Organizing core facilities as force multipliers: strategies for research universities

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Force multipliers are attributes of an organization that enable the successful completion of multiple essential missions. Core facilities play a critical role in the research enterprise and can be organized as force multipliers. Conceiving of cores in this way influences their organization, funding, and research impact. To function as a force multiplier for the research enterprise, core facilities need to do more than efficiently provide services for investigators and generate revenue to recover their service costs: they must be aligned with the strategic objectives of a research university. When core facilities are organized in this way, they can facilitate recruitment of faculty and trainees; serve to retain talented faculty; drive, acquire, and maintain cutting-edge research platforms; and promote interaction and collaboration across the institution. Most importantly, cores accelerate the discovery and sharing of knowledge that are the foundation of a modern research university. This idea has been systematically implemented through the Emory Integrated Core Facilities (cores.emory.edu), which include 16 distinct core facilities and the Division of Animal Resources. Force multiplier core facilities can significantly contribute to the many essential missions necessary for the success of the research enterprise at research universities.

KEY WORDS: strategic alignment, Diversity · Equity and Inclusion · Recruiting · Retention · Cutting-edge · Platforms · Grants · Publications

INTRODUCTION

For more than 20 years, it has been recognized that access to the latest biologic and biomedical technologies and platforms through efficiently managed core facilities is critical to research success in university settings.1–5 Best practices for service delivery continue to evolve and are a frequent topic of discussion in Association of Biomolecular Resource Facilities webinars and annual meetings.3 As core facilities have arisen and developed at research universities, often driven by the needs of specific faculty members within departments, overlap and duplication have resulted. As a consequence, there is a demonstrated need for core consolidation and improved approaches to ensure sustainability.6–8

The overlap and duplication of core facilities, however, provides a valuable insight into how core facilities are conceived of at major research universities with a matrix organization. The approach to core facilities at a research university influences their organization, funding, and research impact.9 Yet the strategic alignment of core facilities with the critical strategic goals and objectives of the research institution is often lacking. Our conception of core facilities can limit or enhance their impact on the broader research enterprise. The purpose of this paper is to reconsider the strategic roles of core facilities and provide a framework to articulate the critical roles that core facilities can play in advancing the strategic goals of a research institution.

THE FORCE MULTIPLIER CORE FACILITY

The term “force multiplier” is a term of art from the U.S. Department of Defense.10 This concept implies that the most valuable attributes of an organization are those that enable the successful completion of multiple essential missions. Strategically, this mindset impacts the design of platforms, the organization of units, and the operations they pursue. Core facilities are one example of a valuable attribute supporting the research enterprise. Applying this broad strategic framework to the core facility organization can reveal often unrealized opportunities to advance the major goals of a research university.

Components of a force multiplier core facility

Typical measures of the efficiency and impact of traditional core facilities focus on services provided to investigators and revenue generated in the course of providing those services. A traditional core facility is functioning efficiently if it is able to provide services that investigators seek while recovering the costs of providing those services. Alternatively, force multiplier core facilities, while including these important
measures of efficiency, seek to expand their mission beyond the traditional focus on services offered and revenue generated and align with critical institutional goals (Fig. 1). Examples of these critical functions provided by force multiplier core facilities include the following.

Recruiting

Recruiting new research faculty to an institution is critical for the continued viability of the research enterprise and is one of the most critical investments made by an institution. New investigators bring fresh ideas and novel approaches that can extend beyond their immediate laboratory, which is particularly important for interdisciplinary team-science approaches. Directly aligning core facilities with faculty recruiting can not only increase the probability that a desirable recruit will join an institution, but also contribute to the impact of their research and provide new opportunities to other faculty members. Ultimately, the goal of any university is that the best candidates choose to come to its institution and succeed.

Retention

An ongoing faculty development program has been shown to enrich faculty vitality and improve their effectiveness. Faculty depart one research institution for another for a variety of reasons; improving faculty retention provides many benefits to the institution. Strategic investments in force multiplier core facilities can provide new opportunities for valued, productive investigators at their current institution and make them less likely to seek opportunities at other research universities. When force multiplier core facilities are combined with internal pilot funding opportunities, faculty may choose to pursue new avenues of research and collaboration at their present institution instead of seeking such opportunities elsewhere.

