

Metrics for Success: Strategies for Enabling Core Facility Performance and Assessing Outcomes

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Core Facilities are key elements in the research portfolio of academic and private research institutions. Administrators overseeing core facilities (core administrators) require assessment tools for evaluating the need and effectiveness of these facilities at their institutions. This article discusses ways to promote best practices in core facilities as well as ways to evaluate their performance across 8 of the following categories: general management, research and technical staff, financial management, customer base and satisfaction, resource management, communications, institutional impact, and strategic planning. For each category, we provide lessons learned that we believe contribute to the effective and efficient overall management of core facilities. If done well, we believe that encouraging best practices and evaluating performance in core facilities will demonstrate and reinforce the importance of core facilities in the research and educational mission of institutions. It will also increase job satisfaction of those working in core facilities and improve the likelihood of sustainability of both facilities and personnel.

KEY WORDS: ABRF, standards, evaluation

INTRODUCTION

Widespread concern over annual U.S. budget deficits and their impact on escalating national debt are driving difficult decisions in Congress.¹ Federal support of research and development (R&D) has declined over the past decade and is likely to remain flat for the foreseeable future.^{2,3} Now more than ever, research institutions must invest their limited resources wisely.

One important strategic response to these economic realities has been the increased reliance on core facilities (shared resources) at universities and private research institutions. Core facilities are not new; they have been an integral part of the research landscape for decades as national resources,^{4,5} institutional resources serving a broad user base, or as departmental resources designed to meet the specialized needs of researchers. What has changed in the past few years, however, is the recognition of core facilities as a cost-effective means for providing state-of-the-art instrumentation and services for the entire research community.^{6,7} This has prompted many

institutions to establish central support and oversight of core facilities, and it has raised a number of questions for institutional leaders such as follows. Which facilities are needed, and which ones should be expanded? How should they be supported? Should they be centralized or remain decentralized, relying on departments to make strategic decisions? Is there an effective way for core administrators to partner with core directors in promoting standards (best practices) and compliance with federal regulations? Are there metrics for measuring growth, productivity, and research impact of core facilities?

An important first step in addressing these and related questions is the development of a set of performance standards and metrics for evaluating core facilities. In this article, we share our experiences on evaluating core facilities at our institutions. We focus on standards and metrics that have general use across diverse institutions while recognizing that no single method of assessment is right for every institution or facility. We hope that readers will find our strategies and insights to be a useful introduction and impetus for developing approaches that are suitable for their institutions and facilities.

CORE FACILITIES ARE RESEARCH LABORATORIES THAT OPERATE AS SMALL BUSINESSES

The U.S. National Institutes of Health (NIH) defines core facilities as follows: “core facilities are centralized shared

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resources that provide access to instruments, technologies, services, as well as expert consultation for scientific and clinical investigators. The typical core facility is a discrete unit within an institution and may have dedicated personnel, equipment, and space for operations. In general, core facilities recover the cost, or a portion of the cost, of providing service in the form of user fees that are charged to an investigator's funds, often to NIH or other federal grants.⁸ Thus, core facilities are research laboratories that are operated as small businesses for the purpose of providing specialized equipment and expertise that would otherwise be impractical for individual investigators to develop and maintain on their own.

The dual nature of a core facility (research laboratory and small business) can create tension within the facility if not handled appropriately. The laboratory component is nearly always managed by scientists with expertise in the relevant technologies, but the business component is sometimes handled by the core director or manager or a department administrator with no special experience in core administration or perhaps managed by a business administrator who is familiar with the institution's accounting and business practices. Ideally, a core director (or manager) oversees both components working in partnership with administrators to balance the goals of providing the best service possible at an affordable cost. This balancing act requires a unique set of skills (technical, business, social), and the core director must understand their mutual interdependence and strive to balance these competing interests. It is important for institutional leadership to understand the need for this balance so that it can enable the hiring of new core directors with the appropriate skill set and support their professional development to fill any gaps in knowledge. This investment in terms of approach and continuing education will result in a greater likelihood that the facility will succeed on all fronts and reward the institution's overall investment in the facility.

