TRANSDISCIPLINARY SCIENCE

Teaching Corporate in College

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By applying the strengths of corporate models for effective teamwork, academic scientists can drive transdisciplinary research and accelerate biomedical translation.

Transdisciplinary (TD) investigations occur when individuals or teams from different disciplines converge to conduct research focused on solving a specific problem that cannot be solved by a single discipline. Working at the intersections of disciplines allows TD research teams to create new science while fostering a higher plane of enquiry—the unearthing of solutions to complex human health and societal problems. Academic medical centers are strategically positioned to drive local, national, and global TD biomedical research. However, academia's disciplinary-bound culture—organized physically and conceptually around specific content areas—limits TD research and challenges scientists who are working within a university's traditional department-based organization. In quest of solutions, we explore the characteristics of high-performing corporate teams that might be adapted for use in academic TD research and discuss the premise that collaborations between academic and industry teams present opportunities to harness the unique strengths of each.

CAREER CONFLICT

Researchers in academic medical centers respond to multiple missions and success metrics and are accountable to several entities. Aside from their research, these scientists are evaluated on their ability to teach, supervise students, attract research funding, care for patients, and perform other services for their departments and institutions. Although these researchers are accountable to their universities, hospitals, and professional accreditation agencies, the goals of these various institutions often conflict with each other and with those of TD research. TD researchers with clinical responsibilities are under constant pressure to do more clinical work that generates revenue for the institution; this creates a distraction from high-quality research, which requires time and focus. Further, organizational structures and policies requiring hours of mandatory online training and compliance usurp faculty members' time and erode their motivation for engaging in TD research.

The academic tenure process and career ladder rest on the individual contributions of a principal investigator, which propagates a laboratory- and discipline-specific identity; this culture puts TD researchers at risk of failing to meet promotion and tenure criteria. TD researchers may receive less recognition
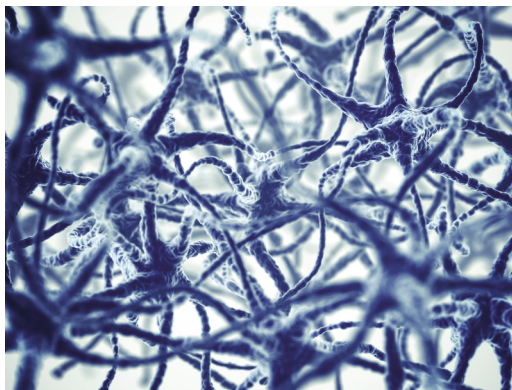
New connections, incisive ideas. When creative minds mesh, high-level performance is possible.

because their specific contributions to multiple-investigator studies are often less readily apparent. Moreover, external factors inadvertently disadvantage TD researchers. For example, peer-reviewed journals order authors by contribution, which mires the spirit of collaboration, and along with funding agencies espouse review processes dominated by disciplinary experts.

Inadequate training of the next generation of TD researchers presents yet another major barrier. Education on team effectiveness and training to acquire collaborative skills are seldom included in undergraduate or graduate curricula. Consequently, when TD research is adopted, most often at later career stages, faculty may lack the essential skills for team effectiveness: decision-making, problem solving, conflict resolution, information exchange, coordination, and boundary management (1).

BUSINESS SCHOOL

Because the corporate world is typically outcome-oriented and time-constrained, involves multiple stakeholders, and is driven by return on investment, projects must be guided by clearly articulated tasks and expected outcomes. We identified six attributes of high-functioning corporate teams that drive reward systems and promote team success (2, 3). Adapting these attributes to academic TD research teams could mitigate the challenges posed by the academic culture of disciplinary identity.

Shared vision transcends individual goals. In the corporate world, both the articulation and execution of strategic goals depend on successful team functioning. The development of therapies for complex pathophysiological conditions that cannot be deciphered by any individual discipline requires shared mental models. Strong group leaders reframe problems in ways that encourage new thinking and innovation. Models of shared purpose in industry establish "collaborative communities" that are "simultaneously innovative and efficient, agile and scalable" (4). Leaders of high-performing organizations spend time and resources to develop emotionally resonant shared purposes that guide efforts at all levels of the organization. For example, Kaiser Permanente's "Value Compass" succinctly defines the organization's shared purpose as "best quality, best service, most affordable, best place to work." By applying their Value Compass, a Kaiser unit developed an innovative protocol for hip and knee replacement, the "Total Joint Dance," significantly improving operating room processes for joint replacement, lowering cost, and improving satisfaction among patients, nurses, physicians, and staff.

Shared accountability and recognition of team success. Corporate team success is rewarded, and individuals are held accountable for contributions to team goals. This is in sharp contrast to academia, where recognition is largely based on individual successes such as numbers of senior-author publications and principal-investigator grants. The

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best corporate team translates its purpose into specific goals that define a set of work products; facilitates clear communication and constructive conflict within the team; identifies attainable goals focused on results; and challenges team members to commit themselves to making a difference.

