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## **Grant Funding Needs Parallel the Start-Up Venture: An Analogy for Translational Research Success**

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## Grant Funding Needs Parallel the Start-Up Venture: An Analogy for Translational Research Success

Stories of shrinking funding for biomedical optics research and development (R&D) can lead to concerns over the potential to translate science into reality. Yet, another perspective on this environment is that the total dollars available for translational research continues to grow every year, and there are regional microenvironments in biomedical optics that are thriving. As the biomedical optics community<sup>1</sup> differentiates into technological and application specific areas, each area struggles with needs for sustained funding and successful development. This editorial offers some ways to think about how best to position a research group for funding, by examining the parallels between what is needed for translational grants versus industry start-ups.

In the United States today, grant funding dollars are more plentiful now than in recent years. The National Institute of Biomedical Imaging and Bioengineering (NIBIB) payline is currently up at the 19th percentile. An examination of the numbers of funded grants at the National Institutes of Health (NIH) shows an even more surprising trend. As shown in Fig. 1, the number of funded grants in physics and engineering has continued to grow systematically (other than an anomalous bump from federal stimulus funding in 2009-10) with biomedical engineering being the clear growth leader for the last 15 years. Even more interestingly, when these data are normalized to the total number of grants at the NIH, as shown in Fig. 2, the funding rate of grants in physics and engineering has actually leaped above 1.5%, for the first time ever. This large change occurred in 2017, and the projected numbers for 2018 show this continuing. Still, it is widely recognized that this funding is accessible only to those researchers who have the most competitive edge to their translational research.

The two most critical areas of funding need are (1) the intersection of basic and translational research, which is largely grant funded to advance ideas into credible proof-of-concept devices and approaches, and (2) the intersection of applied research and industry development, which is largely start-up funded to make a working product prototype and test it. These two intersections are funding valleys in

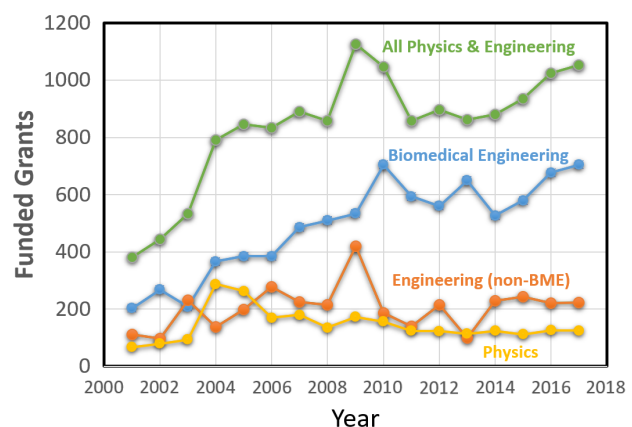
which complaints abound about the inability to make it work financially. However, for needed concepts and devices, there are notable successes occurring every year in our field.

The needs and successes of these two areas, basic to translational research and applied research to industry development, are often described as fundamentally different. However, there are important analogies that can provide insight into making translational research more possible. As the field of biomedical optics continues to grow, it is critical that researchers learn the tools of R&D to create more opportunity for their research to succeed as translational and increase their potential for funding.

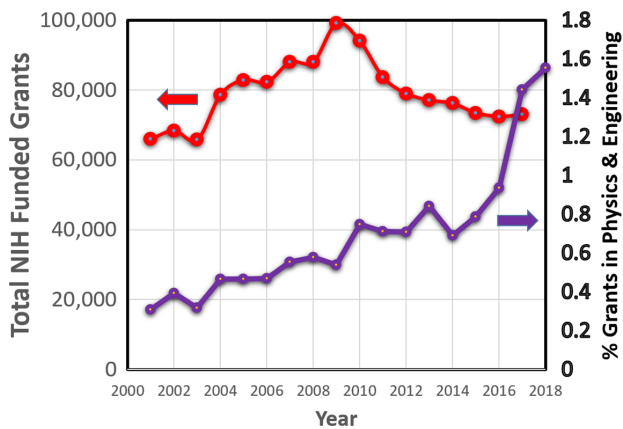
The parallels between the start-up culture in industry and the translational research culture in academic labs can be instructive. They have several aspects in common, and the most savvy labs have these things working for them.

