University of Michigan
Cores Assessment Committee

Final Report
July 2021

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Executive Summary

Shared facilities or centers of expertise which offer services, equipment, and other resources to researchers and investigators (i.e., research core facilities, or simply “cores”) are critical components of the University of Michigan (U-M) research enterprise. In February 2021, Rebecca Cunningham, (Vice President for Research) and Roger Cone (Vice Provost and Director of the U-M Biosciences Initiative) charged a Cores Assessment Committee to perform a needs assessment with the goal of ultimately providing stronger support services for researchers and cores across U-M. The committee’s charge was to 1) assess the current needs on how cores operate and what resources are needed to improve efficiency, and 2) make recommendations for how U-M cores can better support the broader research community. Information reviewed by the assessment committee included data and input from discussions with several key internal stakeholders, focus groups and a survey of core staff and users, interviews with national leaders, data on external funding for equipment, and published reports and articles.

Findings

Major findings of the assessment include:

- Cores provide a variety of critical services to the research community. Decentralized management and lack of common guidance for cores, however, has led to inefficiencies in costs, a fragmented community of core staff, and an underserved research community.
- U-M is underperforming in seeking out and receiving the most common equipment grants from NIH and NSF, potentially due to misaligned incentives and/or too many barriers to submitting such proposals.
- The success of the Michigan Research Cores website and expansion of MiCORES highlights the desire and value of continued institutional support for cores.
- Pain points identified in the survey spanned a wide range of issues including space and equipment, funding, operational and user costs, leadership, staffing and professional development, customer experience, IT, and communications.
- Nationally, peer institutions are responding and structuring themselves to better support cores, including varying ways of increased centralization; however, development of a thoughtful change management process is critical to success.

Recommendations

Core facilities are and will continue to be critical to the success of the research enterprise. U-M must demonstrate it values the cores ecosystem by investing in a way that maximizes the institution’s ability to secure external funding to launch and support cores and also to enable cores to hire the best leadership and technical staff, set rates that facilitate research, make it easy for researchers to find and use cores, and provide training and development to support core leaders, staff and users. High-level recommendations for University leadership include:

1. Set an institutional strategic roadmap for cores at U-M
2. Proactively build community within the U-M cores ecosystem
3. Consider creating a career ladder system for core management and staff
4. Review the recharge rate process and user costs
5. Invest in strengthened resources for core data management and IT support
6. Provide campus-wide guidance for core operations, funding, and credit practices
7. Break down administrative barriers and incentivize equipment proposals
8. Coordinate cost-share for cores and equipment

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Overview

Motivation for the Assessment

Shared facilities or centers of expertise which offer services, equipment, resources and expertise to researchers and investigators (i.e., research core facilities, or simply “cores” for the purposes of this report) are critical components of the U-M research enterprise. The recently launched Michigan Research Cores website lists 95 cores with recharge rates at U-M, but that is only a fraction of the total shared research facilities or resources available widely across the institution. Although cores are most common in the life sciences, they are also critical to other disciplines, including engineering, physical sciences, arts, and social sciences. Operationally, cores are housed in a variety of units, from schools/colleges, to departments and institutes. The Biosciences Initiative, Office of the Vice President for Research (OVPR), and Medical School all actively provide campus-wide resources for cores, including a funding program to support new and existing cores, the aforementioned cores website, and the expansion of MiCORES software. Despite these recent means of support, a lack of broader coordination for cores across the institution leads to inefficiencies in operations and purchasing, poor support of an integral and highly-trained community of staff, and decreased competitiveness for external funding to acquire and maintain specialized research equipment. Nationally, institutions and membership organizations have recently made it a strategic priority to tackle similar shortcomings.

In February 2021, Rebecca Cunningham, (Vice President for Research) and Roger Cone (Vice Provost and Director of the U-M Biosciences Initiative) charged a Cores Assessment Committee to perform a needs assessment with the goal of ultimately providing stronger support services for researchers and cores across U-M (see Appendix A for full charge document). The charge tasked the committee to 1) assess the current needs on how cores operate and what resources are needed to improve efficiency, and 2) make recommendations for how U-M cores can better support the broader research community.

The Committee’s Approach

The committee was composed of faculty and staff across a wide range of units and backgrounds, leading to a variety of valuable perspectives. The committee utilized data and input from internal discussions, focus groups with internal stakeholders, interviews with national leaders, a campus-wide survey of core staff and users, internal U-M data, and published reports/articles. The full committee convened several times between February and June 2021. Additionally, the committee established three subcommittees to focus on various aspects of the assessment, including outreach, operations and finance, and grant competitiveness/administration. The subcommittees met in small groups and performed scope focussed tasks. The approach of each subcommittee is outlined below.

Outreach Subcommittee

The outreach subcommittee was charged with collecting input directly from the research community about what works well and what does not across U-M cores, as well as identifying best practices utilized by other institutions that have substantial core facility operations. The subcommittee sought expert input from U-M faculty and staff through a broad internal stakeholder survey and benchmarked core management practices by researching institutions across region, public/private, and budget models to illustrate the variable approaches institutions

take to supporting cores. In addition, the subcommittee conducted virtual 60-minute interviews using a set of predetermined questions (Appendix B) with the following core administrators who are recognized national leaders from peer institutions:

- Julie Auger -- Executive Director, Research Core Facilities Program, University of California, Davis
- Phil Hockberger -- former Associate Vice President for Research, Northwestern University
- Susan Meyn -- Director for Research Resources & Planning, Vanderbilt University Medical Center

The outreach subcommittee began the process of developing a needs assessment survey by consulting with Jason Owen-Smith, U-M professor of sociology; organizational studies; public policy; executive director of research analytics in OVPR, on institutional data use; and with Richard Gonzalez, Amos N. Tversky Collegiate professor of psychology and statistics; professor of marketing; professor of integrative systems and design; and research professor and center director of the Research Center for Group Dynamics in the Institute of Social Research, on survey methodology.

The subcommittee also met with two focus groups of core administrators and staff to ensure that the survey included concepts that resonated with them.

Focus Group #1	**Focus Group #2**
● BSB Imaging: Erik Nielsen ● Michigan Center for Materials Characterization: Bobby Kerns ● Biomedical Research Core Facilities: Anitha Chennat ● UM3D Lab/3D Printing: Shawn O'Grady	● Natural Products Discovery Core: Ashu Tripathi ● Center for Structural Biology: Jeanne Stuckey ● Lurie Nanofab Facility: Sandrine Martine, Becky Peterson ● Chemistry Mass Spec & NMR: Brandon Ruotolo ● UM HomeLab: Alicia Carmichael ● Michigan Center for Musculoskeletal Health: Karl Jepsen

The subcommittee finalized the survey questions (Appendix C) using input from these discussions and focus groups and sent it to 4,055 core administrators, staff and customers (using lists populated from lists of MiCORES users, the cores website, recharge data, and research associate deans). A total of 337 responses were received, for a response rate of 8.3%.

Operations and Finance Subcommittee

This subcommittee reviewed existing campus-wide resources, sought out relevant data about recharge/usage rates and equipment inventories, and met with several units across campus that support cores in various aspects including the following:

- Office of Financial Analysis
- MiCORES Advisory Committee
- Medical School Office of Research (regarding cores website)

Additional data points relevant to core finance and operations were obtained from the campus survey. The subcommittee acknowledged that there is tremendous diversity in U-M cores and that it was not within the scope of this assessment to study each core in detail. Rather, the subcommittee gathered broader information and observations about the landscape of core operations and finance at the university.

Grants Administration and Competitiveness Subcommittee

This subcommittee reviewed proposal submissions and awards for large equipment grants from NIH, NSF, and other sources; reviewed internal cost-share practices and spending for equipment grants; and explored additional and lesser known funding options within the research community. The committee also queried property control (i.e. list of assets) over the last five fiscal years for purchases over $100,000 to assess source of funds for equipment purchases (see Appendix D). Finally, in addition to specific questions included in the survey, the subcommittee met with the following groups as part of its information gathering efforts:

- Business Engagement Center (Chris Fick, Senior Director, Corporate Relations)
- OVPR Research Development team (Jill Jividen, Director of Research Development and Rachel Wallace, Research Development Officer)
- Biomedical Research Core Facilities- Med School (Cassandra Wong, Director, and Anitha Chennat, Associate Director)
- College of LSA (Assoc Dean Chris Poulsen and Steven Schlecht, Executive Director & CFO)
- Metabolomics Core (Charles Burant, Faculty Director and Maureen Kachman, Research Senior Supervisor)

Committee Findings

Survey Results

The core assessment survey found that facility infrastructure and equipment are important institutional assets that can be leveraged through core facilities. By providing access to a resource that they would not have otherwise, core users identified state of the art equipment housed within core facilities as critical to the ability to conduct their research. Equally, core users shared that core facility equipment plays a role in accelerating research (from both a time and cost perspective) as well as aiding in faculty retention. Core users consistently listed expertise, consultation on experimental design and approach, troubleshooting and help with data analysis as strengths of core facilities. In addition to these strengths, several challenges and opportunities for improvement were shared by core directors, staff and users. Below is a high level summary of this feedback, with more detailed survey results available in Appendices E and F.

Respondent Pain Points

Space and equipment

- Core directors and staff identified struggles with lack of redundancy for critical equipment in case of instrument failure, lack of funding to replace equipment, lack of smaller accessories to support workflow, insufficient space for operations, and limited access to needed equipment. Core staff also found the management of reservations of equipment to be difficult, especially with a wide spectrum in how equipment is used.
- Core users identified needing better access to equipment (in location and availability; coordination to allow access to card reader controlled rooms is cumbersome), and the need for more state-of-the-art equipment to enhance the quality of their research.

Funding

- Core directors and staff identified difficulties with maintaining financial viability with a relatively small user base, the lack of funding for equipment, the lack of funding for professional development and training opportunities for core staff, the perception of financial conflicts of interest or inconsistencies between core facilities within the same unit, and the perception that current institutional funding for cores is inadequate and inconsistent.

Cost

- A large number of core users expressed frustration with the high cost of services from core facilities and feel that the high rates discourage exploring preliminary research. The stability of recharge rates is important for their long term planning, and they desire transparency in cost calculations as users do not understand why rates are so high. There is also a strong sentiment from core users regarding the philosophy and expectation of core facilities to be fully supported through recharges. From their perspective, this philosophy leads to exorbitant recharge rates and the unnecessary and harmful curtailment of research. In addition, they felt the self-sustaining philosophy of cores limits the type of cores that are implemented, thus reducing competitiveness with peer institutions that have mostly abandoned such financial models and instead made strategic investments into cores.

"*Cores are essential to my success but they simply cannot work if they are expected to be 100% recharge supported. I've worked at 3 schools that are more highly ranked than U-M and one that is slightly lower ranked, core facilities costs at all four places were far more affordable because there was no requirement for the cores to pay for themselves. I avoided using the (redacted) core for many years due to cost, which probably hurt my research in the long run. I did not do certain experiments because the cost was going to be too high. The recent change to the pricing has made it possible for my lab to start using the (redacted) core by scheduling our experiments on nights and weekends.*." -- survey respondent (core user)

Leadership

- Some core staff indicated that their management had shortcomings in leadership capability, and lacked a clear vision for their core. Some of them experienced slow and opaque decision making from unit leadership.
- Over half (59%) of core administrator respondents indicated they do not have adequate resources or training to help them manage or oversee their core.

Staffing and professional development

- Core directors consistently shared a feeling of being understaffed in their operations, along with the inability to attract, retain and appropriately compensate expert staff, like data analysts. Core directors are often in competition with large corporations or industry for talent, with industry being able to provide considerably more compensation for equivalent positions. Understaffing can lead to deprioritization of professional development and growth, leading to further job dissatisfaction.
- Consistent feedback from core staff conveyed that there is little opportunity for a change in job title and an unclear career ladder. Although 60% of core staff respondents said they were provided with professional development or career advancement opportunities, these opportunities were not sufficient for core staff to feel engaged. There was also a concern about staff finding the time to do more professional development activities such as attending conferences or publishing their own research articles. Core staff find that the inability to conduct research causes their knowledge base to become outdated.

