the first piece that the search committees will read, and 8% of search committee members and 5% of applicants suggested the research statement is the first document. Similar to almost all parts of the application package, the applicants underestimated the amount of time that the search committees indicated that they dedicate to reading cover letters. However, the differences were the least for the cover letter compared to the other parts of the application package. About 70% of the search committee members indicated they spend at least 30 seconds to two minutes reading each cover letter (Figure 3). While the applicants believe the mention of publications is the most important piece of information in the cover letter, search committee members reported being more interested in reading about the applicants' major projects. The search committees ranked the mention of proposals and publications at the same level of importance after projects, which suggests a broad mention of projects and applicants' important contributions (at the idea development and publications) are useful in the cover letter.

Additionally, only ~ 40% of the surveyed search committee members were interested in seeing any mention of teaching or awards in the cover letter. However, many of the search committee members mentioned that they look for evidence that the applicant has knowledge of the department they are applying to, why the applicant is interested in their department, what the applicant can bring to the department that can make them a unique fit for their school, and how they can use the university resources. For example, one suggestion mentioned, "I find it impressive when the last paragraph describes how expertise and interests of the applicant will be a good fit to the department where the applicant applies." Another comment was to "be sure to address the 'so what?' rather than just listing achievements, describe how you have (and will) advance knowledge, rather than listing papers." It was recommended to "summarize the entire application package. Make it clear why the applicant is the best candidate for the position". Some also mentioned that they read the cover letter to see the applicant's "excitement, enthusiasm, but no hype", their vision and how they "differentiate themselves from the crowd." Overall, the search committee members suggested a specific cover letter based on the applicant's strengths, achievements and their knowledge about the applied department. Our survey results suggest that both the applicants (81%) and the search committee members (85%) agree an excellent cover letter for a materials science or related position must be one page or less.

Curriculum Vitae (CV):

The Curriculum Vitae, or CV, is one of the most critical documents in the application package for any faculty position. Search committee members and applicants both agree on this point, but there is a clear misunderstanding of the amount of time that search committee members will spend reviewing this

document. In total, 84% of the applicants thought that search committee members would spend 2 minutes or less reviewing their CVs, whereas 70% of faculty members indicated that they would take at least 2 minutes up to as long as it takes to completely read the CV. As is customary in the US, a CV can be many pages long, so this misunderstanding likely indicates that faculty applicants expect that there are so many applications that the search committee members do not have time to spend reviewing each CV carefully, but based on the rankings submitted by search committee members, the CV is one of the top two most important documents in the application docket.

A CV is expected to be an overview of all critical aspects of a scientist's career. The key sections that are expected in an academic CV (in the United States) are education, professional history, publications, awards and recognition, leadership/service, and teaching and mentoring experience. Other suggested sections to include that arose from our survey are patents, grants/funding, presentations, highlighting invited talks, and independent research compared to the activities performed during the PhD. An understanding of the priority of search committee members when looking at a CV was quite consistent amongst the two polled groups, although search committee member respondents indicated a slightly higher priority on awards and recognition and a lower priority on funding than the applicants assumed. Applicants might consider including some of these points, such as highlighting independent research, making a definitive statement about why they are applying to each individual position, and clarify how they could be a potential fit with the department. A description of a few sentences of prior research projects was reported to be beneficial. One applicant added some further clarification: "I believe the main project led should be highlighted in the CV for postdocs, and the thesis for PhDs. Adding more risks lengthening the CV too much; I believe that is the purpose of the publication list, in addition of showing where the applicant has been able to publish." Search committee members also indicated that a short summary would be helpful but is rarely seen and not required or expected. One search committee member suggested that "highlighting the candidate's independence and intellectual leadership in collaborative project" would be an important addition.

It is also important to consider what *not* to include in a CV. The search committee members indicated that they did not want to see a skill list, any experience prior to graduate school unless it was pertinent to the scientific training of the individual, or personal information such as photos (in particular), marriage or family status, and hobbies. It was, however, acknowledged that including some of these items in a CV are common in some parts of the world (for example in many European countries). The main point here is that application packages should always be tailored to the location. If applying for positions in the US, these items should not be included, whereas in some other countries they may be expected.