PLANNING TO MEASURE

An important first step in any assessment strategy is to determine the overall purpose of the assessment. Will this be a component of the overall strategic planning efforts of the institution? Is it part of a new initiative to develop a center or area of excellence? Is it aimed at the following core-specific issues:

- Satisfying institutional requirements (*e.g.*, compliance with federal accounting and safety regulations)?
- Improving effectiveness and efficiency of services?
- Aligning services with institutional priorities?
- Reducing costs of research?

Each of these purposes has a different goal and may require different standards and metrics. In the following

sections, we provide examples of performance standards (best practices) and metrics that we believe can help institutions address these questions. These standards and metrics arose out of our collective experiences as core directors and core administrators at state and private institutions and from discussions with directors of government agencies that support core facilities and from core administrators and directors who attended the 2013 annual meeting of the Association of Biomolecular Resource Facilities (ABRF).⁹ At the end of each section, we include important lessons learned that we believe contribute to the effective and efficient management of core facilities.

EVALUATING GENERAL OPERATIONS AND MANAGEMENT

It is likely that the most reliable predictor of a core facility's success is operating with a clear mission driven by strong, effective leadership. The latter ideally includes a committed scientific director, experienced core director or manager, business administrator with experience in core facility support, engaged faculty advisory committee, and central oversight and support provided by a department, school, or center along with the Office for Research and/or Finance. Each member of this leadership team contributes a critical element of success, be it technical experience, business savvy, research needs and vision, financial support, or help with regulatory compliance. If a facility is missing any of these key personnel on the leadership team, we strongly encourage them to fill in the missing role. This may be accomplished by hiring new faculty or staff, but it can also be managed via active partnerships with the appropriate administrative support teams and home department.

The scientific director and faculty advisory committee are important leaders in creating and maintaining a successful facility. They are key stakeholders who shape its direction by providing input on staffing, services, and instrumentation as well as future needs. In addition, they are in a position to lobby central administration on behalf of both the faculty and facility, thereby providing important input on the institution's investment. When there is disagreement among faculty over the direction or effectiveness of a facility, core administrators may want to consider organizing an evaluation of the facility by external consultants with proven expertise and experience with core facilities. This type of program review can be a very effective way to overcome internal disagreements and get the institution the advice it needs to make strategic decisions. Some institutions have built program review into their standard processes for evaluating core facilities, picking 2 or 3 to evaluate each year. This has the added benefit of removing the stigma of being reviewed, given that all facilities are expected to undergo review eventually.

With or without the overarching program review, a common administrative tool used to evaluate the operation of a core facility is the annual report. Annual reports can be invaluable assessment tools for the core's leadership, stakeholders, and core administrators, and it is noteworthy that they may be assembled from information that already exists and collected in other ways. Leveraging existing processes and reports to produce a specific core annual report is a key concept and will reduce perceived or real administrative burden. The content of the report will depend upon the priorities of the institution (see the questions we asked above), but it will probably include information on the core's management and strategic planning, technical capabilities and expertise, financial and resource management, communications, customer base and satisfaction, and institutional impact (research and education). **Tables 1 and 2** provide detailed lists of these categories and types of information found in annual reports. Not all categories are required or necessary. Engage with your leadership team to decide which ones are relevant and important for your core and institution. As much as possible, it is best to report information that can be systematically collected and quantified—establishing the Standard Operating Procedures (SOP) and measures at the outset of the process will provide a useful benchmark for core performance in succeeding years.