"*Let staff be involved in the decisions. Give staff more responsibilities like selling the services that we have to offer. Please do not let someone without direct involvement sell services to potential customers. Reward the staff for great ideas or provide them with the avenue to relay some ideas that they have. More involvement for staff so they do not feel like a mindless robot.*" -- survey respondent (core staff)

"*I wish there were more opportunities for internal grants submitted by core staff. I have ideas for programs that would leverage the shared lab facility that I manage to improve diversity and inclusion in STEM, and to increase access to STEM education, but I have been unable to find funding sources that allow non-tenured track professors or those without research-track appointments to submit applications. I feel my only options are to collaborate with a faculty member which, I fear, would result in my own labor not receiving any recognition (at best) or not pursue these ambitious programs which have the potential to make positive impacts on our local communities as well as society broadly.*" -- survey respondent (core staff)

Customer experience

- Core users can find turnaround times for service to be long, or time for equipment reservation to be limited; both delay research progress.
- Shared equipment does not have checkups or resets between sessions, so experiments can be affected by previous users.
- Several comments pointed out the lack of communication of status of a particular project in a pipeline (like a black box), and little communication if delays were incurred.
- Users also struggle with cores lacking standardized workflows and sample preparation protocols and identified variability in the quality of work across core facilities.
- Core users find that specific technical knowledge can be lacking in the core, and as a user, they need to contact the equipment manufacturer directly.

Information technology

- Core staff find that frequent changes in file servers and systems result in difficulty in maintaining organization and accessibility of data. Some current management software is too slow to navigate effectively. They also identified lack of training on new updates and new software as a pain point and some expressed the desire to be more involved in decision making.
- Core users identified that access to data on certain systems housed in core facilities is unreliable.

Communications

- A common theme from the core directors was the limited ability to communicate/advertise their services and capabilities to attract new users.
- Core users can also struggle with learning what resources are available to them and navigating how to get trained.

What Respondents Want to See Changed

Equipment, Space Planning and Operations

- Core directors desire support from administration/leadership to prioritize placing equipment in core facilities before it is considered for an individual laboratory. In addition, they desire the opportunity for intentional space planning for cores and the ability to co-locate with their user community. They would like to see their space designed to efficiently support workflow processes and to improve their working environment. They would also like to see bundling of equipment purchases to support a comprehensive workflow (i.e. large equipment purchased along with supporting, smaller equipment). They support the regular evaluation and replacement of equipment.
- Core users suggested that a mechanism for tracking progress of samples would be potentially helpful.
- Over 50% of the cores are collaboration-focused according to the core administrator respondents. Many cores contain deep expertise needed in particular data collection channels that, if valued, developed, and shared, has the potential to contribute to new research insights.

Financial

- Core directors and staff expressed the need for support for the budgeting process, and for business and financial modeling. Core directors expressed the need for financial support for staff salaries and space costs to reduce recharge rates, especially during business down cycles.
- Core directors and staff also want coordination of cores across multiple units, with collective negotiations with and support from vendors for materials and maintenance contracts. The goal would be to reduce duplication and increase efficiency and research productivity from an institutional perspective.
- Core users also emphasized the need for investment in core facilities - in equipment, expert personnel, and financial support to enable reasonable recharge rates, and the need for stability in recharge rates in order to plan long term projects, as well as the ability to obtain preliminary data without prohibitive costs.
- Core users also suggested subsidizing facilities to affordable levels or to benchmark levels at other institutions.
- 21% of core users are using an external service provider for core services that are currently available at U-M. The main reason (32%) is a lower cost than at U-M, followed by poor quality /service from U-M (25%), long delivery timeline of product/service (24%), limited services available at U-M (14%) or other (4%).

Training and Professional Development

- Core directors would like more robust training on the financial aspects of managing a core, with easily accessible guidelines for what is allowed to be on a recharge, and how to execute or update if there are changes (only 60% of core directors thought they were provided with adequate resources or training to manage or oversee the core).
- Core staff shared that they would benefit from more clearly defined expectations and additional opportunities for advancement. A career ladder would help staff to set personal goals and have a better understanding of their position and tasks.
- Core staff would also like to streamline workflow and team communication, and utilize LEAN concepts and accountability.
- Core staff would like to be more engaged with business and scientific aspects of the operation. They feel that broader knowledge of techniques/technologies would enable connection with other core staff with related expertise. They would also like more involvement in interacting with core users about services, however, customer service/difficult customer training was also suggested more than once.
- Core staff would like to see more training and updates on new software when it is acquired.
- Core staff would also like more opportunities to improve and update their knowledge base and skills, such as attending advanced workshops and scientific conferences, and feel that there should be an annual budget allocation to support this.
- One interesting comment was having more core facility involvement in manuscript preparation, as a core facility's role in ensuring rigor and reproducibility of research.

> "*...cores should have a more active role in making sure manuscripts submitted by the faculty are scientifically sound. Core directors/staff have a unique perspective on the most common artifacts and misinterpretations data from their instruments can have--and even more so, because they see a wider range of sample times, know more about certain limits of the techniques (like how globally applicable a certain technique or sample prep really is).*"
> -- survey respondent (core staff)

Coordination

- Core directors asked for a better understanding of and connection with other cores across the university, including a mechanism for improved coordination among the cores to best serve the users.
- Core directors also requested an enhanced listing of core best practices, including recharge rate setting.
- Core staff would like to see some consolidation of duplicate cores to allow better access to equipment, staff and resources, and to foster collaborations.

> "*Cores are investments in research infrastructure that are critical to the success of the institution. As we move towards collaborative discovery, cores play a vital role. Each core is unique in how they are conceptualized and formed and it is critical in recognizing that and letting them evolve. They however do all need to be evaluated and managed. Having guiding principles is helpful across UM. Having these principles set with the involvement of people who run the cores is important*" -- survey respondent (core administrator)

Data Support

- Core directors expressed the need for a larger commitment to resources for high performance computing and data management, the formation of data standards, as well as the need for a central "enclave" to store research data.
- Core staff would like to see a data policy and data management on an institutional level.
- Some would like to see standardized time tracking software that can be accessed on the network.
- Some would like to create workstations outside the lab with functional computers and webcams where operators could perform analysis and meet virtually with users or team members.
- Core users would like to see support for consistent, reliable data transmission. They also identify that while technical skills that generate data are often strong, that users are on their own to analyze data with little support.

> "*Although there are skilled technicians available to help, from a student perspective, we are often on our own to understand instrumentation and how to analyze data. This may be better targeted within the curriculum of different departments/programs, but a seminar series on instrument specific interpretation, analysis, and database navigation could go a long way towards improving the overall caliber of science coming out of the school.*" -- survey respondent (core user)

> "*User education. Some folks don't have the computational background to be able to use the different programming methods to work with these equipment/instruments. At the U-M wide level, can we offer workshops to familiarize students with the techniques that are used with these high-end instruments? This is a MAJOR issue. Mechanism to introduce those using high-data output on how to use/manage the data. Looking at basic techniques. Many grad students and PIs simply don't have those basic skills. Need to educate our new scientists because this is a skillset that more biological focused researchers will need to have more and more moving forward*." -- Focus Group Participant (Core Administrator)

Marketing

- Core directors expressed the need for a strong marketing capability for their cores, particularly with university faculty, that would include a dedicated marketing/communications person like those in the major academic departments.
- Core staff would like to see a single instrument search portal for students and faculty.
- Core users would like to see a core website that is easily searchable to find the service they need, that is updated regularly.

Peer Benchmarking

The committee identified national trends through a combination of discussions with peer institutions, information about peer institutions found via website search (Appendix G), and review of published reports, surveys, and articles. The overarching themes found are described below.

There are varying degrees of benefit to centralizing core management
Nationally, cores are often quite decentralized. A recent survey of 58 chief research officers at schools in the Association of Public and Land Grant Universities (APLU), including 30 R1 institutions, identified that cores report to a combination of units, including the central research office (83%), schools/colleges (67%), centers/institutes (42%), and departments (42%) (Carter et al, 2019).

The three leading practice institutions that were interviewed for this assessment all operate their central core support structure somewhat differently, but they generally utilize hybrid or blended models that include local management as well as centralized oversight and investment. The subcommittee heard several reasons why at least some degree of core management centralization has benefited these institutions. First, centralization allowed the institutions to address the overlap of cores and sunset or combine them as needed to eliminate redundancy. Doing so was a lengthy process for each organization, but ultimately allowed for more coordinated and strategic planning as well as institutional investment in cores. This was confirmed in a recent Agilent survey of over 100 institutions which found that core staff at institutions with central oversight typically spent 39 hours per month on administrative tasks versus 44.7 hours at institutions that did not have central administration (Strubczewski, 2019).

Second, centralized support provides safeguards to assure institutional compliance with fee for service regulations. Third, having a central core office or program provides support by offering funding and financial resources, operating as a clearinghouse to know what cores exist, developing and providing best practices, hosting core leadership meetings and professional development opportunities, and advocating to leadership for support that is needed by the cores.

It is also important to note that the subcommittee heard that the NIH has been supportive of instrumentation grants being awarded to shared research facilities and that core centralization continues to be a national trend.

The development of a thoughtful change management process is critical to success
The interviewees spoke about both the importance and challenge of change management when developing a centrally coordinated core program. Interviewees shared that successful approaches included building trust and assuring faculty that their needs would still be met even if the structure changed, committing that the faculty directors retain scientific control of the cores, and emphasizing a culture of collaboration to help stakeholders embrace cores as an essential part of the shared research operation (as opposed to being individual endeavors). The subcommittee also heard about the importance of establishing advisory boards composed of representatives from various units to oversee core policies and procedures, evaluation, investment, marketing and communication, and to navigate the cultural differences between units and disciplines. Another important strategy mentioned was articulating the benefits and incentives for the cores to consolidate so that they feel supported. Finally, interviewees shared important pitfalls to avoid when undergoing a core centralization change process, including being sure to factor in the geography of the campus and the physical location of the cores and users, being mindful about not creating burden by requiring additional administrative processes in a new system, and recognizing that centralization involves "culture change" which takes time to implement.

> "*Through careful strategic planning, coordination, investment, and oversight, we have developed a management model that addresses these structural/cultural differences, needs, and challenges. Our model is a partnership among faculty, core directors, and central administrators that leverages their combined resources to meet the needs of researchers*." (Hockberger et al, 2018)

Cores require unique leadership and administrative skills
Interviewees shared that specialized skill sets are needed to successfully run core operations. First, scientists who are particularly talented in the lab do not necessarily have strong personnel management skills. It is important to acknowledge this and to create professional development opportunities that will help these leaders build and strengthen this expertise. Second, core administration requires a focus on business and prospect development that most department administrators and financial specialists are not accustomed to doing. There is a specialized nature to managing core facilities that includes strategizing and, as one interviewee stated, seeing "science as business." In a survey of chief research officers, "tenure track faculty were rated as significantly less effective at directing/supervising core facilities than administrators and professional staff," suggesting additional training or onboarding may be necessary (Carter et al, 2019).

The success and value of cores must be measured, but not exclusively by traditional metrics
Interviewees highlighted that research and scholarly activity metrics such as publications and grant support are really challenging for cores to measure because they often do not know what the outcomes are after data have been generated in a core. In addition, while maintaining a structured evaluation is important, the success of a core cannot be just finance-driven. Interviewees shared key performance indicators could include evaluation of administration and

leadership; research and technical staff; customer base, usage and satisfaction; resource management; education and outreach; communication and marketing; and self-assessment. One interviewee noted a “balanced scorecard approach” with the categories previously mentioned as well as use of external reviews. Additional metrics could include core ratings in grant reviews, number of core and instrumentation grants awarded, and core directors who have been recruited to other core leadership positions within and across institutions.

Institutions are responding and structuring themselves in a wide range of ways
Based on a high level assessment of how cores are managed/supported at 14 peer institutions (selected on the basis of similarities in size of research enterprise, region, budget model, and/or public/private), the committee observed the following trends:

- *Centralized staff support for core management is limited.*
  Of the 14 institutions considered, only 4 (Northwestern, University of Wisconsin, Vanderbilt and UC Davis) appear to provide central staff support for cores. Stanford provides support via a committee and working groups but the other 9 do not present evidence of any centralized coordination.

- *Centralized support for cores is independent of the budget model (i.e., degree of budget decentralization).*
  Some schools with responsibility-center management (RCM) models (or hybrid models) retained centralized core support including Wisconsin, Vanderbilt, Northwestern, and UC Davis. The degree to which the offices of their senior research officer provide resources or oversight for cores, however, is highly variable--ranging from active management and funding of cores to light coordination.

- *All 14 institutions provide, at a minimum, a listing of available core facilities/services on a publicly accessible website*.
  Of the 14 institutions we assessed through public information, 8 provide a searchable database while the other 6 offer a list format. The 2018 Agilent survey revealed 64% of institutions maintain an easy to use/find list of core facilities (Strubczewski, 2019).

