The missing piece to changing the university culture

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A new type of initiative is empowering graduate students and postdocs to reshape their academic training, providing another avenue to express their passion for research.

As graduate students, we have become disillusioned with our academic training. We began graduate school full of ambition, drive and optimism but have long since come to realize that we have joined a system that does not meet our diverse interests. We yearn for a community that supports creativity and the expression of future career goals instead of one with a narrow, focused interest.

Current PhD training programs are focused primarily on the academic career track despite its disheartening outlook: the number of awarded PhDs is significantly outpacing the available positions[1,2], fiscal pressures have slowed the growth of available independent research jobs[3] and the time it takes to earn a PhD has not improved over the past two decades[4]. Each year, there are seven times more PhDs awarded in science and engineering than there are newly available faculty positions (**Fig. 1**). As a result, only about 25% of biomedical sciences PhD recipients are in tenure-track positions five years after earning their degree[4,5]. The percent of PhDs starting postdoctoral fellowships, however, has not changed, with close to 70% of life science PhDs pursuing a postdoc after graduation in 2010 (ref. 4), which suggests that PhD students are unsure of their career goals or unequipped for a nonacademic career. In addition to the discouraging job prospects, the time required to complete a PhD adds to the bleak outlook. Despite a downward trend, the average time to degree in life sciences and engineering is still high, with half of PhD candidates requiring seven years or more to complete their degree; one-third of candidates who begin will never
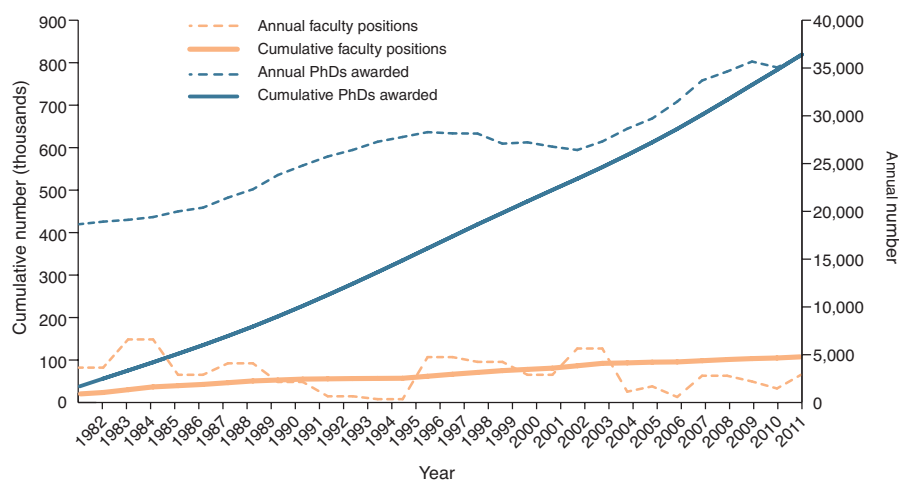
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Figure 1 New faculty positions versus new PhDs. Since 1982, almost 800,000 PhDs were awarded in science and engineering (S&E) fields, whereas only about 100,000 academic faculty positions were created in those fields within the same time frame. The number of S&E PhDs awarded annually has also increased over this time frame, from ~19,000 in 1982 to ~36,000 in 2011. The number of faculty positions created each year, however, has not changed, with roughly 3,000 new positions created annually[2,10].

finish[1,4]. With over 40% of graduate students indifferent or unsatisfied to some degree with their graduate school experience[6], it is clear that initiatives must be taken to revamp the research training paradigm.

The research community has long recognized the need to reform PhD training programs and is taking various approaches to bringing about change. US federal agencies have created funding programs to incentivize universities to expand their curricula to be more interdisciplinary[7] and entrepreneurial[8], but these programs are few and far between. Several National Institutes of Health (NIH) Biomedical Research Workforce Working Groups have recommended that faculty advisers be better engaged during PhD training to provide closer mentorship to students regarding alternative career training[4]. Current incentives, however, are not well aligned with faculty

interests, making it difficult to effect change through faculty-led efforts. Another NIH recommendation is to engage students and postdocs directly by implementing career planning tools to help individuals navigate and identify career paths (http://trainingcenter.nih.gov/idp_consulting.html), but it is unclear whether students and postdocs find these tools useful. Time will tell if such top-down approaches can succeed in shifting the culture of research training programs.