**The Team:** Perhaps the first rule taught in preparing for a venture capital pitch is that the team matters most. If the lead people involved don't have the right experience, drive, and credibility, the pitch will be dead very quickly. The same is true for a translational research group, where it is critical to have a well-rounded team of people who want to work together. Often basic researchers try the single-scientist approach, keeping it all within their laboratory, which can work for basic idea-driven research where innovation and long hours are often the best way to advance research. But in translational work, of the type funded by much of the NIH, having a team that rounds out the translation is critical. This will typically involve expertise starting with physics, engineering, and chemistry, but also must involve medical specialists in the field of application, such as oncologists, cardiologists, surgeons, dermatologists, and pathologists. Other PhD expertise bases such as tumor biology, physiology, or molecular biology are usually required as well, as is biostatistics, and often also industry collaborators.

There is always a debate about whether the intellectual integrity of the individual is more important than that of the group, and there is certainly a lot to be said for the individual at the intellectual level. However, as translation becomes more of the focus, which is true for most NIH work, the team environment is critical. Interestingly, an analysis of biomedical manuscript co-authorship recently showed that on



**Fig. 1** The number of funded grants in engineering and physics over the last 16 years (data from the NIH Reporter database).



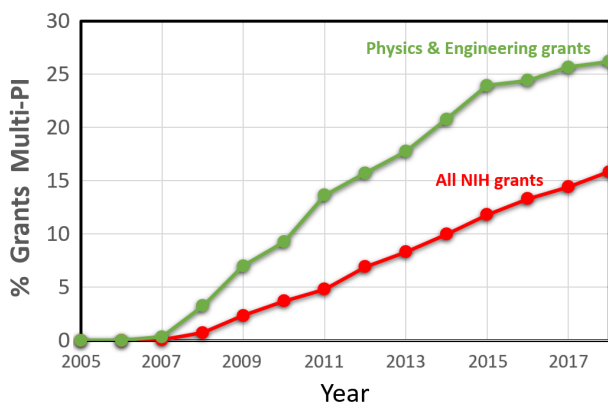
**Fig. 2** The total number of funded grants (left axis) and the percentage of these in engineering and physics (right axis) versus years. Note the large increase to 1.5% along the right axis. (Data from the NIH Reporter database.)

average 80% of the content of a paper was attributable to the co-authors of the work.<sup>2</sup> The profit (p)-index was developed as a tool to correct the h-index for the relative contributions of co-authors in group research.

Most funded NIH proposals have a very well-rounded team of individuals with complementary skill sets, who help the project by making sure that decisions are being made, even early on, that will lead to success. One indication of this is the robust growth in the number of grants with multiple principal investigators (multi-PI) since NIH allowed this format to occur, with very strong uptake in physics and engineering grants, as shown in Fig. 3. Notably, the growth in multi-PI grants within physics and engineering is much faster than the rest of NIH, and today rests near 26% of all funding. While having multiple PIs is only one aspect of developing a team, this is an indication that funding in the physical sciences at the NIH is tied to rounding out the PI role.

Mistakes in shortcutting the team, or not fully utilizing team members, usually leads to grant applications that are not fundable in the NIH system.

In start-up ventures, they say the team is critical, and this means the credibility of the team based upon training,



**Fig. 3** The percentage rate of funded multi-PI directed grants in engineering and physics is significantly larger than that for overall NIH grants (data from the NIH Reporter database).

past accomplishments, and capabilities. The same is true for grant funding in translational biomedical optics. There is an urgent need to form teams across institutions. While this may involve more consultants and contract work as budgets get tighter relative to faculty, staff, and graduate student salaries, ultimately strong mentors and collaborators who have “done it before” are required for new translational researchers to succeed.<sup>3</sup>

**Talk to the Customer:** Another mantra in the start-up world is to ensure that the team talks directly to the customer, to make sure that the solution being advanced has real value. In industry, there must be someone willing to purchase the solution being proposed, and it must solve a real problem somehow such that people will pay for it. While the idea is similar in translational research, this is very much related to the first point about forming the team and including the “customer” inside the team.

The team members must be present to attest to the value of the idea. Translational research can be iterative and require many rounds of testing ideas and having a recursive process for this is critical. A common success plan for biomedical engineering is for the research team to be physically located nearby or even within a medical center, such that the process of generating ideas, developing solutions, and obtaining feedback occurs in person and frequently. The best translational research institutions have their bioengineering department and their medical center in very close proximity, such that there can be daily and weekly interactions between team members. If this does not exist, it can still work, but the barrier to keeping a quick iterative environment is higher. Talking to the customer always matters in an enterprise where something new is being developed, and polling multiple customers is usually critical to ensure that one’s perspective is broad enough.