- *Almost half use a coordinated management system.*
  Of the 14 institutions considered, 4 appear to use iLabs, one uses Stratocore PPMS and another (Northwestern) uses an internal system. Scheduling/management systems for the other 8 were not found.

- *National organizations are helping drive change.*
  The Federation of American Societies for Experimental Biology, for example, has released three prominent reports on the importance of improving core resources. The benefits they outlined focus on four primary areas (FASEB 2017a):
    - Better internal funding and business operations;

- Improved discoverability and access;
- Better planning, coordination, and assessment strategies among stakeholders (including funding agencies)
- Enhanced professional development

Review of Existing Operations and Internal Support Functions

In addition to the home units of core users and staff/administrators, several other units support cores in a variety of ways across the institution. Based on these discussions, and the survey results above, a number of themes emerged, including the following:

Cores provide a variety of critical services to the research community

- Based on survey results, users are driven to use cores at U-M by equipment/resource availability (40%), technical knowledge accessibility (29%), cost (22%), and internal collaborations (8%).
- Some cores provide required compliance and monitoring support such as Animal Husbandry and Housing within the Unit for Laboratory Animal Medicine.
- Service-based cores typically include standard research instruments such as NMR, basic microscopy and mass spectrometry. These cores provide user training and then equipment is available for direct user access.
- There are also expertise-based cores that may have standard research instruments along with higher-end resources that require core technical staff support but could also require core technical staff assistance with method development, software and/or data analysis.

Cores are not uniformly defined or managed at U-M

- The definition of a core is not universally consistent across campus. Considering multiple definitions internally and also from peer institutions and national organizations, the committee developed an internal working definition: “Cores are shared facilities or centers of expertise which offer services, equipment, and other resources to researchers and investigators both internal and external to U-M.”
- Availability of cores to campus researchers is variable, some more unit specific and proximity driven (and choosing not to market services broadly despite broad institutional investment/support of the core).
- This challenge is not unique to U-M. A recent report highlights the wide range of institutional roles/offices that support cores (here termed “shared research resources” (FASEB, 2021), which we find to be an accurate representation of the core ecosystem at U-M as well (Fig. 1).

Figure 1: The ecosystem surrounding cores (here termed "shared research resources") expands from the local level (core staff and users) to university administrators and external sponsors (From FASEB, 2021)

The financial models of cores vary widely

- Most cores cannot financially sustain themselves with a recharge and, as the survey indicates, the majority (72%) rely on internal subsidies of one kind or another.
- Nationally, institutions fund cores through a variety of mechanisms including "user fees (96%), central and/or decentralized funding of directors or staff (77%), annual general fund allocation (62%), a designated portion of Facilities & Administration (F&A) reimbursements (46%), and internal grant programs (31%)" (Carter et al, 2019).
- Sustainability plans for each core vary widely, if available at all. Common issues include 1) funding support for recharge deficiency, 2) funding use when at surplus, 3) recharge rate impact when deficiency is incorporated into renewal rates and 4) variability of core revenue (internal and external) from month to month and year to year. Moreover, it remains inconsistent how cores are funded when start-up funds run out (e.g., impact on recharge rates).
- Recharge rates are not always made public or posted consistently on websites for transparency and financial planning for grant submissions. From the survey, 43% of cores posted their rates on their website, 27% posted it on MiCORES, 15% posted on the Research Cores Website, 3% posted it somewhere else, and 13% didn't post it publicly.
- Cores often receive non-financial compensation for research services outside of recharge rates, such as inclusion of core faculty effort on future grant applications, or inclusion of core faculty/staff as authors on publications resulting from work done by the core.
- The use of these methods is inconsistent between cores and in some cases expectations are unclear beyond recharge (e.g., requiring recharge and co-authorship). National authorship guidelines state that if authorship is anticipated, it is preferably established at the beginning of the project so that both the customer and the Core researcher are cognizant of each other's criteria" (ARBF, 2010).

- A multi-pronged approach to financial, administrative, and staff support as well as strong vendor relationships seem to be the key to a highly organized, well-funded core. (e.g., the BRCF Metabolomics core)

Decentralization can lead to inefficiencies

- Cores are highly decentralized within the Ann Arbor research community, operating at levels of departments, divisions, schools/colleges, center/institute, and university-level (e.g., OVPR). This decentralization leads to a variety of reporting lines and financial oversight, some for historical reasons that are no longer applicable.
- Equipment and service contracts are negotiated and managed per core and/or per unit, not collaboratively or collectively to optimize savings and potential vendor relationships.
- Cores across U-M offer various rates for the same equipment and/or services (often due to varying unit subsidies and/or obligations).
- Redundancies in services and across campus can lead to internal competition, which financially impacts the core operations by reducing customer bases. However, because of a lack of coordination across units, this competition does not often lead to lower costs for users.

The cores website has laid a good foundation for discoverability

- The cores.research.umich.edu website has served as a valuable resource for users as well as campus leadership. It serves as one of the first true campus-wide efforts to catalogue and publicly list research cores from across U-M.
- There are currently 95 cores listed on the site and, since it launched in January 2019, there have been 11,528 unique page views. A recent addition of 12 filterable service categories (areas of expertise) make it easier for users to navigate if they do not know where to begin.
- Although the website was initiated through a collaboration between the Medical School Office of Research and Biosciences Initiative, it is inclusive of cores outside the life and biomedical sciences (e.g., engineering, social, and data sciences).
- For the 95 cores currently listed, inclusion on the website was voluntary. These cores represent a subset of the 334 recharge IDs identified by the Office of Financial Analysis (OFA), which is currently developing a process to streamline reporting processes for recharge rates specific to cores.
- Management of the website is currently overseen by the Medical School's Biomedical Research Core Facilities (BRCF) office and requires manual updating and validation of information such as core descriptions, rates, URLs, and contact information.

The success of MiCORES highlights the value of central support

- Initially adopted by the BRCF in Fall 2013, Agilent CrossLab iLab Operations Software is a core facility management system designed to support operations for centralized labs and shared resource facilities.
- In 2018, through a collaboration between the Biosciences Initiative, OVPR, and the Medical School Office of Research, the license was expanded institutionally and the software was branded internally as MiCORES.
- MiCORES is currently being implemented with cores, labs and shared resource facilities across the university community and is offered at no cost to cores.
- MiCORES benefits core administrators and staff because it simplifies scheduling and billing and provides high-level metrics regarding core operations. It also integrates with

M-Pathways and therefore also allows for greater financial accountability.

- The system also benefits users as more cores across U-M implement, and familiarity with interface and system is more consistent across campus. Of the 95 cores that are currently listed on the cores website, 29 use MiCORES and have it listed on their core profile page.
- The initial 2-yr subscription cost for 30 licenses was $145k/yr, with an expansion to a 50 core site license in 2019 at $201k/yr.
- The staffing to implement the system was provided by Biosciences, Med and OVPR initially, is currently entirely provided by OVPR, and is moving to ITS in July 2021.

Equipment Funding and Grant Competitiveness

Lack of coordination leads to inefficiencies in purchasing power

- Procurement Services has negotiated with select suppliers (Strategic Suppliers) to provide discounted costs available to the U-M community. Currently, this list includes eight "equipment and apparatus" suppliers and one "equipment service agreement" supplier.
- Discussions are currently ongoing between Procurement Services and members of the research community in an informal BSI/Research Efficiencies Committee to identify current state and potential improvement in the area of service agreements and PO conception to receiving.
- Anecdotally, the committee also heard about attempted negotiations failing with potential suppliers but it is unclear how well various internal units (e.g., Procurement, Business Engagement Center, schools/colleges, cores) are coordinating in these attempts.

U-M is underperforming in seeking out and receiving equipment grants

- Of the 13 institutions to receive at least nine S10 awards since 2016, U-M is underperforming based on the size of its NIH portfolio (see table below). U-M ranks 3rd overall in active NIH funding but ranks 12th out of 13 in terms of S10 awards per $100M of funding.

Institutions with most NIH S10 awards since 2016 (ranked by total awards)									
Institution	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**	**Active NIH Dollars***	**Awards per $100 million**
Stanford	3	3	7	4	2	4	23	745,945,129	3.1
Vanderbilt	6	4	3	2	2	4	21	595,759,224	3.5
UCSF	6	2	2	4	4	2	20	877,293,516	2.3
Wash U	2	2	4	6	2	4	20	686,045,237	2.9
Johns Hopkins	3	2	5	4	2	1	17	980,638,661	1.7
Pittsburgh	2	3	4	1	2	2	14	755,820,472	1.9
UC Davis	3	1	1	4	4	0	13	375,158,551	3.5
Wisconsin-Madison	0	1	5	2	3	2	13	455,455,924	2.9
Northwestern	1	1	2	5	3	0	12	537,692,540	2.2
Michigan	2	0	1	3	2	3	11	766,111,551	1.4
Baylor	1	1	3	1	5	0	11	434,334,111	2.5
Washington	2	5	0	1	1	0	9	707,757,453	1.3
Minnesota	4	0	1	0	3	1	9	426,871,614	2.1

**As of June 21, 2021*

- Based on an analysis of NIH S10 submissions over $500,000 from 2016-2020, U-M researchers had a 36% success rate. Average success rates for S10 proposals across NIH is 27%. Therefore, it stands to reason that the overall strength of U-M proposals is high but we are collectively not taking advantage of this opportunity to strengthen equipment on campus, regardless of whether or not it will be housed in a core.
- U-M has received 5 major research instrumentation (MRI) awards since 2016 from NSF. 31 other institutions received the same or more (see table below). When normalized to the total NSF dollars received, U-M ranks second overall in NSF funding but last of 32 institutions with 1.5 awards per $100M from NSF (see Appendix H).

There are not enough incentives and/or too many barriers to submitting equipment grants

- Institutional commitment (e.g., cost sharing, staff and space support) is a reviewed criterion for S10 proposals. Such commitment is also required and/or favored for other federal equipment grants. Institutional processes and resources (e.g., support letters, budget templates, equipment negotiations, and funds towards hiring new technical staff) have been critical components for successful proposals.
- Even if successfully funded, PIs report challenges in working with Procurement to acquire assets. Multiple anecdotes reported by PIs describe that they were forced to go back out to bid for equipment they explicitly wrote into proposals.

NIH is the largest external source of U-M acquired assets

- A total of 138 assets were identified in the inventory query, for a total of $36.4M in external-sponsored expenses. NIH provided funding for 42 assets (32% of expenses). DOD provided 28 assets (18% of funding), NSF provided 20 assets (19% of funding). (Appendix D)
- The R and U series grant mechanisms provided for the vast majority of the NIH-sourced equipment (37 items out of the 42 NIH sponsored acquired equipment). The S10 series provided for the other 5 pieces of research equipment.
- Other grants mechanisms for equipment included NSF Major Research Instrumentation (MRI), DOD Defense University Research Instrument Program (DURIP), and the DOE Cesium Irradiator Replacement Project (CIRP).

Cost-sharing practices for equipment vary widely across the institution

- Institutional commitment is a reviewed criterion for NIH S10 proposals and oftentimes U-M's institutional support is not as robust as peer institutions.
- Within U-M, Schools/Colleges/Institutes have different cost share processes.
- Multiple uncoordinated central sources of cost share (e.g., OVPR, Provost, Biosciences Initiative) obscures line of sight into which cores/units are receiving institutional investments, and obscures the need for broader strategic investments.

Recommendations

Cores are critical for U-M to attract and retain talent in many fields and to produce cutting-edge, impactful research. Based on the findings described in this report, however, there is significant opportunity to improve the institutional support of cores. For the purposes of this report, the committee developed high-level recommendations that identify initial priorities for developing a long-term plan in support of cores and the research enterprise as a whole.

1.) **Set an institutional strategic roadmap for cores at U-M**
Establishing a long-term plan for improving excellence in U-M cores is an important step in the path to better supporting the research community. While the outcomes are yet to be determined, it is critical that the planning process include:
    - Cross-campus collaboration across leadership of the major units that operate cores.
    - Acknowledgement, based on conversations with other institutions that underwent similar transformations, that leadership engagement is required and that any major changes will need to take place gradually (i.e., over 2-5 years).
    - Identification of what degree of centralization will work for U-M, and which units should oversee/manage institutional resources moving forward. Building off the success of MiCORES and the Michigan Research Cores website, leadership must identify how to move forward productively to support cores across campus for the betterment of the entire research community.
    - Public announcement of the planning process so as to send a strong signal to the research community, including core staff/administrators and users that rely heavily on cores, that U-M understands the needs and is working towards addressing these issues.
    - Development of a common institutional definition/designation of a core (including multiple types of cores, or other terms as appropriate), with clear expectations for access, discoverability, pricing, and other parameters.
    - Awareness that such an undertaking will require dedicated OVPR faculty/staff time, working in close collaboration with unit leadership (e.g., RADs) and the core community, and that increased support may eventually require more permanent long-term staffing and funding to support the plan.