One of the challenges faced by core administrators is how to assess the content of annual reports. Objective evaluations are preferred whenever possible to avoid personal bias and inconsistency. Tables 1 and 2 list metrics and measurables for 8 categories in an attempt to provide objective assessment criteria across a wide spectrum of activities. Metrics are defined as subcategories related to the type of information listed within a category. Measurables are defined as metric-specific assessments (*e.g.*, number of items, income, expenses, percentage of total, percentage change from previous year, rankings relative to other facilities on campus, and so on). Categories that are less amenable to quantitation are assessed using lists and yes/no questions that can be evaluated by the number of items listed or the number of YES answers. The boxed text called Scoring Criteria for Annual Reports shows a method of scoring annual reports that uses this approach at one of our institutions (Northwestern University). Scores and other assessment methods may be used as a somewhat objective measure for acknowledging outstanding core facilities via an annual awards program and to reward staff for their exceptional efforts.

Scoring Criteria for Annual Reports—An example showing how one might generate a quantitative assessment across several categories using metrics and measurables as listed in Tables 1 and 2.

80 points possible: Based upon data provided in annual report, as well as other considerations pertaining to the operation of the facility, each category (management, staff, customer base, etc.) has a maximum of 10 points possible and an overall rating as follows:

Outstanding = 10 points

Excellent = 8–9 points

Very good = 6–7 points

Good = 4–5 points

Weak = 0–3 points

1. General management (10 points)

a. Faculty director, operations director (manager), and faculty advisory committee: was there a formal meeting in the past year? Were meeting notes provided? Did the meeting adequately address important issues facing the facility? Did the faculty director and faculty advisory committee approve and sign the annual report? (8 points maximum)

b. Research safety certification and business continuity plan: were these updated in the past year? Is the plan stored in research office vault folder? (2 points maximum)

2. Research and technical staff (10 points maximum)

a. Technical expertise: was there full-time technical support for the facility? Were qualifications of technical staff appropriate and adequate to meet the needs of the user base? Did the staff publish papers or submit grants in the past year? (5 points maximum)

b. Professional development: did technical staff participate in continuing education during the past year (by attending training courses, workshops, conferences, publishing papers, providing help with grant submissions, etc.)? Did they present at a regional or national meeting? Did this meeting include sessions related to core facilities? (5 points maximum)

3. Financial management (10 points)

a. Operations: prior year fiscal year (FY) recharge income/operating expense ratio; scored relative to other core facilities (5 points maximum)

b. Grant activity: internal or external (2 points for each external grant awarded; 1 point for each external grant submitted or internal grant awarded) (5 points maximum)

4. Customer base and satisfaction (10 points)

a. Size and diversification of customer base: large (\$800K or more of recharge income) and diverse (5 points); medium (\$200K to \$800K of recharge income) and diverse (4 points); small (under \$200K of recharge income) and diverse (3 points); large and not diverse (2 points); small and not diverse (1 point)

b. User survey results: based upon facility's relative ranking of weighted score = top 10% (5 points), top 40% (4 points), top 67% (3 points), top 85% (2 points), top 100% (1 point)

5. Customer publications and grants (10 points)

a. Publications: by users during the past year; scored relative to user base (5 points maximum)

TABLE 1

Categories and information for annual reports. This table was generated with input from core administrators and directors at the ABRF 2013 annual meeting who were asked to consider what metrics and measurables are important at their institution.

Category	Type of Information	Metric	Measurables
General management	Core mission and leadership	History and life cycle stage	Y/N: Described origin (PI laboratory, department), years in operation, 5-yr assessment (new, growing, stable, declining)
		Mission statement	Y/N: Provided mission statement
		Faculty director	Y/N: Provided name, expertise, % effort, roles, and responsibilities
		Core director	Y/N: Provided name, expertise, % effort, roles, and responsibilities
		Faculty advisory committee	Y/N: Provided names of members, list of meetings in past year, and meeting notes with action items
		Business administrator	Y/N: Provided name, expertise, % effort, roles, and responsibilities
Research and technical staff	Expertise and professional development	Research and IT staff	List: Names, qualifications (degrees), % effort, roles, and responsibilities
		Attendance at scientific conferences	List for each staff: Scientific conferences attended or presented in the past year
		Attendance at courses or workshops	List for each staff: Training opportunities, courses, or workshops attended in the past year
		Staff publications	List for each staff: Papers authored (published or submitted) in past year List: Papers for which staff provided methods, data, or help with analysis but were not coauthors
		Staff grants	List: Facility grants that are ongoing, new or submitted in past year List: Customer grants (R01, center grants, program project grants (PPG)) for which core personnel wrote sections for PIs
		Financial management	Budget and planning
		Expenses	Labor costs for last FY completed (\$ and % of total expenses) Costs for service contracts for last FY completed (\$ and % of total expenses) Other costs for last FY completed (\$ and % of total expenses)
		Revenue	Recharge income for last FY completed (\$ and % of total income) Grant income for last FY completed (\$ direct costs and % of total income) External income for last FY completed (\$ and % of total income); was unrelated business income (UBI) reported to central administration? Other income (subsidies, program income) for last FY completed (\$ and % of total income)