A dramatic demonstration of the power of clear specific goals, accountability, and reward systems is the Intuit Inc. business case, wherein a highly siloed company transformed itself into a successful collaborative organization. Starting in 2000, employees who achieved their individual and team goals and also collaborated across units received higher performance ratings and obtained higher pay and bonuses than those who reached their individual goals in a manner inconsistent with collaboration. The changes at Intuit led to a shared vision, a common language, and a culture of collaboration that contributed to Intuit's emergence by 2009 as a preeminent national and international provider of financial management software services.

Emotional intelligence and trust. Effective corporate teams have high member participation and collaboration, behaviors that require three basic conditions: mutual trust; group identity (a sense of belonging to a unique and worthwhile group); and group efficacy (a sense that working together is preferable to working individually) (5). A well-established model of group emotional intelligence is present at IDEO, a design company whose teams are responsible for the look and feel of Apple's first mouse, the Palm V personal digital assistant, and the Crest toothpaste tube. IDEO teams use creative problem-solving but also work under clients' time constraints for delivery of aesthetic solutions that balance human needs with engineering realities. Team members establish cultural expectations for behavior and common values that foster collaborative behaviors.

Leaders in high-functioning corporate teams earn the trust of team members by establishing environments of transparency, direct communication, and expression of authentic concern. Constructive conflict, distinct from interpersonal conflict, enhances team performance. At the Fortune 500 medical devices company Johnson & Johnson (J&J), a small internal group charged with facilitating collaboration among J&J's independent outsourcing companies extracts lessons from conflicts. Representatives from the various outsourcing companies convene

regularly to discuss conflicts, explore their strategic implications, and identify trends in clinical-research outsourcing that are rapidly disseminated throughout J&J. The operating companies benefit from insights about new opportunities, while J&J realizes more value from its relationships with suppliers.

Communication, technology, proximity. The corporate world tackles communication challenges among large, complex, and widely dispersed teams by investing in so-called signature relationship practices—ones that are memorable, unique, and well suited to a company's business environment (3). The Royal Bank of Scotland designed its new head office building in Edinburgh specifically to foster employee collaboration. Built around an indoor atrium, the new structure enables employees to meet, socialize, and exchange ideas, which creates a sense of community. By providing social amenities such as restaurants, cycling trails, jogging tracks, and picnic areas, the bank created a "Main Street" running through campus, thus encouraging employees to remain on site and get out of their offices to meet their co-workers. The resulting culture of strong social relationships provided a solid basis of collaboration.

Corporate teams also leverage communication-enhancing technologies to solve challenges of team size, dynamic composition, geographic dispersion, amount and type of diversity, and level of interdependence among team members. At Salesforce.com, the challenge of bringing the top tier of the company closer to the workforce was solved by using Chatter, a social network for business enterprises, to engage off-site teams. At one national meeting, 200 executives were joined by all 5000 Salesforce.com employees—virtually. Television monitors placed throughout the meeting room displayed the special Chatter forum for off-site attendees. A video service broadcasted the meeting live to all employees, who could then connect via company-provided iPads and instantaneously express their views. "Suddenly, the meeting went from a select group participating to the entire company participating" (2).

Toolbox of collaboration skills. The corporate world prepares individuals for working effectively in teams by equipping them with a toolbox of collaboration skills, including an in-depth understanding of team formation and dynamics and leadership and management principles, and a variety of practical tools. This curriculum forms the core of graduate business school education but is seldom taught in medical school

or in science graduate courses. Typical skills include conflict management, leadership development, meeting management, communication, negotiation, and assessments of personality and communication styles.

Adaptability in the face of change. In the corporate world, TD teams can be stable, long-term collaborative associations that tackle major enduring issues related to operational efficiency, product development, marketing strategies, and other bottlenecks. In contrast, some teams are highly dynamic, assembled rapidly to address an emergent business challenge, and dismantled when the problem is solved or the crisis passes. This latter type of team is becoming more and more common in the highly competitive, global business landscape and has led to the concept of "teaming," a flexible, adaptable version of teamwork. For example, engineering of the remarkable WaterCube that housed the aquatic events at the Beijing Olympics was achieved by the teaming of people from more than 20 disciplines and 4 countries, many of whom may never work together again. This approach of fashioning a short-lived team to tackle a bold goal is designed to promote innovative thinking, but the approach doesn't work as well when one needs strong team performance in an area that requires familiarity, trust, and effective division of labor, such as in the operating room or the NBA playoffs.

Team leadership. Studies on R&D teams report that transformational leadership is important for the success of research projects (6) and a strong predictor of technical quality, schedule performance, cost performance, profitability, and speed to market. Increasing team size and changing composition has led corporate teams to adopt shared leadership approaches requiring teams to self-regulate, self-manage, and distribute certain leadership tasks traditionally handled by one official leader. As teams are given greater autonomy, they assume greater responsibility for learning and development, underscoring the need for explicit training and processes to help gather feedback and learn from experience.