2.) **Proactively build community within the U-M cores ecosystem**
Creating a network(s) or community of practice to share challenges and best practices, and inform U-M research leadership, will help encourage cross university learning and collaboration to support the success of U-M cores. This may include:
    - Creating a forum for core directors (faculty and staff), administrators and/or core staff through events (e.g., annual core facility day and/or a symposium), newsletters, online communities, and/or other opportunities.
    - Providing training in core organizational leadership and management functions to raise the performance level of the entire core system.
    - Encouraging broader participation in membership organizations like the Association for Biomolecular Resource Facilities.

- Establishment of incentives for inter-core collaboration and efficient operations including funding, administrative support, and staff development. The Medical School has an approach somewhat like this and could be a place to start.

3.) Consider creating a career ladder system for core management and staff

Per a recent national report, “professionalizing (a) career track could not only lead to greater job security, it could increase the value facilities provide to the research community.” (FASEB, 2017b). Core management and staff do fundamentally different work than the job classifications that are currently available at U-M, but provide critical functions that support research, ensure data quality, and drive innovation. Given inconsistent job classifications and salary expectations, it can be difficult to recruit and retain core directors due to the competitive salaries offered by industry opportunities. These issues could be addressed by:

- Establishing core-specific positions and descriptions, with pathways for advancement that are distinct from research faculty or generic research staff roles.
- Commissioning a benchmarking survey for compensation to ensure competitiveness for the highly skilled talent required to manage cores.
- Consider expanding PI eligibility to include core staff/directors that are not on the research faculty line. Current guidance states that “neither research associates, research assistants, nor other staff may serve as independent U-M PIs, regardless of experience and education.” Core staff may fall somewhere in between “research associates/assistants” and research faculty.

4.) Review the recharge rate process and user costs

Given the frustration expressed by core users with the high and variable cost of core services, the recharge rate setting process must be examined. This may include action steps such as:

- Conducting an internal U-M survey to determine how many faculty are utilizing services outside of the university because of the prohibitive costs. A Business Objects report of procurement data may also help illustrate the current state.
- Conducting a study of comparable universities to see what drives the recharge rate setting process. Note that Vanderbilt has a recharge rate range of +/- 25% vs U-M’s range of +/- 5%. These ranges drive very different decisions for cores. The larger range gives more flexibility for core leadership to manage business cycles.
- Creating and evaluating a U-M financial model to improve sustainability and accountability of cores. This should take into account ongoing expenses and ensure marketable, competitive rates.
- Evaluating other models to reduce costs such as a regional consortium similar to that established at universities across Chicago (Northwestern, U. Chicago, UIC) with a longstanding MOU that allows "open access" to researchers at all three institutions to cores at rates for internal faculty.

5.) Invest in strengthened resources for core data management and IT support

The cores are producing up to petabytes of data and yet there is not a clear infrastructure to safely support or manage this information. Other universities have institution-level data policies and storage, but U-M does not. In alignment with the priorities of the Research Support Analysis and Data Service Needs Committee (charged by VPR and CIO in 2021), opportunities for improvement include:

- Expanding/centralizing data storage and access for cores.
- Providing IT support (for directors and staff) and consistent, reliable data transmission (for users).
- Creating data policy as well as data management and data transfer best practices for core facility generated research data.

6.) **Provide campus-wide guidance for core operations, funding, and other practices**
Institutional guidance is needed to support the success and growth of U-M cores. The development of best practices and guidelines should be informed by the core community (see #2). Such guidance may include:

- Developing and issuing guidance may require the establishment of a standing committee (facilitated by OVPR) of core faculty and staff, and representatives from other support units.
- Suggesting consistent recognition of core services, including publication and authorship expectations, inclusion on grants, and/or acknowledging other scholarly contributions.
- Developing tools such as template statements of work agreements for cores and users so that expectations for recognition are clear from the beginning.
- Developing systems to track credit in publication metadata and/or other systems, such as using ORCID IDs or other unique identifiers (Haak et al, 2017), and incentivize users to credit/cite cores on their publications (e.g., see Vanderbilt's S10 program).
- Providing clear guidance on financial expectations for core sustainability and unit subsidies, with the recognition that there may not be one single best approach given the variety of cores that exist at U-M.
- Ensure that U-M is maximizing leverage with suppliers of equipment, materials and service contracts across the institution, and that cores are aware of such negotiated rates and other resources.
- Defining clear metrics for assessing core performance. Although "there are various strategies for evaluating the performance of core facilities, and no single approach will work for all institutions…an important first step is the creation of a set of performance standards and metrics that are appropriate for your institution." (Hockberger et al, 2018).

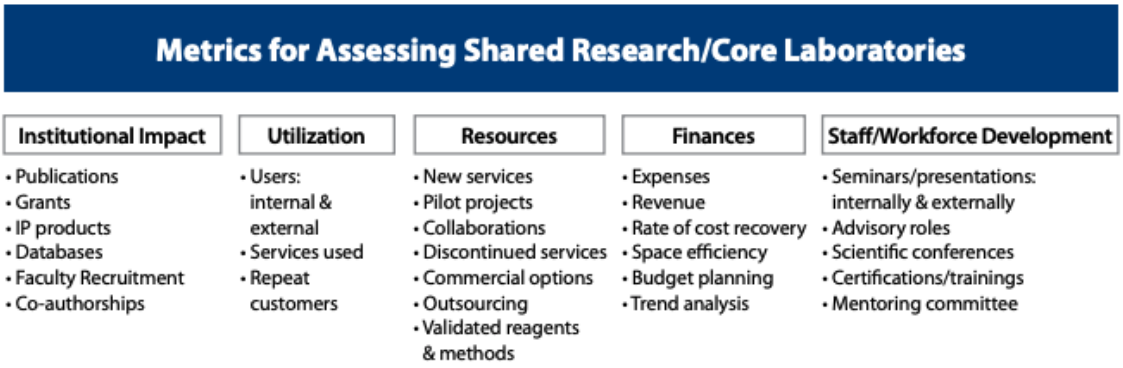

Figure: Potential metrics for assessing cores (here termed "shared research/core laboratories") spanning operations, collaborations, professional development, and scientific impact (from FASEB, 2021).

7.) **Break down administrative barriers and incentivize equipment proposals**
The committee identified several opportunities to enhance the process for submitting equipment proposals through strengthened research development and administration services, including:

- Making a standard boiler plate institutional letter of support (see Appendix I) available for equipment proposals (not just for NIH S10s).
- Providing project teams with assistance for writing equipment proposals and understanding the administrative process (e.g., how-to webpages/documents).
- Expanding the learning opportunities for faculty and project teams specifically pertaining to the intricacies of these types of proposals. It may be helpful to ask successful project teams for pointers to include into the training offerings. The S10 grant workshops have been a good model for this with encouraging results.
- Expanding research administrator training (e.g., RAAC training committee) to encompass core management and/or equipment proposal submissions.
- Developing an incentive program to reward cores with subsidies or non-financial support for seeking external funding for new equipment and/or other upgrades.

8.) **Coordinate internal investments and cost-share for cores and equipment**
The Provost's Office, OVPR, and other central units must coordinate on their cost-sharing expectations and commitments. The committee's suggestions for supporting this include:

- Coordinating the primary central cost-share policy (operated by OVPR) with faculty recruitment/retention negotiations if/when equipment or shared research facilities are included.
- Considering a policy that if central support is requested, equipment must be used for a core or other centralized, widely accessible facility and must be available to the wider campus community.
- Offering more education for investigators/administrators regarding what constitutes institutional support (consider the NIH's definition of institutional commitment), the base level of support the infrastructure of the institution provides, and how to demonstrate institutional support in equipment proposals.
- Advertising broadly available funding opportunities to aid with equipment proposals.

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Appendices

A. Cores Assessment Committee Charge
B. Peer Benchmarking Interviews Questions Template
C. Cores Assessment Survey
D. Source of Funds for Sponsored Acquired Equipment
E. Cores Assessment Survey Findings Summary
F. Cores Assessment Survey Themes
G. Peer Benchmarking Summary
H. NSF MRI Awards Since 2016
I. Sample Institutional Letter of Support Template

Appendix A:
2021 Cores Assessment Committee Charge

Statement of Purpose	Convene a campus-wide committee of faculty and staff to assess the current needs on how cores operate, what resources are needed to improve efficiency, and other recommendations for how our cores can better support the broader research community.
Sponsorship	Rebecca Cunningham, Vice President for Research Roger Cone, Vice Provost and Director, Biosciences Initiative
Objectives	● Produce a report for university leadership outlining needs from research community related to the ecosystem of research cores or other shared facilities ● Identify possible solutions for improving efficiencies and better supporting the research community
Scope	● Interviews with faculty and staff groups, as well as external users, to form needs assessment from research community (i.e., what's working well, what's not) ● Review of existing campus-wide resources like the cores website and MiCORES implementation ● Review of proposal submissions and successes for large equipment grants from NIH, NSF, and others ● Review of benchmarking data ● Work with stakeholders across campus to identify and collect relevant data and information about the ecosystem of cores and related shared facilities and resources (e.g., recharge and usage rates, inventories of equipment, etc)
Timeline	Committee convenes in early 2021 with a report due by June 1
Chair(s)	Nick Wigginton (OVPR) Kicki Hakansson (LSA/Chemistry)
Membership	Cassie Wong (BRCF/med) Alan Taub (COE) Cathy Andrews (LSI/LSA) Martin Clasby (Pharmacy) Wes McGee (Taubman) Jennifer Ohren (BSI) Melissa Dyson (ULAM) Melissa Karby (OVPR) Jeannette Jackson (ISR) Yu Leo Lei (Dentistry)
Staff support	Wendi Mohl in OVPR will provide administrative support for scheduling meetings. Sabrina Ervin will serve as project manager.

Appendix B:
Peer Benchmarking Interview Questions Template

1. How do you determine what is a core facility?
2. How do you define the value brought to the institution by the cores?
3. What is your investment strategy when it comes to core facilities?
4. How do you provide guidance to cores - are they integrated (centralized) or handled separately?
5. What do you wish were different?
6. What are the national trends that you see happening with management of core facilities?

Appendix C:
Cores Assessment Survey

Q2 Which category best describes your role/association with U-M cores?

- ☐ Core Customer
- ☐ Core Director / Core Administration
- ☐ Department Chair / Associate Dean
- ☐ Facility Manager / Facility Administrator
- ☐ Information Technology / Other Staff
- ☐ Lab Manager / Core Manager / Managing Director
- ☐ Staff Scientist / Researcher / Technician

Skip To: Q13 If Which category best describes your role/association with U-M cores? = Staff Scientist / Researcher / Technician
Skip To: Q13 If Which category best describes your role/association with U-M cores? = Information Technology / Other Staff
Skip To: Q19 If Which category best describes your role/association with U-M cores? = Core Customer

Q3 Which service model most accurately describes your core facility's operations?

- ☐ Customer service focused
- ☐ Collaboration focused
- ☐ Both / Combination

Q4 Which business model most accurately describes your core facility's operations?

- ☐ Equipment based
- ☐ Service / Project based
- ☐ Both / Combination

Q5 How many unique customers do you typically have each year?

- ☐ Less than 10
- ☐ 10 > 50 (more than 10, less than 50)
- ☐ 50 > 100 (more than 50, less than 100)
- ☐ > 100 (more than 100)

Q6 Do you receive funds beyond what you recover from recharge?

- ☐ Yes
- ☐ No

Display This Question:
If Do you receive funds beyond what you recover from recharge? = Yes

Q6a What type of funds do you receive? (Select all that apply)

- ☐ Internal support (Provost)
- ☐ Internal support (School / College / Department)
- ☐ External support (Sponsored Funds)

- ☐ Other _____

Q7 Where do you post your approved U-M recharge rates? (Select all that apply)

- ☐ Unit Website
- ☐ Research Cores Website (cores.research.umich.edu)
- ☐ MiCORES
- ☐ Not posted / Not applicable
- ☐ Other _____

Q8 Do you collaborate / interact regularly with other cores?

- ☐ Yes
- ☐ No

Display This Question:
If Do you collaborate / interact regularly with other cores? = Yes

Q8a In what way(s)?

Q9 Which of the following funding opportunities for equipment have you used/are you aware of?