**Culture is Critical:** In a world where the dot-com culture has completely shaped the way that large companies think about innovation, it is obvious that the culture where the work is happening must be positive, fertile, and focused on innovation and ideas. This is very much related to the first point about the team, but the culture here includes the attitude and wider environment where the team exists. This positive culture model is encouraged by leaders who reward positive ideas and forward thinking with a balance of hard work and an ethos to get things done.

The challenging aspect of this is that in a large well-funded enterprise, it is easier to have this positive culture, whereas in a small fledgling operation such as a single-PI laboratory, it can be a challenge. Each lab can at times feel like a small business where the lone PI has to do everything. Clustered PIs who work in a joint laboratory or building can truly collaborate and freely exchange ideas, which can create a start-up culture where ideas are welcome, and innovation is rewarded.

Interdepartmental buildings are popping up on most large university campuses, to help foster the rounded team approach and an idea-focused culture. However, today, if someone is stuck in the older world situation of a traditional department building, this can be a major issue. Still, networking exists via many social media outlets, and broadening one’s network to include colleagues throughout the scientific world is possible, but again requires higher energy and focus

to make it work well. More and more, broadening a research team to include industry is also considered critical,<sup>4</sup> and leads to better translation beyond clinical assessment. This can include economic viability input, as well as an infusion of entrepreneurial perspective.

**Funders Invest in Things They Care About:** In the angel funding and venture capital world, it is widely known that investors have topical preferences where they are experts and focus their funding decisions in these areas. Similarly, program officers at government funding agencies specialize in different areas, and so it is important to get to know who is focused on which areas, and what their emphases are. Increasingly, government funding agencies are making decisions about what to fund, with more discretion for the programs that demonstrably address targeted needs. As a result, more frequently today, programs in the funding agencies are choosing between moderately scored grants. This is done either before peer review, in the form of targeted request for applications (RFAs) or contract solicitations, or after peer review, in the form of discretionary programmatic emphasis decisions. Being aware of these programs is critical and can increase the likelihood of receiving funding priority.

Additionally, funding rates vary considerably from 0% up to 100%, but with most in the 5%-20% range. Being aware of current rates is a critical part of being smart about applying to the most likely opportunities.

Just as pitching to the wrong investor is a waste of time for a start-up, so is pitching in grant application to the wrong funding agency. A secret to success is to be well aware of where the best potential funding mechanisms exist and diversifying across them as much as is feasible.

**Navigate the Valley of Death:** The notorious “valley of death” for company start-ups lies between the funding that a company gets and the long time before they actually make a profit selling their product. A different valley exists between basic research and translational research,<sup>5</sup> mostly because of the culture differences between the two. A translational investigator must be willing to shift their work towards translation and ensure that their innovative plans match what is needed for the translation to succeed. In many cases, this is not a match, and so the valley of death exists because of a technology trajectory might not match the translational needs exactly or it might not perform as required. Often, the expert in a particular technology goes in search of other applications to see if they have a prospective solution for some need. This search process is colloquially described as “the hammer looking for a nail.” While this pathway has been well traveled by

many translational researchers, there is no guarantee that a useful application may be found for even the most interesting technology.

A perceived valley of death for any new technology is really usually just a mismatch, mistaking technology-based research for needs-based research. To make translation work, developers of basic biomedical optics technologies must be flexible in searching for needs as well as solutions. This journal recently initiated a needs-based series of articles, called perspective reviews,<sup>6</sup> which should be one useful guidepost for the community of biomedical optics.<sup>7</sup>

Translational research in biomedical optics, the largest fraction of technology in medicine, has driven the majority of innovations in biomedical technology research and industry R&D.<sup>8</sup> The community needs to ensure that active motivated researchers are well positioned to advance their work in the coming years, keeping plans for grants focused around innovative technologies and applications, having an eye towards making the best team that they can create, talking to their potential customer(s), creating a culture of innovation throughout their network, targeting the right funding opportunities, and ensuring that they balance needs with solutions. Biomedical optics has so many successful innovative technologies, and it is critical that translational research groups get the financial backing needed to move through to entrepreneurship and development.

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