We believe that top-down approaches alone will not bring about the needed change, as they fail to appreciate the role that graduate students and postdocs—who are grossly underrepresented in this discourse—play in eliciting change. We believe that researchers in training should advocate for innovative training opportunities as well as lead their own initiatives for experience-based learning to shape their own

career paths. University leaders and faculty members must empower graduate students and postdocs, who must take matters into their own hands, forge their own paths and prove the value of interdisciplinary and entrepreneurially minded programs.

One graduate student– and postdoc-led initiative—autonomous from the university system—is changing how PhD students and postdocs are trained. This nonprofit organization connects teams of graduate students and postdocs from Washington University in St. Louis (WUSTL) with local, resource-constrained startup companies to help solve real business challenges. Through these mutually beneficial collaborations, students and postdocs gain valuable experience and training in the commercialization of science while helping companies overcome obstacles and achieve growth.

Serving the university and entrepreneurial communities

The Biotechnology and Life Science Advising (BALSA) Group was founded in December 2010 by a group of graduate students and postdocs dissatisfied with their academic training and disheartened by dismal job prospects. Its mission: to better prepare PhD students and postdocs for academic and nonacademic careers, foster the growth of the local biotech business community, strengthen the ties between academia and industry and, by empowering graduate students and postdocs, shift the culture at WUSTL. The BALSA Group carries out its mission by leveraging the diverse scientific knowledge and expertise of graduate students and postdocs. We have developed a self-sustaining model in which students and postdocs collaborate with startups, established corporations or the Office of Technology Management (OTM) at WUSTL in the form of 6- to 8-week consulting projects. As The BALSA Group has grown to meet various community needs, we have developed two unique project paradigms: (i) working with startups and established corporations and (ii) working with the OTM. Although projects with companies vary greatly based on a company's specific needs, the scope and approach of each project with the OTM is focused on the technology and commercialization assessment of WUSTL inventions.

Since its incorporation in February 2011, The BALSA Group has worked with 37 companies through 53 projects. These companies include nascent startups, early stage companies and established corporations. BALSA provides various services to clients depending on their immediate needs. Most projects focus on strategic market analysis, technology

due diligence or other strategic analysis. For example, a BALSA team could assess the receptivity of a specific market segment to a client's product by interviewing and surveying potential end users and customers. Using this primary information, BALSA members can form objective, unbiased recommendations that the client can use to formulate their business strategy. Throughout the project, BALSA members interact directly with company leaders who view the team as an extension of their personnel. In fact, clients involve BALSA members in discussions about company affairs, which allows members to contribute their energy and expertise toward improving the company's operations and strategies. The BALSA Group has demonstrated that researchers with no prior business knowledge can make valuable contributions to both early and late stage companies.

The BALSA Group has also established an ongoing partnership with WUSTL's OTM to provide support to the university and principal investigators interested in commercializing their work. BALSA teams assess the commercial viability of invention disclosures submitted to the OTM by faculty members and provide recommendations on whether to patent the technologies. Specifically, teams assess market potential, the competitive landscape, barriers to market entry and potential licensing partners. Over the course of one seven-week project, three inventions are evaluated. Because the scope of each OTM project does not change and all technologies are assessed across the same criteria, projects proceed on a rolling basis and are concurrent with project managers training new consultants. One of these new consultants will then lead the team on the next OTM project. In this way, current BALSA leaders train future project leaders, obviating the need for the OTM to invest resources and effort in training modules. To date, we have evaluated 22 WUSTL technologies, and the OTM has followed BALSA's recommendation to either file a patent or not in 6 cases; most of the remaining cases are still under review. BALSA's efforts are facilitating the transfer of technologies to the commercial sector and shifting the entrepreneurial culture at the university by directly engaging graduate students and postdocs in the process of technology transfer.