- ☐ NIH
- ☐ NSF
- ☐ State of Michigan
- ☐ Department of Defense
- ☐ Department of Energy
- ☐ Internal grant programs
- ☐ Private funding (e.g., industry, foundations)
- ☐ Other _____

Q10 Which of the following funding opportunities for software have you used/are you aware of?

- ☐ NIH
- ☐ NSF
- ☐ State of Michigan
- ☐ Department of Defense
- ☐ Department of Energy
- ☐ Internal grant programs
- ☐ Private funding (e.g., industry, foundations)
- ☐ Other _____

Display This Question:
If Which of the following funding opportunities for equipment have you used/are you aware of? = NIH
Or Which of the following funding opportunities for software have you used/are you aware of? = NIH

Q10a NIH funding type:

- ☐ U grants
- ☐ R grants
- ☐ P grants
- ☐ S grants

Display This Question:
If Which of the following funding opportunities for equipment have you used/are you aware of? = NSF

Q10b NSF funding type:
- ☐ Major Research Instrumentation grants
- ☐ Mid-scale Research Infrastructure grants
- ☐ Center grants

Q11 Do you create an annual report to document core metrics (volume, customer count/type), financials, subsidies, and/or publications?
- ☐ Yes
- ☐ No

Display This Question:
If Do you create an annual report to document core metrics (volume, customer count/type), financials... = Yes

Q11a Who receives that report?

Q12 Do you feel you are provided with adequate resources or training to help you manage or oversee your core?
- ☐ Yes
- ☐ No

Display This Question:
If Do you feel you are provided with adequate resources or training to help you manage or oversee yo... = Yes

Q12a Can you provide examples of materials/training/etc. that you received?

Display This Question:
If Do you feel you are provided with adequate resources or training to help you manage or oversee yo... = No

Q12b What resources would be helpful?

Q13 What are the strengths of your core / facility operations?

Q14 What are the pain points for your core / facility?

Q15 If you were given a "clean sheet" of paper with the ability to redesign your core, what would you do? (not including the impact of COVID)

Q16 Are you aware of cores at different institutions that do things that you wish you could do here at U-M?

- ☐ Yes
- ☐ No

Display This Question:
If Are you aware of cores at different institutions that do things that you wish you could do here a... = Yes

Q16a Who / Where are they?

Display This Question:
If Are you aware of cores at different institutions that do things that you wish you could do here a... = Yes

Q16b What do they do differently?

Display This Question:
If Which category best describes your role/association with U-M cores? = Staff Scientist / Researcher / Technician
Or Which category best describes your role/association with U-M cores? = Facility Manager / Facility Administrator
Or Which category best describes your role/association with U-M cores? = Information Technology / Other Staff

Q17 Do you feel you are provided with professional development or career advancement opportunities?

- ☐ Yes
- ☐ No

Display This Question:
If Which category best describes your role/association with U-M cores? = Staff Scientist / Researcher / Technician
Or Which category best describes your role/association with U-M cores? = Facility Manager / Facility Administrator

Or Which category best describes your role/association with U-M cores? = Information Technology / Other Staff
And Do you feel you are provided with professional development or career advancement opportunities? = Yes

Q17a Can you provide examples of those opportunities?

Display This Question:
If Which category best describes your role/association with U-M cores? = Staff Scientist / Researcher / Technician
Or Which category best describes your role/association with U-M cores? = Facility Manager / Facility Administrator
Or Which category best describes your role/association with U-M cores? = Information Technology / Other Staff
And Do you feel you are provided with professional development or career advancement opportunities? = No

Q17b What professional development opportunities would be helpful to perform your job-related tasks and/or improve job satisfaction?

Q18 Is there anything else that you would like to share?

- ☐ Yes
- ☐ No

Skip To: End of Survey If Is there anything else that you would like to share? = No

Q18a What would you like us to know?

Skip To: End of Survey If Condition: What would you like us to k... Is Displayed . Skip To: End of Survey.

Q19 What school/college/unit are you in?

- ☐ Architecture & Urban Planning
- ☐ Art & Design
- ☐ Business
- ☐ Dentistry
- ☐ Education
- ☐ Engineering
- ☐ Environment and Sustainability
- ☐ Information
- ☐ Information Technology
- ☐ Institute for Social Research
- ☐ Kinesiology
- ☐ Law

- ☐ Literature, Science, and the Arts
- ☐ Medicine
- ☐ Music, Theatre & Dance
- ☐ Nursing
- ☐ Pharmacy
- ☐ Public Health
- ☐ Public Policy
- ☐ Rackham School of Graduate Studies
- ☐ Research
- ☐ Social Work
- ☐ U-M Dearborn
- ☐ U-M Flint

Q20 What is your position at the university?

- ☐ Professor / Associate Professor / Assistant Professor (tenure and research)
- ☐ Research Scientist / Research Investigator
- ☐ Postdoc / Graduate student / Undergraduate student
- ☐ Staff

Q21 Are you currently a PI on a sponsored grant?

- ☐ Yes
- ☐ No

Display This Question:
If Are you currently a PI on a sponsored grant? = Yes

Q21a From which source:

- ☐ Federal
- ☐ Foundation
- ☐ Industry

Display This Question:
If From which source: = Federal

Q21b Which agency?

- ☐ Department of Defense
- ☐ Department of Energy
- ☐ NIH
- ☐ NASA
- ☐ NSF
- ☐ Other _____

Q22 How do the cores that you interact with enhance research excellence and productivity?

Q23 What limitations do you experience / perceive when it comes to using cores at U-M?

Q24 What drives your decision to use a campus core / facility?

- ☐ Equipment / Resource availability
- ☐ Technical Knowledge accessibility
- ☐ Cost
- ☐ U-M collaborations
- ☐ Other _____

Q25 Do you currently use an external service provider for equipment, services, and/or consultation that is currently available at U-M?

- Yes
- No

Display This Question:
If Do you currently use an external service provider for equipment, services, and/or consultation th... = Yes

Q25a Why?

- ☐ Lower cost
- ☐ Limited services available at U-M core
- ☐ Poor quality / service from U-M core(s)
- ☐ Delivery timeline of product / service(s)
- ☐ Other _____

Q26 Is there anything else you would like to share?

- ☐ Yes
- ☐ No

Display This Question:
If Is there anything else you would like to share? = Yes

Q26a What would you like us to know?

Appendix D:
Source of Funds for Sponsored Acquired Equipment

Query results of sponsored acquired equipment over $100,000 that was purchased in the last five fiscal years

Sponsor	Grant Mechanism	Count of Mechanism	Sum of Dept Cost
COVID		**9**	**9**
	State of Mi	2	$221,585
	FEMA	7	$1,197,519
DARPA		**1**	**1**
	Focus Center Research Proposal	1	$421,793
DOD		**28**	**28**
	DURIP	22	$5,190,493
	MURI	3	$594,411
	Space Vehicles	1	$314,763
	Young Investigator Program	1	$169,830
	Long-Range Science and Technology Projects BAA	1	$134,039
DOE		**8**	**8**
	Accelerator Scholarship	1	$132,400
	CIRP	1	$254,655
	Next Generation Photovaltaic Technologies II	1	$267,450
	Nuclear Infrastructure	2	$301,323
	REMOTE	1	$126,364
	Supertruck	1	$512,403
	University Turbine Systems Research (UTSR)	1	$133,780
Foundation		**6**	**6**
	Emerald Foundation	1	$100,020
	Pediatric Epilepsy Research Foundation	1	$108,692

	Target ALS Foundation	1	$109,700
	Open Philanthropy Project	1	$370,765
	Prostate Cancer Foundation	1	$100,000
	Sloan Foundation	1	$567,000
Industry		**6**	**6**
	Ascentage Pharma	1	$116,712
	Ford Motor Co	4	$921,775
	Infoscitex	1	$405,448
Internal		**12**	**12**
	N/A	12	$3,251,092
Navy		**1**	**1**
	Young Investigator Program	1	$188,143
NIH		**42**	**42**
	R00	1	$333,565
	R01	22	$4,779,047
	R35	8	$1,706,780
	S10	5	$3,802,768
	U01	3	$549,794
	U24	1	$153,829
	U2C	2	$415,420
Non-Profit		**1**	**1**
	HHMI	1	$907,818
NSF		**20**	**20**
	Advance Technologies and Innovation	1	$282,427
	Disciplinary Research Programs	1	$129,935
	Earth Sciences Instrumentation	1	$424,418
	Energy,Power,Control, and Networks (EPCN)	1	$150,000

	INSPIRE	1	$250,287
	MRI	12	$4,947,674
	Research Grant	1	$292,446
	Condensed Matter Physics Program	1	$165,091
	Experimental Atomic Molecular and Optical Physics Program	1	$156,500
Other		**4**	**4**
	MSU Subcontract	1	$113,994
	Stockholm University	1	$202,311
	Swiss Fed Tech	1	$283,113
	University of Wisconsin Subcontract	1	$156,500
Grand Total		**138**	**$36,415,871**

Appendix E:
Cores Assessment Survey Findings Summary

Cores Assessment Feedback - Core Customers

What school/college/unit are you in?

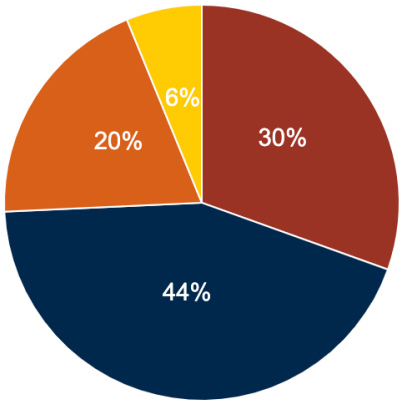
210 Responses

Field	Percentage
Medicine	47%
Engineering	20%
Literature, Science, and the Arts	10%
Research	7%
Pharmacy	4%
Dentistry	4%
Rackham School of Graduate Studies	2%
Public Health	3%
Kinesiology	1%
U-M Dearborn	0%
Social Work	0%
U-M Flint	0%
Information Technology	0%
Institute for Social Research	0%
Public Policy	0%
Nursing	0%
Music, Theatre & Dance	0%
Law	0%
Information	0%
Environment and Sustainability	0%
Education	0%
Business	0%
Art & Design	0%
Architecture & Urban Planning	0%

Cores Assessment Feedback - Core Customers

What is your position at the university?

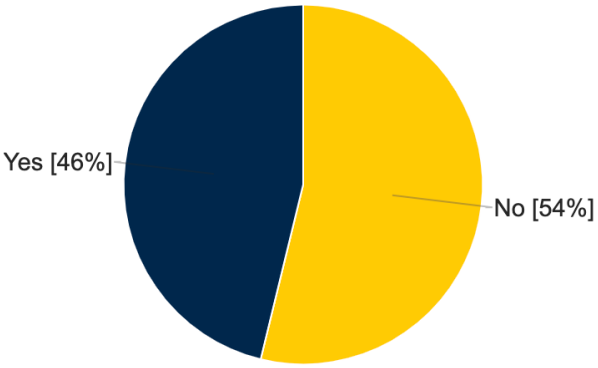
210 Responses



Postdoc/Graduate student/Undergraduate student
Professor/Associate Professor/Assistant Professor
Staff
Research Scientist/Research Investigator

Are you currently a PI on a sponsored grant?

210 Responses



From which source:

95 Responses

Field	Percentage of Choices
Federal	69%
Foundation	14%
Industry	17%

Which agency?

