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Attracting and Retaining Top Scientists and Engineers at U.S. National Laboratories and Universities: Listening to the next generation

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Society depends upon scientists and engineers to help address critical challenges in national security, efficient and sustainable energy systems, environmental stewardship and other complex areas of global importance. In the US, national laboratories and universities have traditionally served as research and development engines and sources of critical expertise in service to the nation.

Traditional career models for laboratory staff and university professors are based on long-term career stability to develop deep expertise and enable scientists and engineers to devote sustained effort to solving complex problems. However, generational transitions as well as changing dynamics of federal funding may cause major shifts in this workforce paradigm, which formed several post WWII generations. In contrast to the historical long-term career model, Millennials (born between 1979 and 1994) are comfortable shifting from job to job(1). As part of a recent study group, our team, composed of scientists and engineers from multiple national laboratories as well as university professors, considered the opportunities and challenges posed by this transition. In what ways should universities and national laboratories adapt to provide career opportunities that will attract, retain, and develop the best possible technical staff?

To gain insight into the values of young scientists and engineers and how their attitudes may shape the future workforce, two surveys were conducted through the University of Washington's (UW's) Clean Energy Institute, and a third through the University of Notre Dame's Center for Sustainable Energy. The *first* survey targeted the 450 Department of Energy (DOE) Early Career Award (ECA) recipients from the past 10 years and received 98 responses. The *second* survey was of the 104 students and post-doctoral researchers primarily in STEM fields who studied at the Clean Energy Institute in 2017, and received 72 responses. The *third* survey was sent to about 100 students participating in the Notre Dame Energy program at the University of Notre Dame, and received 66 responses. Although the wording of the

ECA and UW/ND surveys is distinct (Supplementary info), they cover the same topics.

The DOE ECA program is funded by the Office of Science and is open to researchers within 10 years of obtaining their Ph.D. It is a highly selective award that provides five years of significant funding. About half the awardees are at universities, with the rest at national laboratories; research topics span the full diversity of the DOE mission. The 98 responses to this survey were split nearly equally between national laboratory and academic employees, consisting mainly of practicing scientists and engineers aged 35-45 years old. In contrast, the student respondents at UW and ND were mainly in their early 20's.

In the ECA survey, when asked to rank the top attributes that **attracted them to their current position** (Fig. 1A), >60% of recipients cited the “freedom to set research direction” as the first or second most important factor, and about 50% cited the “ability to work on innovative research” as one of the top two factors. More than three-quarters of the ECA survey respondents reported a job satisfaction level >70%. Surveys of UW/ND students found that students at both institutions had similar responses: “work/life balance” was the highest-priority workplace attribute (Fig. 1C) and it was a top-three issue for nearly 60% of the 138 students, consistent with previous reports(1). They ranked “mission-focused work” and “independence in setting one’s research direction” as the next two most important factors. Interestingly, work/life balance was one of the least important factors in attracting ECA winners to their current position (Fig. 1A). Based on the data in Fig. 1, it is clear all respondents highly valued careers that enabled them to unleash their individual talents and creativity within a larger mission of national and global priorities.

ECA recipients, currently focused on research and development, were also asked to **rank top impediments** to achieving their highest-priority research goals. Interestingly, “lack of funding” was not the top issue. Instead, >75% of the respondents ranked “overcommitted/highly fragmented effort” as one of their top two impediments, almost twice the scoring for “lack of funding.” This is, one assumes, partially attributable to the generous 5-years of funding by the ECA program. So, while this high achieving group may not be struggling with a lack of resources, they apparently find themselves over-extended, perhaps through other institutional demands (e.g. committees, teaching, etc.), involvement in multiple research programs, and efforts to sustainably fund the exciting science initiated by their Early Career Awards, in addition to the demands of a 24/7 on-line work culture.

The ECA survey also asked about **factors that might motivate recipients to change positions**. The ability to lead a high-impact project ranked highest, consistent with responses for what attracted them to their current position (Fig. 1A). Looking ahead, about what may motivate a position change, “work/life balance” and “job security” now ranked highly with ECA recipients. One explanation for these changes in value could be demographic changes occurring in early- to mid-career,

most notably those associated with having a family. More than 75% of the respondents in the ECA survey were between 35 and 45 years old. A recent study that found 82% of married researchers aged 40–49 have children in the household(2), which would be consistent with the elevated importance of work/life balance in this survey group.