Continued

TABLE 1

(Continued)

Category	Type of Information	Metric	Measurables
Customer base and satisfaction	Size, breadth, and trends	Internal users	Total number of faculty (PIs); % change from previous year Total number of postdoctoral fellows, students, and staff; % change from previous year Departments: names, % change from previous year Schools: names, % change from previous year Centers: names, % change from previous year
		External users	Total number from nonprofit and for-profit organizations, % change from previous year
		Repeat customers	Total number, % return customers, % change from previous year List: high \$\$/volume projects (core defined), multiyear projects
	Service standards and feedback	Customer service	Y/N: Customer promise (warranty) statement posted and accessible Y/N: Definition of deliverables and/or list of services posted and accessible Y/N: Refund policy and internal service agreements posted and accessible Y/N: Turnaround time posted and accessible (per service or service line)
		Customer survey	Y/N: Evaluated effectiveness of personnel, instrumentation, services, policies Y/N: Provided comparison of results across cores (ranking of facilities) Y/N: Provided comparison of results from prior surveys Y/N: Addressed customer concerns in annual report

b. Grants: submitted by or awarded to users in the past year and dates of funding; scored relative to user base (5 points maximum)

6. Educational and outreach activities (10 points)

a. Educational: did the staff participate in formal coursework or laboratories for undergraduate or graduate students? Did the staff give presentations as part of seminar series in a department or center? Give presentations to new faculty or students? Participate in other educational activities that benefitted the university research community? (5 points maximum)

b. Outreach: did the facility sponsor presentations or workshops by outside speakers or vendors? Did the facility participate in K–12 activities? Was there pilot testing of new equipment or services? Did the facility participate in research fairs or open houses on campus? (5 points maximum)

7. Communication of services (10 points)

a. Facility website: did the facility update their website during the past year? Are recharge rates up to date? Was there

communication with users about changes in rates? Was there communication about new or special services or opportunities? (5 points maximum)

b. Central website: does the facility keep their information on this website up to date? (5 points maximum)

8. Self-assessment (10 points)

a. SWOT analysis: is there an in-depth SWOT analysis of issues facing the facility? Did the report explain how leadership plans to address these issues in the coming year? Did the report address issues raised by the user survey? (5 points maximum)

b. Bonus points: did the SWOT report adequately address issues raised in last year's review? Who are the key stakeholders of the facility, and were their needs met? How did you address their return on investment? If you underwent program review in the past 5 years, how are you addressing those recommendations? (5 points maximum)

Regardless of how your institution evaluates annual reports, the process provides an opportunity to align core

TABLE 2

Categories and information for annual reports. This table was generated with input from core administrators and directors at the ABRF 2013 annual meeting who were asked to consider what metrics and measurables are important at their institution.