MISSION POSSIBLE?

Can corporate practices be adapted for TD research in academia? Many examples attest to a resounding "yes." One fundamental corporate practice, rewarding of teams, is being adopted by funding agencies to push academic institutions to adopt appointment and promotion criteria that recognize teamwork.

Institutions with U.S. National Cancer Institute–designated cancer centers are expected to have language in their faculty appointment and promotion policies that recognizes the importance of team science in order to demonstrate the institution's commitment to TD collaborations. For example, at Arizona State University, new models of multidisciplinary team research have been created to foster collaboration and team science (7). Likewise, the University of Southern California has developed guidelines for evaluating TD faculty scholarship, including assessment of contributions to creativity, new knowledge and products, and publications (www.insidehighered.com).

Like corporate practices, academic institutions are also fostering collaboration through creative space designs wherein research scientists from many disciplines come together to solve the most challenging scientific problems. Two examples among many are Janelia Farm (http://janelia.org) and the MIT Koch Institute for Integrative Cancer Research (http://ki.mit.edu). The Janelia Farm campus environment is designed specifically to enable collaboration and flexibility by maximizing opportunities for interaction among scientists from a broad range of disciplines. Similarly, the Koch Institute buildings allow for the physical colocalization of faculty members from several MIT departments and have extensive dedicated interactive space, including a gallery of scientific art that faces the street to engage the community. Bottom line: Architecture matters; buildings are designed for their users and reflect and support the organization's values and culture.

Organizational structure is also a reflection of mission priorities. The proliferation of federal and privately funded institutes and centers in academic institutions is another indication of a new focus on research designed to solve problems. Much like corporate structures that support teams, the strategic goals of these institutes and centers require team participation in ways that classic departmental structures never did; they articulate large, audacious goals and employ team structures designed to accomplish these goals. Importantly, these institutes often incorporate team-based training that includes a toolbox of collaboration skills introduced early in the training of students involved in TD research. Some programs are adopting models for effective collaboration, such as the NIH field guide (http://ombudsman.nih.gov/collaborationTS.html) and a recently published practical roadmap for TD team-based research (8).

BEST OF BOTH WORLDS

Collaborations between academia and industry that harness the strengths of each should help to overcome some of the challenges of team science within academia's current disciplinary-bound culture. Numerous effective collaborations in phase III clinical trials have provided new diagnostics and therapies for cancer, cardiovascular, and other diseases. The proliferation of industry-academia partnerships, such as the Intel Science and Technology Centers and the Pfizer Centers for Therapeutic Innovation, highlights how industry practices and academic philosophy can be leveraged to foster innovation via TD teams (9). Industry benefits from the opportunity to diversify its research portfolios with projects that address unmet medical needs while bringing the benefits of resources and development capabilities to academic partners. The California Institute for Biosciences—a consortium of University of California, San Francisco; Univeristy of California, Berkeley; and University of California, Santa Cruz—brings together academic researchers to foster innovative partnerships with leading pharmaceutical companies, including Bayer, Celgene, and Merck (www.ucsf.edu/locations/mission-bay/academic-industry-partnerships). One example, the UCSF Viral Diagnostics and Discovery Center, focuses on the identification of viruses associated with acute and chronic diseases.

Industry-academic partnerships can also provide a strategic mechanism for hastening the translation of research to improvements in clinical medicine. For example, the SPARK program at Stanford University was designed to help academicians overcome obstacles to moving research innovations from bench to bedside and to educate faculty and trainees on the translational research process and paths to clinical application (http://sparkmed.stanford.edu). SPARK is based on a strong foundation in basic and clinical research, uses highly skilled industry advisors, and provides a cost-effective model for generating proof of concept using biomedical industry standards. Over a 5-year period, 15 products have entered clinical testing or commercial licensing, reflecting a development rate >50%. Eight new companies were formed, and many researchers have secured substantial outside funding based on SPARK-funded work.

However, despite notable case studies of team effectiveness, more empirical research is needed to better delineate the factors that predict successful collaboration in terms of efficiency and outputs. The National Research Council (NRC) has embarked on a consensus study of the science of team science, with the goal of enhancing the effectiveness of collaborative research in science teams (http://sites.nationalacademies.org/dbasse/bbcss/currentprojects/dbasse_080231). One study goal is to determine the types of organizational structures, policies, practices, and resources needed to promote effective team science in academic institutions, research centers, industry, and other settings. The NRC study will extend the discussion presented herein and provide evidence-based analysis of the key elements of academic-industry collaborations that enable TD research success.

The principles that drive high-performance corporate teams are directly linked to team-level reward systems; trust and effective communication; collaboration skills; nimble adaptability; and team leadership and management. Many of these same drivers are emerging as important prerequisites for successful TD research (10). Given the barriers implicit in the disciplinary culture of academia, we propose that harnessing the strengths of academic science and the corporate team-based culture should spur the success of academic TD research and accelerate biomedical translation.

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