Diversity, equity, and inclusion

Addressing systematic racism in the research enterprise will require the concerted action of multiple interventions. Along with a variety of concrete actions proposed to address structural racism in the research enterprise, a force multiplier core facility can help build relationships, aid in recruiting diverse faculty members, and provide a standard infrastructure available to all faculty members at a research institution. With a force multiplier core facility, the availability of cutting-edge platforms is democratized, with equivalent access across the research enterprise. In addition, the expansion of professional staff scientist roles can provide opportunities beyond the traditional faculty tenure track path. Improving diversity, equity, and inclusion (DEI) at research universities is likely to require many new approaches and strategies. Force multiplier core facilities are one component that can be leveraged to help address structural racism in the research enterprise.

Engagement

Much like interdisciplinary graduate programs that span traditional administrative silos, force multiplier core facilities can provide bridges across these institutional divides. These core facilities, if well-conceived, managed, and marketed, can become important nodes of interaction among investigators. Developing effective, collaborative research teams can be enhanced through force multiplier core facilities.

Space

Research space is a limiting resource. Alignment of core facilities governance and location with existing academic departments can promote efficient use of space. Force multiplier core facilities can serve the research needs of multiple investigators, thereby avoiding duplication of resources and promoting efficiency. In addition, cost recovery metrics accounting for space can be assigned to the core facility instead of being counted against a specific department’s footprint. Faculty within departments can pursue their unique research activities within their assigned space, which can be expected to enhance departmental cost recovery.

Platforms

Research is an expensive endeavor. As one example, a recent Association of American Medical Colleges survey of medical
schools reported an average institutional investment of $0.53 for every dollar of sponsored research received. The ever-increasing cost and the rapid pace of essential research platforms contribute to this cost. Ensuring that expensive research platforms are effectively managed in a force multiplier core facility will maximize the benefit to the institution and outperform the tradition of placing a platform in a single principal investigator’s laboratory.

Grants

A force multiplier core facility contributes to faculty grant applications in a number of ways. The environment of a research institution is a scorable category. Well-organized core facilities directly address the requirement to demonstrate that the environment will be capable of supporting the proposed research. Letters of support, descriptions of facilities and other resources, and major equipment lists provided by a force multiplier core facility directly address this scorable category. In addition, the technical experts in the core facility can advise investigators with their experimental design and provide technical support and methods documentation that might not be obvious to the nonexpert core user and may prove essential for a grant to be well reviewed and ultimately funded.

Centers

A research institution should have a strategic plan for centers as sites of innovation and interaction across traditional departmental boundaries. Paradigm-changing research often arises from interactions fostered in centers at research universities. Force multiplier core facilities are ideally suited to support innovative center research. At the same time, the innovative technologies, assays, and platforms developed within a center provide the future services that will be offered and made widely available by the force multiplier core facility.

Education

Core facilities can provide strong support to the educational mission at a research university. Existing didactic educational programs for a wide variety of trainees can be enhanced by hands-on experience provided by force multiplier core facilities. For research-focused trainees, such as graduate students or postdoctoral fellows, training on the effective use of specific platforms can aid in their degree progression and the development of their research skills. Finally, even experienced investigators can benefit from educational services provided by a force multiplier core facility. For example, clinical investigators at an academic medical center who are experts in human phenotypes and clinical presentation of a human disease can leverage expertise in the force multiplier core facility to advance research studies that are beyond the capability of their single laboratory.

Knowledge

Ultimately, force multiplier core facilities are sites of knowledge sharing across or among research institutions. Efficient knowledge sharing, learning from the mistakes of others, and solving problems only once are all critical features of a force multiplier core facilities. Research institutions that are more effective in these areas can be expected to outcompete their peers for funding and research impact.

FORCE MULTIPLIER CORE FACILITIES AT EMORY UNIVERSITY

At Emory University, we have systematically applied the force multiplier framework to our core facilities in order to promote strategic alignment with our institutional goals. We first conducted a strategic review of service centers/core facilities in 2015, which revealed a decentralized core structure with more than 55 independent service centers across Emory University. The decentralized structure limited awareness of core facilities, contributed to duplication of services in some cores, increased administrative overhead, and reduced the impact of core facilities on important institutional research goals.