The success of each project, whether with a company or the OTM, is due to the effectiveness of the team structure and dynamic. Each team consists of an adviser, a project manager and three or four new or experienced consultants. Within the team, each member has an important and complementary role to play. The adviser's role is to ensure project objectives are met by guiding the team within the broader

context of the clients' short-term goals. Project managers play a central role in driving projects as they direct consultants by setting weekly goals and agendas, initiating tasks, providing feedback and coordinating each team member's efforts. Consultants collect, analyze and synthesize data, which they summarize and present at each weekly meeting. The weekly meetings are critical to successfully completing a project as they serve as progress updates in which the entire team interprets findings and translates them into actionable recommendations. They also serve to refocus the project and ensure the objectives are completed in a timely and comprehensive manner. Importantly, the structure of BALSA projects and the leadership provided by the adviser and project manager, who have experience working on BALSA projects, creates an environment in which new members can actively learn and participate. BALSA's ability to create a dynamic team environment is at the heart of the organization's success and has allowed us to contribute to the WUSTL research and St. Louis business communities.

Adding value to young researchers and the community

The success of The BALSA Group is driven by the needs of the St. Louis business community, the WUSTL community, graduate students and postdocs. BALSA's value proposition is carefully crafted to meet each of these stakeholders' needs.

St. Louis has a vibrant entrepreneurial community, with 136 early stage (1–5 years), 43 emerging (5–10 years) and 50 established (>10 years) companies in the life sciences and over 250 companies in the technology sector[9]. Better understanding customers, regulations and funding strategies are at the forefront of most companies' minds, especially nascent startups. Consulting services to address these needs, however, are well beyond financial reach. This is where members of The BALSA Group are particularly poised to provide value-added services to early stage startups and established corporations. BALSA members' scientific expertise affords them a critical understanding of each client's technology and strategic goals. As such, clients are able to communicate their company's needs and objectives effortlessly. Because of their scientific training, BALSA teams approach each project with a critical perspective using primary data to make objective conclusions. This pragmatic, data-driven approach provides clients with recommendations that can be readily implemented. Many clients have derived immediate value from BALSA's services, using BALSA recommendations to refocus research and development, enter new markets or

reformulate business plans. Although not affiliated with the university, The BALSA Group has worked closely with WUSTL's OTM to further its mission of engaging, educating and training university researchers in entrepreneurial concepts. Beyond technology assessment, The BALSA Group is also serving as an internal consultant to evaluate and assess the entrepreneurial mindset of WUSTL faculty. BALSA is working with OTM leaders to better understand why female faculty members are underrepresented in entrepreneurial ventures, develop strategies to support female entrepreneurs and conduct training workshops targeting female faculty members. Finally, thanks to the efforts of The Skandalaris Center for Entrepreneurial Studies, the university now offers an entrepreneurial citation that can be acquired by attending workshops and classes, completing internships and participating in a BALSA project. Graduate students and postdocs stand to gain the most from working with BALSA because the group gives them opportunities to explore alternative careers and develop skills that they have very little exposure to during their scientific training. Indeed, traditional PhD and postdoc training programs do not emphasize technology transfer or commercialization and fail to provide hands-on management or leadership training. The BALSA Group has created an environment in which students and postdocs can supplement their academic training to expand their business acumen and develop leadership and teamwork skills. By working directly with companies and evaluating new inventions through the OTM, BALSA members get hands-on exposure to industry challenges and a broad array of business concepts, including competitive and market analysis, technology due diligence, regulatory affairs, licensing and business plan development. Unlike classes or workshops, BALSA members apply these business concepts in real-world scenarios in which their work has financial and economic implications. As a result, BALSA members are well versed in basic business concepts, making them more competitive and well-rounded for the next steps of their careers.

In addition to providing graduate students and postdocs with business experience, BALSA projects are an opportunity for motivated individuals to develop leadership and teamwork skills by managing a team of their peers. A big part of leading a BALSA project is learning how to coordinate the efforts of a group toward one focused goal without going down tangential and unproductive paths. The success of the project is dependent upon the cohesion, effectiveness and productivity of the entire team. Project managers learn how to effectively guide, motivate and inspire team members to build rapport, ensure member accountability and create an enjoyable learning environment. Furthermore, by working in a high-pressure environment with strict deadlines, all members must learn to cooperate and rely on one another. They must effectively manage their time to collect, synthesize and communicate large amounts of fragmented data in a short period of time. Learning these skills and experiencing a sense of urgency trains more productive and well-rounded researchers.