These surveys revealed that both STEM students and ECA winners are highly attracted to positions that allow them to perform independent research. This is consistent with a previous study of more than 1700 Ph.D. scientists and engineers that explored the role of individual motivation on scientific performance and effort (3). As top performers with a reliable income source, supplied by their 5-year grants, it was not surprising that the ECA survey respondents focused on research independence and challenging mission-oriented work. Clearly, organizations that wish to attract and retain high-performing scientists and engineers must ensure that (i) researchers clearly understand and value the mission of the organization, and (ii) the researchers should continue to have flexibility in determining the best way to meet that mission.

It is interesting that even highly successful ECA recipients felt that over-commitment and fragmentation were major impediments to their research. This suggests broader issues at play, since the ECA program provides a strong support network and more extended funding than many other programs. These scientists and engineers, however, still exist in a 24/7 environment of constant connectivity, increased competition for research funding and growing focus on shorter term outcomes. Gone are the days when serial renewals of a single grant will fund a career of research. And while we do not know directly if this is the case with the ECA winners, we observe that academic and national laboratory institutions often ask their best technical staff to serve on multiple committees or programs.

Modeling and experimental studies looking at multitasking and performance also may explain some of these concerns. A 2012 study entitled “Juggling on a High Wire: Multitasking Effects on Performance” explored the relationship between multitasking and performance, with performance evaluated in terms of both productivity and accuracy(4). Participants were asked to perform a collection of tasks; the primary task required some degree of concentration, train of thought and verification, but participants also had additional tasks of shorter duration. The results showed that some multitasking improved productivity, believed to be associated with keeping participants alert and engaged. Beyond a certain point though, what the authors refer to as constant “goal displacement” results in both decreased productivity and accuracy. As study participants reached overload conditions, the costs associated with swapping tasks and the need to recall information and refocus impairs productivity as well as accuracy. Thus, for scientists and engineers who are constantly balancing the need for combined productivity, creativity, accuracy and engagement, there is evidence that

multitasking beyond a certain level has a negative impact across the full range of measures of evaluation and impact.

Research has also shown that the productivity of a research organization is directly related to the level of organizational commitment on the part of the scientists and engineers in the organization (5). Consistent with our ECA survey results, the study found that research organizations seeking loyalty in their scientific and engineering workforce need a high impact mission and implementation strategy, where successes are effectively communicated, including individual contributions to that success (5). Flexible administrative policies and procedures that minimize the bureaucracy and overhead to make research employees more effective, particularly in pursuing innovative work, was another practical consideration for high performing research organizations (5); this seems consistent with the concerns raised by our study of over-commitment and fragmentation, and may also address some work/life balance issues, by freeing productive time.

Academic and national laboratory institutions provide outstanding opportunities to perform innovative and independent research. The DOE Office of Science Early Career Award program is a good example—by offering five years of full-time funding it provides researchers with an opportunity to focus on ground breaking and important work. Maintaining that type of mission-centered, yet creative ethos for the nation’s best scientists and engineers, while acknowledging changing family dynamics, increasing trends toward job mobility and the need for work/life balance in the modern work environment, will be key to attracting and retaining this talent in national laboratory and academic settings. For example, providing opportunities for both short and longer-term duration projects, including exchanges between different laboratories and partner universities, may be a good workforce development investment. These surveys and reflections are only a starting point for what must be sustained discussion and action.

The nature of global and national challenges will continue to evolve, as will the nature and priorities of generations of the workforce. What will not change is the need for scientist and engineers to address these challenges. In the United States, scientific and engineering expertise at the national laboratories and a strong base of university research have played key roles at critical times in history. If we are willing to adapt in efforts to recruit and retain our best scientists and engineers, we are confident that these outstanding institutions will be ready to play that role in the future.