While the validity and importance of publication metrics are currently an active area of debate in the scientific community, at present, the metrics of scientific publications are a critical part of assessment of grant proposals and candidates for academic positions.⁵ Because of this, these are important aspects to consider for this part of the CV. The inclusion of journal impact factors is largely considered to be in poor taste and indicates a misunderstanding of impact. This can be a red flag for search committee members who recommend to not include the journal impact factor in a CV. One important consideration that was pointed out by a search committee member is that "the journal IF tends to bias in favor of candidates that are in specific areas of research." Several respondents (both applicants and search committee members) said that it could be useful to include citation numbers for a given publication in the CV. Multiple search committee members said that all applicants should have a google scholar page. One search committee member had an important conclusion on this topic: "Papers take time to mature and an obsession with metrics at an early age is a bad sign. Focus on the science!"

Faculty applicants assumed that journal impact factors were more important for the overall impression of their research portfolio than reported by members of the search committee. The search committee members were more interested in the quality of the papers than the journals in which they are published and suggested that one must read some representative papers in order to know the true quality. They also expressed that there are differences in expectations for PhD students than postdocs or more senior researchers. For recent PhD graduates, multiple first author publications are beneficial, while for postdoctoral applicants, the position in the author list becomes less critical. It was also pointed out that sometimes the ratio of first author papers to non-first author papers is important as it may be interpreted as padding a paper count if there are too many non-first author papers. In general, the search committee members tended to think that the place in the author list was less important as long as significant contributions can be explained. Corresponding authorship was not expected, except for more senior postdocs. One important comment was that search committee members did consider if people were padding their paper count by including unpublished manuscripts, as this is something that is frowned upon.

Applicants were much more interested in including manuscripts in preparation or under review than what search committee members wanted to see. From the comments, the general consensus is that manuscripts in preparation should never be included in the CV (unless specified by search committees in their job advertisements, as was found for instance in some job ads in the 2021-22 season as a consequence of their response to the COVID-19 pandemic). This contrasts with manuscripts that have been submitted, which are acceptable to include for those applying at the assistant professor level only. In this case, the journals where the manuscripts have been submitted should never be named unless the manuscript has been accepted for publication. One search committee member suggested that “Manuscripts in preparation might be described in cover letter, and would be more credibly addressed by supervisor support letter. I am frequently turned off and suspicious by claims of manuscripts submitted and under review that surpass the candidates actual published work. The published work is what counts.” The faculty candidates were sometimes reluctant to not include manuscripts in preparation because they want to demonstrate continuous productivity. For instance, one applicant said “My post-doctoral work hasn't been through review yet, so I wanted to make sure it was clear that I was productive.” But based on search committee responses, it is clear that this would be better addressed in either the cover letter or recommendation letters.

Research Statement:

The research statement is a document that is intended to conceptualize the direction of the applicants' future research program. It is important for demonstrating how the proposed research can benefit the institution that is being applied to through potential future faculty collaborations, how existing infrastructure will be taken advantage of, and potential student involvement. It is also a way for search committee members to see how the applicant thinks about scientific problems and to help them understand the likelihood that an applicant will be able to obtain funding for their future research directions. There is considerable spread in the expected length of the research statement, and the applicants should make sure to thoroughly read the job posting, as common page lengths can vary. Some considerations for preparing the research statement include how many different research directions should be presented, what is the most important aspect for evaluation of the research statement, what is noticed first, how different should the topics presented be from recent work, how much should it focus on integration within the prospective department, and how to address future challenges and prospective funding sources.

Typical contents of the research statement include multiple research directions or topics and may include an executive summary. Our results indicate that there are some misunderstandings between faculty applicants and search committee members on what should be included, and that a larger number of research directions or topics are not necessarily required in the application. More than half of the candidates (55%) thought that mentioning three research directions is necessary for their application, but only 28% of search committee members agree with this. Instead, 28% of search committee members said they prefer to see just one topic, while 34% prefer two topics. The remaining 10% did not specify the importance of including any specific number of research directions. In general, the search committee members stated that “some breadth” in the proposed research area is necessary, while others emphasized that more than one research topic was important because “more than one demonstrates some versatility by the candidate”. In general, “one can be enough if it is broad, other times more are needed but should probably still be somehow connected”.

Both the faculty applicants and search committee members indicated that the most important aspect is the potential to deliver impactful results. Both the applicants and search committee members preferred a solid idea very likely to achieve measurable results to be the most important parameter, followed by a hypothesis having potential to deliver impactful results. Both groups surveyed considered a plan which includes collaboration with a faculty to be of least importance.