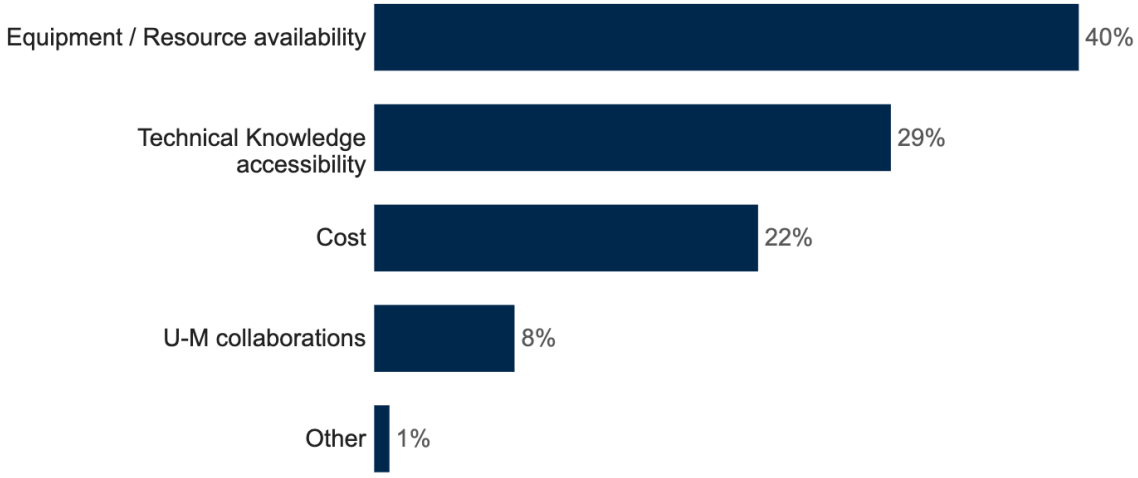
84 Responses

Field	Percentage of Choices
NIH	55%
NSF	16%
Other	7%
Department of Defense	12%
Department of Energy	7%
NASA	3%

Cores Assessment Feedback - Core Customers

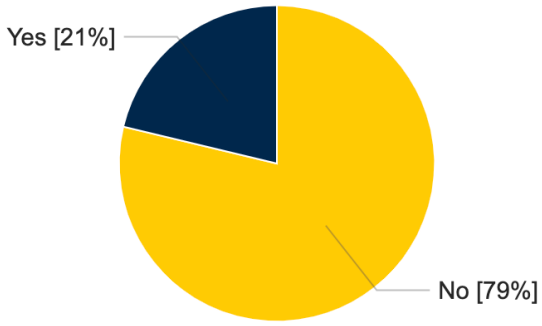
What drives your decision to use a campus core / facility?

206 Responses



Do you currently use an external service provider for equipment, services, and/or consultation that is currently available at U-M?

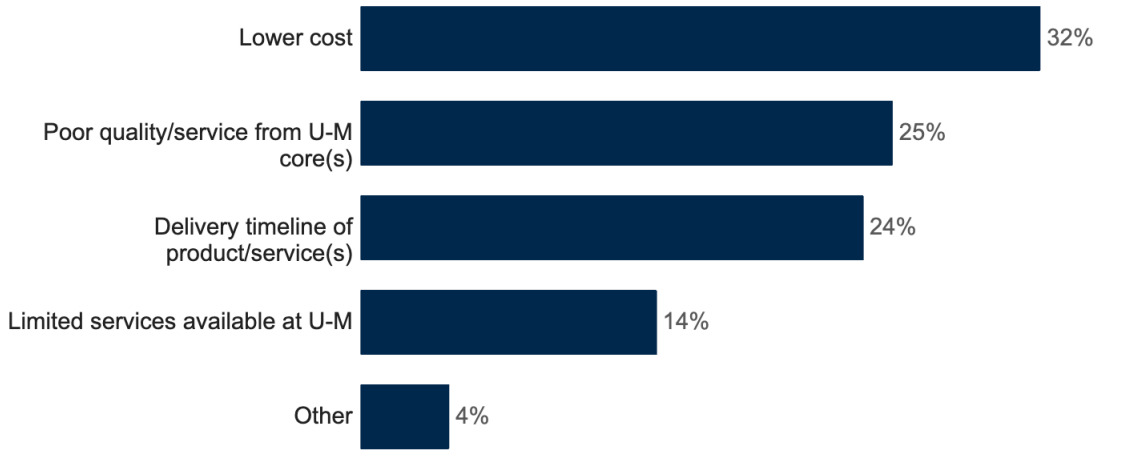
207 Responses



Cores Assessment Feedback - Core Customers

Why?

43 Responses



Cores Assessment Feedback - Core Staff

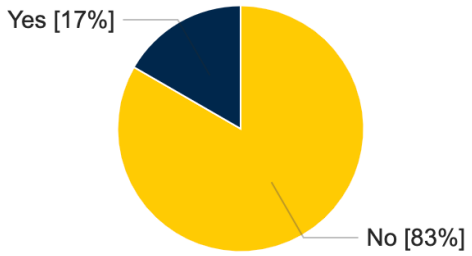
1

Which category best describes your role/association with U-M cores?

46 Responses

Are you aware of cores at different institutions that do things that you wish you could do here at U-M?

42 Responses



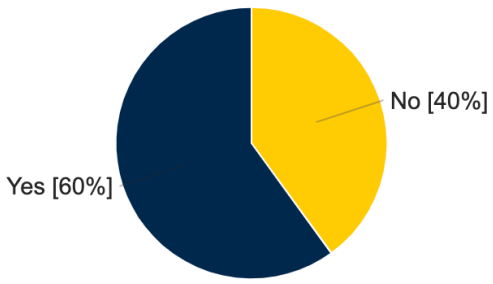
Who / Where are they?

NUANCE in Northwestern; Oakridge; Brookhaven; Ames Lab; MIT; etc.
Purdue University https://www.purdue.edu/discoverypark/birck/facilities/index.php
I work with biomass and cellulose, and the MSU Forestry school is much better equipped with instrumentation suitable for processing my materials
Harvard CNS, Penn State MCL
LNF
Memorial Sloan Kettering
I don't know exactly who but I doubt the autoclaves at most research institutions are as old as the ones here.

Cores Assessment Feedback - Core Staff 8

Do you feel you are provided with professional development or career advancement opportunities?

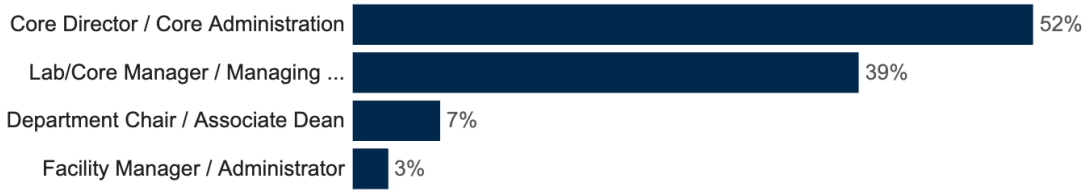
40 Responses



Core Assessment Feedback - Administrators / Managers / Directors 1

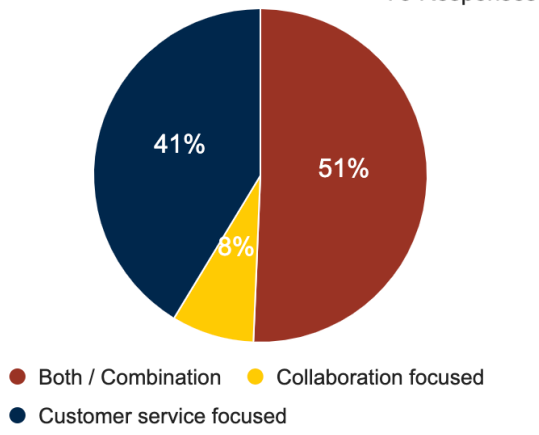
Which category best describes your role/association with U-M cores?

75 Responses



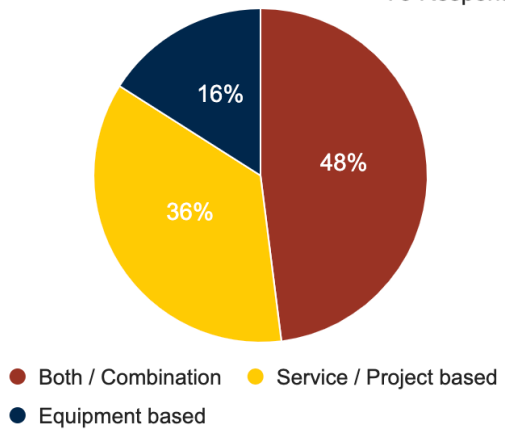
Which ***service*** model most accurately describes your core facility's operations?

75 Responses



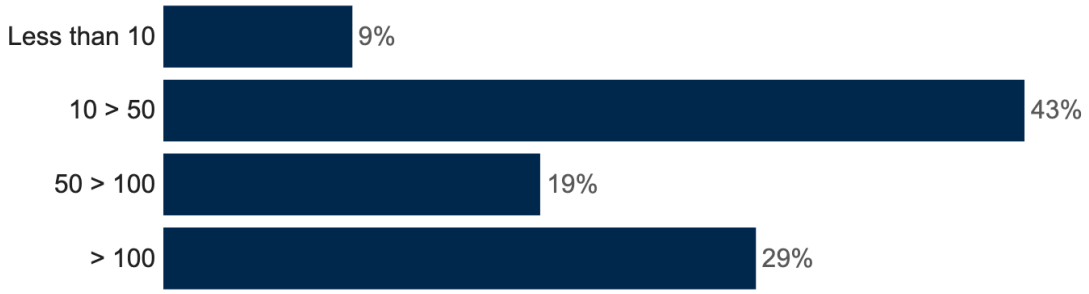
Which ***business*** model most accurately describes your core facility's operations?

75 Responses



How many unique customers do you typically have each year?

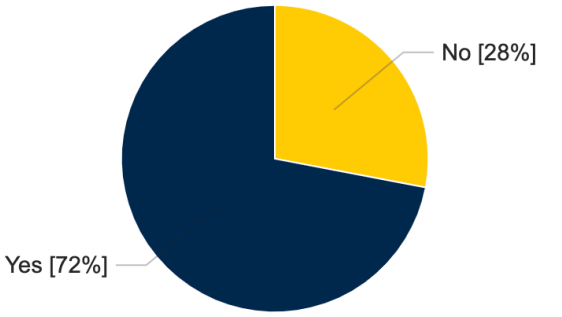
75 Responses



Core Assessment Feedback - Administrators / Managers / Directors 2

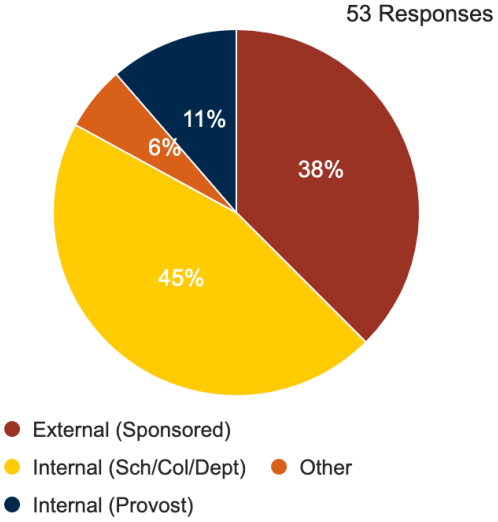
Do you receive funds beyond what you recover from recharge?

75 Responses



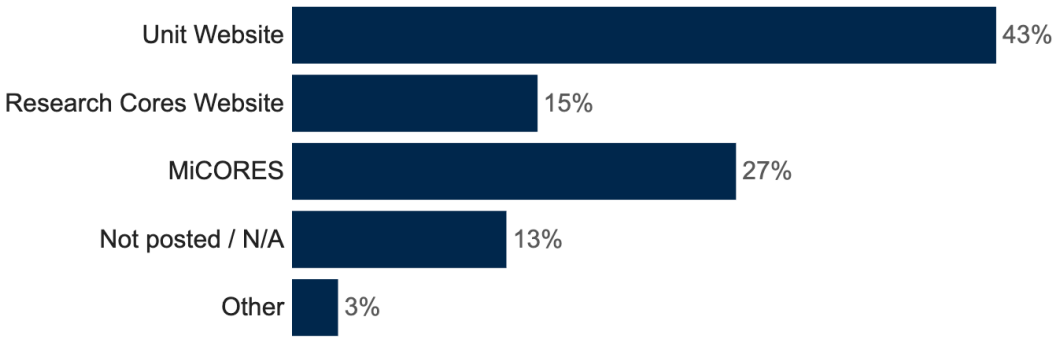
What type of funds do you receive?

53 Responses



Where do you post your approved U-M recharge rates?

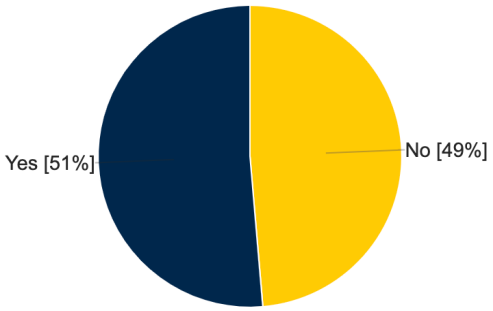
74 Responses



Core Assessment Feedback - Administrators / Managers / Directors 3

Do you collaborate / interact regularly with other cores?