At the beginning of fiscal year 2016, the Emory Integrated Core Facilities (EICF) organization was established to coordinate core facilities at Emory University. Each integrated core facility was organized as required by the NIH S10 grant mechanism to align core expertise, financing, and decision making (Fig. 2). The Executive Oversight Committee members included Emory units making financial contributions to core facilities. Scientific Directors, typically tenured senior faculty members, were appointed with 5% effort. Their role is primarily strategic, to assist in the ongoing development of novel services and platforms in

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**Core Facility Advisory Committee**

- **Executive Oversight Committee**
- **Scientific Director**
- **Core Director**
- **Major User Group**

**FIGURE 2**

The Core Facility Advisory Committee structure established for each of the EICF.
the core facility. Core Directors oversee the daily operations of the core facility. The Core Director role is fully financially supported by the core facility revenue and subsidy provided by the funding entities. Emory established a staff scientist career path for wet lab (2016) and computational (2017) staff to fill these positions. Each core facility established a Major User Group of faculty to then advise the Scientific and Core Director. Quarterly meetings with the Associate Vice President for Research in the Woodruff Health Sciences Center review core operations, finances, equipment, personnel, and strategic opportunities. The Executive Oversight Committee meets annually or as needed with the core leadership to review core activities and make strategic decisions.

Marketing the core services was identified as one of the primary duties of the Core Director. Regular seminars are led by the individual Core Directors in order to introduce new platforms and their applications that may be of interest to investigators. In parallel, a main core website (www.cores.emory.edu) was developed to provide a single site for information regarding core facilities, using a standard template across different core facilities.

Recruiting, retention, DEI, collaboration

The establishment of the EICF led to changes in the procedures for hiring and retaining faculty. Within Emory’s School of Medicine, a Cores, Animals, Space, and Equipment tool form was developed and became part of the hiring process. New faculty being recruited are introduced to the EICF and meet with the Associate Vice President for Research, and their startup needs are identified and aligned with resources in core facilities. If new platforms are needed, the preference is for the platform to be funded by the institution and placed in a core facility in order to benefit all investigators. Funds to use the new platform are typically provided in the startup package. This strategy lowers the cost that department chairs bear in recruiting new faculty members while maximizing the research impact of the new platform for the institution. Retention activities are pursued in a similar fashion.

Emory’s core facilities support institutional DEI goals by providing a supportive infrastructure to all Emory investigators. Within core facilities, DEI actions included standardizing the interview process and questions across core facilities and providing unconscious bias training to core personnel. Including DEI actions as a topic in the quarterly core meetings helps ensure that new opportunities are pursued.

Because the EICF core facilities span traditional academic silos, like interdisciplinary graduate programs, they have become sites for collaboration. The core marketing activities that include seminars and sponsored training build a sense of community and lead to chance interactions among investigators with similar interests. Websites and core facility listservs provide another means to promote interaction among investigators. Core directors look for potential opportunities for synergy and often help direct faculty investigators to resources in other core facilities. Finally, all the core facilities at Emory use a single software platform (PPMS; Stratocore, Paris, France) with a single user database that helps improve core facility discovery in units throughout Emory University.

Space, platforms, centers, grants

Placing major platforms within force multiplier core facilities maximizes the community of potential users and ensures their ongoing maintenance. Recruiting initiatives, such as in structural biology, have been aligned at Emory with investments in expensive cryo–electron microscopy platforms. Aligning cores with departments and centers, which are the sites of innovation, leads to the development of new services that can then be widely provided to the larger community of investigators. Individual investigator grants are supported through standardized Facilities and Other Resources and Major Equipment documents provided by each force multiplier core facility that can be easily included in grant applications. In addition, scientific directors provide letters of support that help convince reviewers that the environment can fully support the proposed research. EICF Core Directors submit and have competed successfully for NIH S10 equipment grant applications. The EICF administrative sections are drafted and provided to the Core Directors, and direct financial support, typically 10% of the cost of the platform, is provided by the institution to demonstrate institutional support. Finally, the education mission can also be supported by providing trainees, like undergraduates, graduate students, or postdoctoral fellows, hands-on training with the latest platforms.