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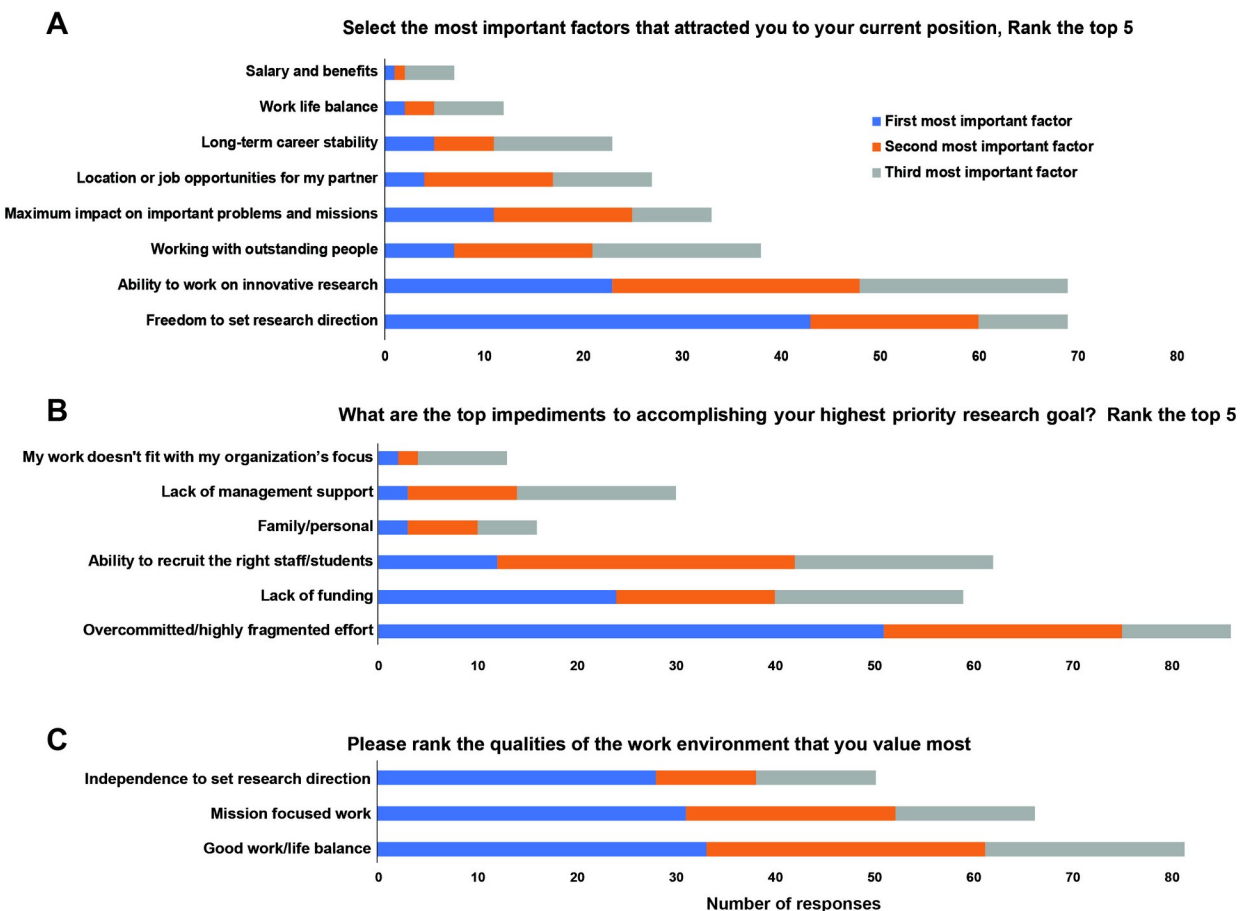


Figure 1. Survey results. (A) Early career award winner rankings of the most important factors attracting them to their current position. (B) Early career award

winner rankings of top impediments. (C) STEM student work environment rankings. Early career survey n=97, STEM student survey n=138.

References

1. K. K. Myers, K. Sadaghiani, Millennials in the Workplace: A Communication Perspective on Millennials' Organizational Relationships and Performance. *Journal of Business and Psychology* **25**, 225-238 (2010).
2. M. L. Heggeness, K. T. W. Gunsalus, J. Pacas, G. McDowell, The new face of US science. *Nature* **541**, 21-23 (2017).
3. H. Sauermann and W.M. Cohen, What Makes Them Tick? Employee and Firm Innovation, *Management Science* **56**, 2134-2153 (2010).
4. R. F. Adler, R. Benbunan-Fich, Juggling on a high wire: Multitasking effects on performance. *International Journal of Human-Computer Studies* **70**, 156-168 (2012).
5. S.J. Perry, E.M. Hunter, and S.C. Currall, Managing the Innovators: Organizational and professional commitment among scientists and engineers, *Research Policy* **45**, 1247-1262 (2016).