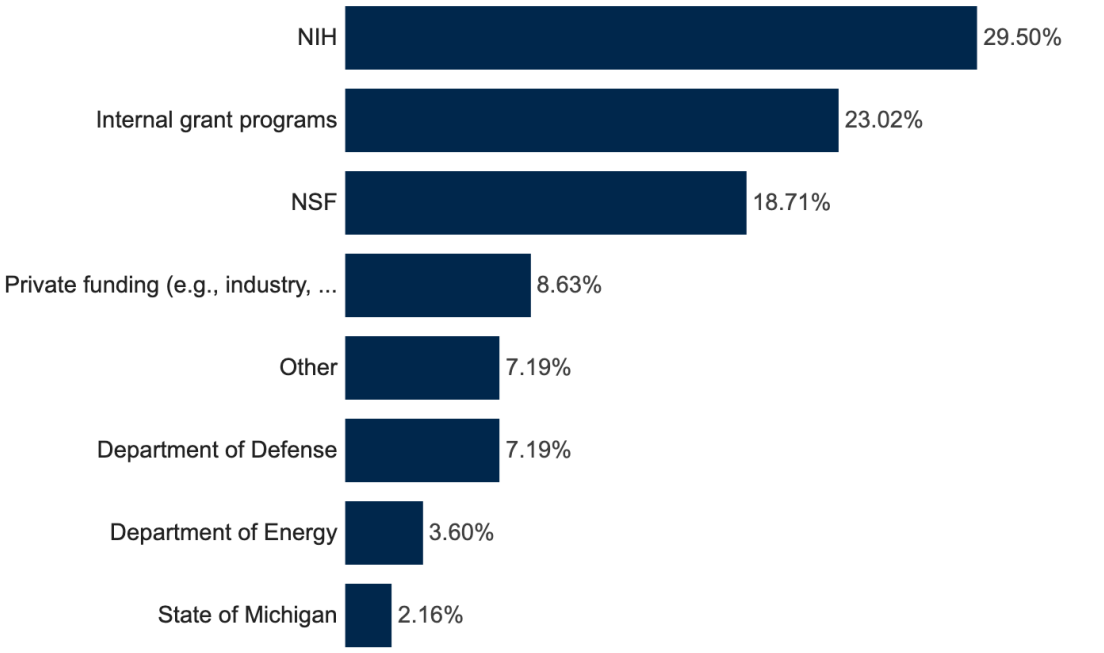
74 Responses



Core Assessment Feedback - Administrators / Managers / Directors 5

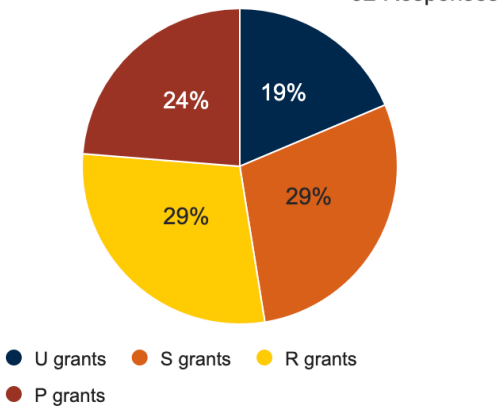
Which of the following funding opportunities for ***equipment*** have you used/are you aware of?

63 Responses



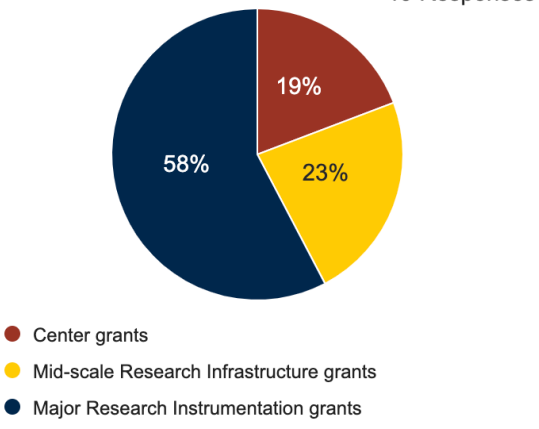
NIH equipment funding type:

32 Responses



NSF equipment funding type:

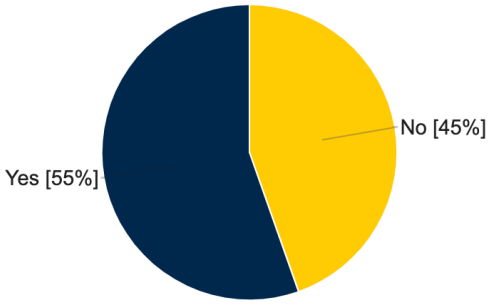
19 Responses



Core Assessment Feedback - Administrators / Managers / Directors

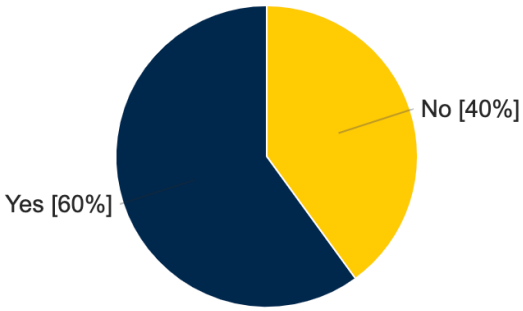
Do you create an annual report to document core metrics (volume, customer count/type), financials, subsidies, and/or publications?

74 Responses



Do you feel you are provided with adequate resources or training to help you manage or oversee your core?

75 Responses



Appendix F:
Cores Assessment Survey Themes

Theme	What is Working	What is Not Working	What Respondents Want to See Changed
Facility Infrastructure/ Equipment This theme encompasses equipment, space, facilities and other physical infrastructure. Equipment is not only an important asset to the institution, but can be leveraged effectively through core facilities, especially for expensive or highly technical equipment, often requiring dedicated expertise and knowledge for optimal results.	State of the art equipment is recognized by both **core directors and staff** as one of the strengths of their core facility. By providing access to a resource that they would not have otherwise, **core users** identify state of the art equipment housed within core facilities as critical to the ability to conduct their research. Equally, core users identified that core facility equipment plays a role in accelerating research (from both a time and cost perspective) as well as aiding in faculty retention.	As pain points, ***core directors and staff*** identified struggles with lack of redundancy for critical equipment in case of instrument failure, lack of funding to replace equipment, lack of smaller accessories to support workflow, insufficient space for operations, and limited access to needed equipment. Coordination to allow access to card reader controlled rooms is cumbersome. ***Core users*** identified needing better access to equipment (both in location and availability), and the need for more state of the art equipment to enhance competitiveness with other institutions.	***Core directors*** desired support from administration/leadership to prioritize placing equipment in core facilities before it is considered for an individual laboratory. In addition, they desired the opportunity for intentional space planning for cores and the ability to co-locate with their user community. **Core staff** would like to see more training and updates on new software when it is acquired. They would also like to see bundling of equipment purchases to support a comprehensive workflow (i.e. large equipment purchased along with supporting, smaller equipment). They would like to see their space designed to efficiently support workflow processes and to improve their working environment. They support the regular evaluation and replacement of equipment.
Financial This theme covers funding for core operations, investment in non-recharge covered activity, and recharge rate setting. It also addresses the cost of services to researchers and the downstream effects that it has on research.	**Core staff** identify their volume of activity as an opportunity to negotiate better prices with suppliers.	**Core directors and staff** identified the following pain points: the difficulty in maintaining financial viability with a relatively small user base, the lack of funding for equipment, the lack of funding for professional development and training opportunities for core staff, the perception of financial conflicts of interest or inconsistencies between core facilities within the same unit,	**Core directors and staff** expressed the need for support for the budgeting process, and business and financial modeling. They also wanted funding to reduce recharge rates and to support staffing costs. They wanted the coordination of cores across multiple units, with collective negotiations with and support from vendors for materials and maintenance contracts. The goal would be to reduce duplication, and increase

		and the perception that current institutional funding for cores is inadequate and inconsistent. A large number of **Core users** expressed frustration with the high cost of services from core facilities. The high rates discourage exploring preliminary research. The stability of recharge rates is important for their long term planning, and they desire transparency in cost calculations (users do not understand why rates are so high).	efficiency and research productivity from an institutional perspective. **Core users** expressed the need for stability in recharge rates in order to plan long term projects, as well as the ability to obtain preliminary data without prohibitive costs. Core users emphasized the need for investment in core facilities - in equipment, expert personnel, and financial support to enable reasonable recharge rates. Core users also had suggestions to subsidize facilities to affordable levels, or to benchmark levels at other institutions.
Policy/Operations This theme covers operational approaches and policies of cores.	Limited positive responses on this theme	**Core directors** had a consistent theme of feeling understaffed in their operations, along with the inability to attract, retain and appropriately compensate expert staff, like data analysts. Core directors are often in competition with large corporations or industry for talent, with industry being able to compensate considerably more for equivalent positions. Understaffing can lead to deprioritization of professional development and growth, leading to further job dissatisfaction. **Core staff** found the management of reservations of equipment to be difficult, especially with a wide spectrum in how equipment is used. **Core users** can find turnaround times for service to be long, or time for equipment reservation to be limited; both delay research progress.	**Core directors** expressed the need for financial support for staff salaries and space costs, especially during business down cycles. **Core staff** would like more engagement with operational decision making. **Core users** suggested that a mechanism for tracking progress of samples would be potentially helpful.

		Shared equipment does not have checkups or resets between sessions, so experiments can be affected by previous users. Several comments pointed out the lack of communication of status of a particular project in a pipeline (like a black box), and little communication if delays were incurred. There is a strong sentiment from core users regarding the philosophy and expectation of core facilities to be fully supported through recharges. From their perspective, this philosophy leads to exorbitant recharge rates and the unnecessary and harmful curtailment of research. In addition, they felt the self-sustaining philosophy of cores limits the type of cores that are implemented, thus reducing competitiveness with peer institutions.	
Scheduling/Resource Allocation This theme addresses scheduling of resources, staffing, workflow and teamwork within a core facility.	**Core staff** identify teamwork as a strength of their core. **Core users** identify after-hours access to equipment helps to alleviate scheduling bottlenecks and increases access. Several users appreciated cores that had consistency and quality of data/output.	**Core directors** had a consistent theme of being understaffed in their operations, along with the inability to attract, retain and appropriately compensate expert staff, like data analysts. Core directors are often in competition with industry for talent, with industry being able to compensate considerably more for equivalent positions. Understaffing can lead to deprioritization of professional development and growth, leading to further job dissatisfaction.	**Core staff** say they would benefit from better defined expectations and opportunities for advancement. A career ladder helps staff to set personal goals and have a better understanding of their position and tasks. They would also like to streamline workflow and team communication, and utilize LEAN concepts and accountability.

		Core staff consistently identified understaffing as a challenge (many comments). IT, communication and work scheduling were also pain points. Consistent feedback from core staff that there is little opportunity for a change in job title and an unclear career ladder. Low monetary compensation for core staff positions is an issue. **Core users** can struggle with cores lacking standardized workflows and sample preparation protocols. They experience communication issues with respect to research delays and status updates. They also have identified variability in the quality of work across core facilities, along with long turnaround times for services.	
Information Technology This theme addresses IT related issues, including data management, transfer, storage and policy as it relates to core facilities.	No responses in this category	**Core staff** find that frequent changes in file servers and systems result in difficulty in maintaining organization and accessibility of data. Some current management software is too slow to navigate effectively. **Core users** identified that access to data on certain systems housed in core facilities is unreliable.	**Core directors** expressed the need for a larger commitment to resources for high performance computing and data management, the formation of data standards, as well as the need for a central “enclave” to store research data. **Core staff** would like to see a data policy and data management on an institutional level. Some would like to see standardized time tracking software that can be accessed on the network. Some would create workstations outside the lab with functional computers and webcams where operators could perform analysis and meet virtually with users or team members. **Core users** would like to see support for consistent, reliable data transmission. They also identify that while

			technical skills that generate data are often strong, that users are on their own to analyze data with little support.
Education/Communication/ Visibility This theme addresses core facility communication to users, including education, training, advertising and marketing.	The **core directors** generally felt they had a good level of technical competence of the staff, state-of-the-art instrumentation and in general, collegial interactions with users. They also felt that they are able to train users, both internal and external, as well as developing new techniques and processes.	A common input from the **core directors** was limited ability to communicate/advertise their services and capabilities to attract new users. There was also a concern about their staff finding the time to do more professional development activities such as attending conferences or publishing their own research articles. **Core users** can struggle with learning what resources are available to them and navigating how to get trained.	**Core directors** expressed the need for a strong marketing capability for their cores, particularly with university faculty. This included a dedicated marketing/communications person like those in the major academic departments. They also asked for an enhanced listing of cores best principles for operations and setting rates. **Core staff** would like to see a single instrument search portal for students and faculty. **Core users** would like to see a core website that is easily searchable to find the service they need, that is updated regularly.
Support This theme addresses support for core facilities, originating from unit, department, school/college or institutional leadership and management.	**Core directors** indicated their ability to direct users to other cores that they are aware of that can better serve their needs, acting as an “honest broker, connecting researchers to services”.	**Core staff** identify a lack of leadership or management ability, and the lack of a clear vision for their core. Some of them experience slow and opaque decision making from leadership.	The **core directors** asked for a better understanding of other cores across the university, including a mechanism for better coordination among the cores to best serve the users. They also requested an enhanced listing of core best practices, including recharge rate setting. **Core staff** would like to see some consolidation of duplicate cores to allow better access to equipment, staff and resources, and to foster collaborations.
Professionalism/ Service/ Collaboration This theme addresses how cores can share their scientific expertise and knowledge in a professional and collaborative manner.	**Core directors** called out their ability to work both internal and external to UM, with one indicating serving users in 13 countries. The arrangements allow for flexibility to perform work as both services and collaborations. **Core staff** consider their expertise to be one of the strengths of their core.	**Core staff** find that the inability to conduct research causes their knowledge base to become outdated. **Core users** find that specific technical knowledge can be lacking in the core, and as a user, they need to contract the equipment manufacturer directly.	**Core staff** would like more involvement in interacting with core users about services. They would also like more opportunities to improve and update their knowledge base and skills. Some examples they listed were the ability to attend advanced workshops and scientific conferences. Recurring budget for