Education and knowledge

Emory’s Integrated Core Facilities have increased their role beyond the research mission. For the education mission, the EICF are introduced to graduate students in the interdisciplinary programs that compose the Graduate Division of Biologic and Biomedical Sciences in the Laney Graduate School at Emory University. Trainees in the Emory Genetic Counseling Training Program, housed within the Department of Human Genetics, are able to gain familiarity with the genomics platforms found within the Emory Integrated Genomics Core as part of their education. Finally, the growing use of the EICF has helped them develop into important centers of knowledge for Emory investigators. Expertise developed over time is shared among investigators who lack experience with the latest platforms but seek to use these same platforms to speed their research. Our anecdotal observations are that the benefit accrued in using a
core facility is highest for clinical-translational investigators who are experts in human phenotypes but often lack experience in the platforms found within the EICF.

MEASURING IMPACT OF FORCE MULTIPLIER CORE FACILITIES AT EMORY UNIVERSITY

Measuring impact of force multiplier core facilities can be pursued by both quantitative and qualitative means. One obvious quantitative measure of impact is revenue generated by the core facilities. Revenue is easily measurable and acts as a proxy for a number of correlated outcomes. At Emory, the EICF have shown strong revenue growth, reflecting increasing usage of core facilities across the research enterprise (Fig. 3). Of note, the revenue for financial year 2020 exceeded that of financial year 2018, even with core facilities shut down for one-quarter of the year due to the COVID-19 pandemic. Qualitative measures include a larger role in faculty recruitment, increased engagement of investigators by core facility leaders across the organization, and the development of new services within existing core facilities.

DISCUSSION

Although the importance of core facilities to research success has been recognized for more than 20 years, opportunities remain to increase their impact at research institutions. The conception of core facility missions within the broader strategic framework of a research university drives their impact on the research enterprise. Core facilities conceived of as force multipliers for research can fulfill critical functions beyond providing services and generating revenue. Strategic goals of research institutions can be advanced by expanding the missions assigned and expected of force multiplier core facilities.

Emory’s approach to Integrated Core Facilities has been designed to embrace and embody the organizational and strategic ideas of a force multiplier core facility. Their impact has already been substantial and continues to grow beyond the original conception. At Emory, the planning of new and expanded core facilities was critical in the design of our new research building, Health Sciences Research Building II. Within the state of Georgia, the idea of a core as a force facility...
multiplier led to the establishment of the Georgia Core Facilities Partnership. This novel agreement was ratified by all 8 research university members of the Georgia Research Alliance and allows investigators to use each other’s core facilities at internal subsidized rates. This agreement went into effect in January 2018. Increased engagement across institutions has already led to collaborative research projects, new grant applications, and integrated core facility planning within the state.

Implementation of the force multiplier core facility concept is not without its challenges. Perhaps the largest is cultural. The classic notion that every principal investigator is wholly independent of all other investigators is a common belief, even in spite of the increased development of, and funding for, team-based science. Clear communication of the force multiplier core facility concept can change this culture while enhancing the impact and efficiency of the research enterprise. In parallel, enhancing the discovery of core facilities in large, siloed research institutions remains a critical need if the strategy described here is to be successful. Measuring quantitative and qualitative outcomes remains challenging, often because of barriers to the gathering of key metrics such as publications, grants, and faculty recruiting and retention. Developing improved automated methodologies to capture and synthesize these types of data is critical for measuring core facility impact and return on investment. Finally, regular interaction and oversight of force multiplier core facilities and the services they provide are critical if they are to positively impact the research enterprise.

The competition for research impact and funding unites investigators within their home institutions. Conceiving of cores as force multipliers can provide investigators more time to pursue their research interests while, at the same time, allowing research institutions to use their limited resources efficiently. As accessing and effectively using the latest technologies and platforms for biologic and biomedical research continues to drive success of the research enterprise, force multiplier core facilities may become increasingly important in the success of the research enterprise at research universities.

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