The expectations on the extent to which the research statement should be different from the previous PhD or post-doctoral research was relatively clear. Most of the survey participants from both applicant and search committee member pools agreed that there is not a need to propose entirely new domains, but at the same time the proposed research should not just be a continuation of the previous PhD research. The search committee members indicated that the proposed research directions should be linked in some way to the prior research areas in order to show that the knowledge and expertise of the applicant can be utilized in new directions, but that they should not compete with their PhD or postdoc supervisors regarding potential funding and publications. It was suggested that the applicants propose two research directions – one that is low-risk that is related to prior post-doctoral research, and one that is relatively high-risk that is geared towards entirely new domains.

When queried about the first thing a search committee notices in a research statement, there was no clear consensus, with 10% of the search committee members stating that they notice the figures, 31% check the titles, 28% read the executive summaries. The rest of the search committee members (31%) do not have any such preferences and they read the research statement thoroughly. The applicants indicated that they thought the search committee members first check the figures (35%), titles (31%), and executive summary (31%), and none of them expected that the entire research statement is read thoroughly, in stark contrast with what the search committee members suggest. The remaining 3% of applicants did not make a selection. Even more surprising is that while about 35% of the faculty candidates thought that figures are the first thing that is noticed in a research statement, only 10% of search committee members agreed on this point.

Detailing how the applicant’s expertise will integrate within the department is another important consideration, but often it is not clear to what extent this topic needs to be addressed. 54% of search committee members and 39% of applicants indicated that one paragraph should be used to detail this point, whereas 26% of the search committee members think that including just one sentence is enough. It is important to note that while 12% of the applicants polled feel that it is not required to mention how their expertise will fit within the department, only 2% of search committee members agreed. It is clear from the results that there is an expectation that at least part of the research statement should be tailored to the department, but only a small portion of it need be changed for each application. There

was some confusion on this point between applicants and search committee members, where 18% of applicants thought that the entire research statement should be tailored towards the department, whereas only 8% of search committee members agreed.

Once the research directions have been decided upon, it is necessary that the research statement should highlight a semblance of a plan for the proposed research. The majority of search committee members are interested in seeing how the research statement addresses possible challenges and resolving strategies. Other topics to consider including in the research statement are milestones for the proposed projects, the availability of necessary facilities and equipment, and suggestions for funding (one search committee member mentioned specifically looking for the “potential funding sources”). Some highlights and suggestions from search committee members are that they look for “clear elucidation of knowledge gap”, clearly defined objectives, and the possible ways to achieve goals in terms of “what do you want to do, how are you going to do it, and if you do, so what”. They also expect “Demonstration critical thinking ability” of the applicant in the research statement as it is considered as a “creative document”.

Teaching Statement:

The teaching statement or teaching philosophy is a document that describes an applicants’ general approach to teaching. It is important that as an incoming faculty member, the department is confident that the new hire will be able to begin teaching courses with minimal supervision, so this document is important for alleviating any concerns that the search committee might have on this point. While the teaching statement can explain an approach to teaching in broad concepts, it is important to illustrate how these concepts have been put into practice and ideally, what has been learned from past teaching experiences. It is important that one be willing and able to teach not only existing curriculum, but also that the applicant be poised to develop new and interesting courses that students will be excited about. Integration of diversity, equity, and inclusion (DEI) concepts and how these will be integrated into regular teaching assignments can be highly beneficial for this document. Especially for those individuals applying for R1 universities in the US, the teaching document is often neglected as being relatively less important than other documents in the application, and while the results of our survey indicate that this may be true with search committee members and candidates agreeing that it is the fourth most important document, all candidates should keep in mind that teaching is nevertheless central to all faculty positions and a well thought out teaching statement is critical for progression to subsequent rounds of interview.

The majority (>75%) of both sets of respondents place importance on including specific courses in the teaching statement. Applicants remark on tailoring the statement to the job posting or the current course handbook of the institution they are applying to. Comments from search committee members discuss how including general course titles can only help, as it will indicate the candidate has done their due diligence in researching the institution and department to which they are applying and give the search committee a sense of what subjects the candidate is comfortable teaching. The majority (>60%) of search committee members and applicants agree that TA-level teaching experience is expected for those applying for a tenure-track position, while roughly 10-15% expect no prior experience and ~15-20% expect experience preparing lectures for a course.

The greatest discrepancies amongst search committees and applicants are in the time expected for reviewing the teaching statement during the hiring process, similar to what was found for review of the other parts of the application. Figure 3 shows a breakdown of the time expected for reviewing this document and highlights that applicants may be less optimistic about the time search committee members will spend reviewing their teaching statement.