	Core users consistently listed expertise, consultation on experimental design and approach, troubleshooting and help with data analysis as strengths of core facilities.		workshops on campus was suggested. Customer service/difficult customer training was also suggested more than once. Broader knowledge of techniques/technologies would enable connection with other core staff with related expertise. One interesting comment was having more core facility involvement in manuscript preparation, as a core facility's role in ensuring rigor and reproducibility of research.
Learning/Training & Development This theme addresses a core's ability to develop their team, both in expertise and leadership capabilities. As technology and business continues to evolve, a core facility must be adaptable to remain relevant to changing research needs and possibilities.	**Core directors** indicated a number of sources for training; including MiCORES, Office of Financial Analysis, written documents/policies, and working with colleagues across campus. Some **Core staff** have opportunities to join professional societies, attend conferences, attend related classes and workshops, participate in equipment demonstrations and training, and U-M HR courses. **Core users** appreciate the continuous interaction between students and core staff in some cores.	**Core staff** identified lack of training on new updates and new software as a pain point. Some expressed the desire to be more involved in decision making.	A common message from the **core directors** was more robust training on the financial aspects of managing a core, with easily accessible guidelines for what is allowed to be on a recharge, the process, how to execute or update if there are changes. **Core staff** would like to see more engagement with business and scientific aspects of the operation. Core staff would also like to see more support for their professional growth. Lunch and Learn style formats with a hands on component was suggested.

Appendix G:
Peer Benchmarking Summary

Institution & Core Website (if available)	University budget model (RCM, hybrid, or incremental)	Central (OVPR-equivalent) staff support for cores?	Central Core Office/Staff Mission & Goals (if available)	Other central support (e.g., software, funding?)
Northwestern Office of Core Facilities Administration	Hybrid RCM	Yes, an associate vice president, who oversees the strategic direction, new initiatives, and long-term sustainability of the University's core facilities. There are 7 people listed on the CFA website, but roles are not included.	The Office of Core Facilities Administration (CFA) oversees and supports approximately 50 university core facilities on its Evanston and Chicago campuses as well in partnerships with Argonne National Laboratory and Northwestern Memorial Hospital. Core facilities enable sharing of University resources that individual researchers would not otherwise be able to afford. Core facilities are created and directed by Northwestern faculty and supported by the University to meet the collective needs of its research community. While each core facility has a faculty advisory committee, additional Committees serve advisory roles to the Office for Research.	They allow requests for operating support of core facilities as well as institutional cost share support. They also provide guiding materials for core managers and promote professional development opportunities for the core facilities community. They have an internal, centralized system called NUcore for ordering use of core services and facilities.
University of Wisconsin Office of Campus Research Cores	Modified RCM	Yes, there is a Director of Research Cores but no other staff are identified.	The mission of the Office of Campus Research Cores is to support, coordinate and optimize core structure and services for campus researchers and external clients. Goals: - Readily accessible information on campus cores through a central web portal - Campus core facilities have the capacity to serve all who need their services - Defined processes to facilitate local decision making concerning phases of the core life cycle - Scientific synergies through collaboration	The Office developed a Research Cores Directory for shared equipment and services, including data for >120 units, >500 shared instruments and resources, and >450 professional services. There does not seem to be software for centralized scheduling and management. Also have a Research Core Revitalization Program - in 2020, funded 17 projects aimed to strengthen campus research core capacities by supporting the upgrade, replacement or duplication of heavily used shared research resources. Awards ranged from $20K-$300K.
University of Pennsylvania eagle-i Core Facilities	RCM	No, not from website search	N/A	The list of all core labs at UPenn is provided on the website but more detailed info is on the eagle-i Network page. This network includes more than 90,000 biomedical research resources from 28 participating institutions.

Vanderbilt VU Cores	RCM	Yes; the Vice-President for Research ensures coordinated support of VU Core Facilities and financial oversight is provided by the Office of Contract and Grant Accounting	Research at Vanderbilt University is supported by designated institutional cores and shared resources. These facilities offer cutting edge scientific services, enabling access to high-end equipment, advanced techniques and specialized expertise for all Vanderbilt investigators. Org chart is available on homepage of website.	They use iLab for core scheduling and management. They also provide several policy and guideline documents for core operations.
UC Davis Research Core Facilities Program	Hybrid RCM	Yes, the program is housed in the Office of Research. There is an Executive Director and 4 staff listed on website	The mission of the Research Core Facilities Program is to enable researchers at UC Davis to have access to the state-of-the-art technology for their scientific research, to streamline the core facility administration while improving accountability and transparency, and to provide training opportunities for faculty, graduate students and staff.	They explicitly define the difference between a shared resource facility (SRF) and a campus research core facility (CRCF). The CRCFs get campus recognition as a model of excellence, are able to apply for financial support from the RCFP, can access core facility management software at a subsidized cost, and can be marketed through the Office of Research. They also offer a service and equipment finder database and are currently exploring offering business contracts that are pre-negotiated with the Contracting Office to accelerate the process with external users. They use Stratocore PPMS for core management.
Stanford Community of Shared Advanced Research Platforms (c-SHARP)	Hybrid	No. Support comes from a committee and working groups, not from an office with staff.	The c-ShARP committee is charged at the University level to engage the research community in defining, coordinating, and prioritizing infrastructure resources for our shared facilities. They develop and maintain a roadmap for the future of shared research facilities and also solicit and review collaborative proposals for annual major acquisitions and updates for shared research facilities.	They have a proposal process for equipment acquisitions, programs, or other enhancements to Shared Facilities that benefit the user community at large. iLab is used to manage 26 of the shared scientific facilities
Minnesota	Modified RCM	No, not from website search	N/A	Labs & core facilities are listed on a page within the OVPR site. Expertise & Facilities

Purdue	Incremental	No, not from website search	N/A	A list of Research Cores is available on a page within the Executive VP for Research and Partnerships site. Interested parties are instructed to contact the core directly. Research Cores list
University of Illinois	Hybrid RCM	No, not from website search	N/A	Facilities, labs and services are listed on a page within the Office of the Vice Chancellor for Research & Innovation site. Find Facilities, Labs, and Services
Penn State	Incremental (but evolving)	No, not from website search	N/A	They used their RIMS system to manage core facilities but are migrating to iLab (here). They also list their shared facilities on a webpage here.
Ohio State	Modified RCM	No, not from website search	N/A	Core facilities are listed on a page within the Office of Research site. Multidisciplinary Research Centers and Areas
Indiana University Bloomington	RCM	No, not from website search	N/A	They have a Core Research Facilities and Equipment website that includes a searchable campus database of equipment and laboratory facilities at Indiana University Bloomington. Core Research Facilities and Equipment
Johns Hopkins	Hybrid RCM	No, not from website search	N/A	They have a Core Facilities website through ilab that is linked through the Vice Provost for Research website. Core Facilities

University of Washington	RCM	No, not from website search	N/A	They have a Shared Research Facilities and Resources page within the Office of Research website. It includes a searchable database of equipment, facilities and services available to the UW research community. Shared Research Facilities and Resources

Appendix H:
NSF MRI Awards Since 2016

Institutions with Most NSF MRI Awards Since 2016 (ranked by total awards)								
Institution	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**	**Total NSF Award (2018-2020)**	**Awards per $100 million**
UCSD	2	1	2	2	2	9	$232,138,000.00	3.9
U. Arizona	1	1	3	2	1	8	$151,958,000.00	5.3
CalTech	1	2	1	2	1	7	$284,714,000.00	2.5
U. Hawaii		1	2	3	1	7	$116,946,000.00	6.0
Kansas State		3	1	1	2	7	$48,195,000.00	14.5
SUNY at Buffalo	1	2	1	2	1	7	$64,234,000.00	10.9
UCSB	2	1	1	1	1	6	$171,181,000.00	3.5
Colorado, Boulder	1	2	1	1	1	6	$299,192,000.00	2.0
U. Central Florida	1	1		2	2	6	$91,575,000.00	6.6
Iowa State	2	2			2	6	$95,368,000.00	6.3
Indiana U.		2	2	2		6	$161,822,000.00	3.7
North Carolina State	1	1	1	1	2	6	$169,991,000.00	3.5
Rutgers		1	2	2	1	6	$124,714,000.00	4.8
Penn State	2	1	1		2	6	$234,668,000.00	2.6
U. Texas, Austin	2		1	1	2	6	$275,044,000.00	2.2
Wisconsin-Madison	1	1	1	1	1	5	$279,288,000.00	1.8
U-M Ann Arbor	1	2	0	2	0	5	$327,997,000.00	1.5
Alabama-Tuscaloosa		1	2	1	1	5	$56,283,000.00	8.9
U. Delaware	1		2	1	1	5	$109,410,000.00	4.6
Florida State	1		2	1	1	5	$200,369,000.00	2.5
Florida International		1	2	1	1	5	$67,063,000.00	7.5
U. Illinois, Urbana-Champaign		3	2			5	$342,179,000.00	1.5
U. Illinois at Chicago	3	1	1			5	$82,129,000.00	6.1
Purdue U.	1	1		2	1	5	$217,137,000.00	2.3
UMass Amherst		2	1	2		5	$119,224,000.00	4.2
U. Maryland	1	2	1		1	5	$183,441,000.00	2.7
Montana State	2	1			2	5	$39,178,000.00	12.8
Ohio State U.	2	1			2	5	$182,137,000.00	2.7
U. Pennsylvania	1	1	2	1		5	$152,443,000.00	3.3
Clemson U.		2	2	1		5	$62,227,000.00	8.0
U. Tennessee	1		2	2		5	$63,780,000.00	7.8

Appendix I:
Sample Institutional Letter of Support Template

LETTERHEAD

Date
PI
Address

Dear Dr. PI,

I am pleased to support your application for the NIH S10 [Shared Instrumentation Grant or High-End Instrumentation] Program titled "TITLE OF PROPOSAL/INSTRUMENT."

The University of Michigan has a significant number of investigators involved with TYPE OF RESEARCH. The proposed acquisition of the INSTRUMENT will greatly benefit/advance/drive research toward EXAMPLE OF RESEARCH GOAL.

Brief summary of projects/research that will benefit from instrument

Brief justification, e.g., university does not have equipment, university has very outdated equipment, current equipment not available to team, etc.

The proposed purchase of INSTRUMENT will fill an important need to further establish/advance the University of Michigan as a leader in RESEARCH.

On behalf of OFFICE/UNIT/CORE, I can attest that funds from this grant will be spent expeditiously to purchase the requested INSTRUMENT within the award period specified by the NIH. DETAIL ANY OTHER INSTITUTIONAL COST-SHARE/COMMITMENTS. You have assembled a formidable team that has the technical and administrative expertise to successfully establish, manage and maintain the new INSTRUMENT.

I am confident that the INSTRUMENT will ACHIEVE STATED GOALS FOR RESEARCH. Data generated from this system will be integral part of existing and new grant applications, leading to enhanced research, increased research capacity and the creation of new jobs in biomedical research.

I wish you and your colleagues success in this grant application and the research studies that will benefit from this state-of-the-art equipment.

Sincerely,

Institutional Official