Ongoing challenges

As we work to become a permanent fixture within the community, we are constantly faced with several cultural and operational challenges, including gaining full faculty support and ensuring the organization is sustained amid high turnover rates. Although we have support from deans and department chairs, many graduate students and postdocs are not comfortable discussing their participation in BALSA with their PIs. This lack of transparency among graduate students and postdocs, however, goes beyond their work with BALSA. Many graduate students hide their interest in nonacademic career paths because they are afraid of being judged—or worse, ostracized—by faculty who are not supportive of exploring alternative careers during PhD training. We are working hard to change the perception that a nonacademic career choice is less honorable than a faculty-track one. We approach individuals at all levels of WUSTL and demonstrate the benefits that BALSA offers to the university, faculty, graduate students and postdocs. We believe exposure to nonresearch opportunities—whether teaching, consulting or determining government policies—will lead to more motivated and productive researchers. Hands-on experience in any of these areas helps young researchers identify different ways in which they can apply their scientific skills and determine whether any of these alternative paths fits their interests. After all, how would someone know they do not like to teach, or consult, or write government policies, if they never try it?

The biggest challenge to establishing a student-led organization is ensuring continuity and sustainability. Like many university groups, BALSA's leadership is replaced as graduate students complete their degrees and postdocs move on from the lab. The BALSA Group has overcome this challenge by institutionalizing the organization, setting mechanisms in place to prepare younger members to lead the group and continuously soliciting input from all members. Early on, we drafted bylaws and articles of incorporation that established the organization's operational structure and continues to safeguard BALSA's mission. We also devised standard operating procedures (SOPs) that laid the framework for running projects. These documents not only describe the timeline of typical projects, from initial client engagement to project delivery, but also serve as manuals for managing a project, effectively leading a team and resolving conflict. Furthermore, the SOPs set in writing the expectations for each team member, from the first-time consultant to the experienced project adviser. Fully disclosing and setting the expectations before someone commits to a project ensures complete transparency and team member accountability while building trust among the team.

Having these manuals in place allows new consultants and project managers to quickly get up to speed with company operations, obviating the need for formal training. These guidelines are meant to engage new members and support their progress to becoming project managers and subsequent BALSA leaders. As part of the organization's structure, new project managers are considered members of BALSA's board of directors, which includes officers of the executive board. Being part of the board means new project managers can attend weekly board meetings, participate in discussions about daily operations and vote on policy or personnel changes. New members are therefore quickly exposed to BALSA's internal operations and can contribute in any way they want, including through executive duties like managing clientele. Because we quickly incorporate members into BALSA operations, new members can run for an officer position immediately and eventually president within a year, ensuring the organization's longevity.

Finally, because we are always trying to improve the organization and meet the needs of our members, each team member fills out an internal questionnaire at the completion of a project to assess how BALSA met her or his expectations and how operations could be improved. By engaging faculty and WUSTL leaders, establishing SOPs, integrating new members early in BALSA affairs and continuously soliciting improvement suggestions from members, BALSA has become a self-sustained, vibrant organization that will continue to bring value to the community.

Future plans

We are continuously trying to improve the quality of the BALSA experience and to develop

strategies for expanding our influence within the university and across the St. Louis community. In the near term, we are working to increase access to BALSA opportunities for students and postdocs across a wider breadth of graduate programs and universities in St. Louis. Our goal is to engage students from other quantitatively oriented programs, including social work, political science, economics and law, and to recruit motivated graduate students and postdocs from both the University of Missouri–St. Louis and Saint Louis University to bring researchers together from unique training backgrounds. Furthermore, we hope to engage WUSTL faculty entrepreneurs to provide them with early support as they navigate the commercialization process. In the long term, we are developing strategies to expand our geographic influence outside of St. Louis and support young researchers at other institutions to start similar initiatives, broaden the panel of services we provide and identify ways of using our revenues to benefit our members and our community. Together, these goals are focused on creating valuable change at WUSTL and improving the support and expertise that BALSA provides to the St. Louis life science business community.

Changing the culture of a university requires shifting goals, values and attitudes at all levels of the institution. BALSA is redefining the role students and postdocs play in effecting change at WUSTL, empowering them to shape their research training as they envision and providing them with another avenue to express their passion for research. BALSA serves as an open affirmation of students' and postdocs' desire to take an active role in shifting their university's culture. By participating in BALSA, students will stay engaged during the ups and downs of their PhDs, become more confident in their career decisions and gain the courage to lead their own initiatives. In turn, this will reduce the graduation attrition rate, lead to more fulfilling careers and strengthen the university. We hope The BALSA Group will inspire graduate students and postdocs at other universities and serve as a model for bringing about change.

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