When asked what qualities make an exceptional teaching statement, search committee members and applicants highlighted the need to be specific and use concrete examples when discussing experience and teaching methodology. Search committee members had more comments overall, ranging from having candidates include curriculum and course development specifics to discussion on "commitment to diversity and inclusion in the classroom" to "balance of teaching required core courses as well as introducing new courses." The majority of comments indicated self-assessment of prior teaching experience, descriptive teaching plans, curriculum development, and knowledge of modern pedagogy as all key to creating an excellent teaching statement. It was also noted that portraying a passion for teaching and genuine care and interest in student learning would add to one's statement.

Diversity Statement:

Diversity statements are a recent addition to the faculty application package that are becoming more and more commonplace, particularly in the US. Many universities and departments are actively reframing their mission statements to include a focus on diversity and diversity statements are an important consideration for helping departments understand how applicants can help them attain these goals. These documents are critical for demonstrating that the applicant understands the importance of DEI initiatives, what activities already exist within the school or department that is being applied to, and how the applicant will enhance diversity efforts on campus. They also serve as an opportunity to show what qualities the applicant will bring to the department, and often include a description of the past experiences and how these have impacted the personal and professional growth of the applicant.

While neither the search committee members nor applicants generally believed that the diversity component played a major role in the progression of an applicant, a greater proportion of search committee members indicated that this document is important. Relative to the importance of this document with respect to the other components of the faculty application package, 92% of faculty candidates and 78% of faculty members indicated that this component played the least critical role with respect to the entire package. It is worth noting, however, that this belief was not universal among faculty members as 10% of polled individuals indicated that this aspect represents one of the two most important aspects of the entire package. There were similar discrepancies in terms of expectations on the amount of time spent reviewing this statement. Namely, 79% of applicants expected that search committee members spent less than 1 minute reviewing their statement initially whereas only 55% of search committee members agreed.

Based on comments from search committee member responses, there remains little consensus on the importance of this application component. For instance, some responses from search committee members indicated that this component "contributes little to [the] evaluation of the candidate" is "not important in early stages" of the application review process whereas other responses indicated that this component is "becoming more and more important...even during the first screening step". With respect to what makes an impressive diversity statement, clear and attainable future goals or plans received the most votes from search committee members followed closely by previous experience in diversity, equity, and inclusion matters and an understanding of the present diversity initiatives on campus. Many search committee members emphasized that they look for specific actionable items and "authenticity".

Conclusions:

While each document in a faculty application docket is important for evaluating the overall prospects of an applicant, it is clear that the cover letter and CV are the two documents that help the other materials get a closer look. The research statement is critical for helping the search committee understand how an applicant thinks about science and whether their future research directions will be a good fit for the

future direction of the department or program. While the teaching statement is a less important document for evaluation of applicants at R1 universities in the US, it is amongst the most crucial documents for PUIs. The diversity statement is currently considered the least important document, at least in early stages of evaluation, but its importance appears to increase for narrowing down applicants in later stages of assessment.

It is clear from the results of our survey that there are often misunderstandings about what makes for decisive components in different application documents. Similarly, the extent to which these documents are scrutinized is also largely misunderstood. On top of these quantitative observations, perhaps the most important findings come from the open comment fields where search committee members could give unsolicited advice and we could get a feeling of disquietude in the faculty applicants. While this study can still be considered subjective because it is based on the view of those who took their time to complete the survey, it is nevertheless the first data-driven examination of faculty application documents. Our ultimate goal is to make these results broadly accessible to future faculty applicants as well as hiring departments in an effort to shed light on the application and hiring process.

References:

1. Miller, V. M. The Future of Materials Science in Academia: Landing Your First Faculty Position. *JOM* **72**, 2803–2806 (2020).
2. Chabynec, M. L. Finding and landing an academic position in materials science in the US. *Nat. Rev. Mater.* **4**, 509–512 (2019).
3. Vigoreaux, J. O. & Leibowitz, M. J. Obtaining a faculty position in STEM at a research-intensive institution. *BMC Proc.* **15**, 1–11 (2021).
4. Folland, T. G. *et al.* Understanding and supporting the needs of early-career materials scientists. *MRS Bull.* **45**, 969–971 (2020).
5. Langfeldt, L., Reymert, I. & Aksnes, D. W. The role of metrics in peer assessments. *Res. Eval.* **30**, 112–126 (2021).