Category	Type of Information	Metric	Measurables		
Resource Management	Operations	Technologies	List: Equipment (models, brief descriptions, purchase dates, depreciation status) Y/N: Is your facility's equipment up to date?; do you have a replacement plan?		
		Services	List: Services (models) Y/N: Is your facility's equipment up to date?; do you have a replacement plan?		
		Space and renovations	List: Offices (square feet), laboratories (square feet) and recent renovations Y/N: Does your facility have sufficient space to meet its needs?; does it look attractive to customers?		
	Quality and stability	Laboratory best practices		Y/N: Facility prepares and maintains SOPs Y/N: Facility provided % of services with quality control measures; provided example Y/N: Facility provided % of services with SOP; for pass/fail relative to quality control Y/N: Facility provided % of services with SOP; list deviations tracking and reporting Y/N: Facility provided list of equipment calibration and maintenance logs	
			Quality management	Y/N: Facility provided % of staff trained relative to SOPs, logs Y/N: Facility provided staff turnover rate (%) in past year List: Services/service lines discontinued/sunsetted in past year List: New services/service lines introduced in past year List: Other academic service providers and comparables List: Alternative commercial services/outsourcing and comparables	
			Safety and compliance	Certifications	Y/N: Research safety plans updated and approved by the Research Safety Office Y/N: Emergency and business continuity plans updated and approved by central administration Y/N: Certifications approved as applicable—EHS, OSHA, IACUC, CLIA, GLP, COI, IRB
				Compliance	Y/N: Follow institutional policies and procedures Y/N: Follow NIH FAQ (DOT-OD-10-138)
	Communications	Website and activities	Website	Y/N: Up-to-date listing of instruments, services, fees, personnel, contact information; provide URL Y/N: Does your website have presence on the institution's website	
			Print medium	List: Examples of traditional advertising (brochure, news articles, posters) in past year	
			Tours, visitors, meetings	List: Types, dates	
Corporate seminars, workshops			List: Titles, dates		
		K-12 activities	List: Types, dates		

Continued

TABLE 2

(Continued)

Category	Type of Information	Metric	Measurables
Institutional impact	Education	Lecture courses (for credit)	List: Course title, type (graduate, undergraduate), dates, hours (preparation, delivery)
		Laboratory courses (for credit)	List: Course title, type (graduate, undergraduate), dates, hours (preparation, delivery)
		Seminars, presentations (noncredit)	List: Titles, dates
		Tutorials, laboratory presentations (noncredit)	Y/N: Titles, dates (didactic and/or hands on training provided by core)
	Research	Publications	List: Publications of customers (in past year) using core-generated data List: High-impact publications of customers (in past year) using core-generated data
		Grants	List: Grants of customers (in past year) obtained using core-generated data List: High-impact grants (in past year) obtained using core-generated data
		Technology development	List: Patents, inventions, discoveries in past year obtained using core services List: Instrumentation, software or resources developed in past year
Strategic planning	Self-assessment	SWOT analysis (strengths, weaknesses, opportunities, threats)	Y/N: Described ways in which facility is building upon strengths Y/N: Described ways in which facility is addressing weaknesses, opportunities, and threats
		Stakeholders feedback	Y/N: Described ways in which facility is addressing needs of key stakeholders
		Annual report feedback	Y/N: Described ways in which facility is addressing issues raised by feedback on last year's report
		Program review feedback	Y/N: Described ways in which facility is addressing issues raised by program review

COI, conflict of interest; EHS, Environmental Health and Safety; IACUC, Institutional Animal Care and Use Committee; IRB, Institutional Review Board; OSHA, Occupational Safety and Health Administration.

performance with institutional priorities. If full cost recovery is the primary goal of a facility, the report should emphasize financial management and how to attain that goal. If your institution values the intellectual and scientific contributions of a core facility to the broader research community, the report should emphasize those values and address whether the investment is contributing to these goals.

Another strategy for evaluating any organization that may be adapted for assessment of core facility performance is the “balanced scorecard” approach. It was developed by faculty at the Harvard Business School as a way to address the multifaceted goals of a company. The approach begins by identifying what is important for the overall success of the company (*e.g.*, financial health, reputation for excellence,

growth in market share) and then deriving discrete, measurable activities that reflect these goals. Once measured, the activities are plotted as a “spider diagram,” displaying the relative strengths and weaknesses across these activities. This can then be used by management to allocate resources to achieve a balanced scorecard. Although developed originally for an electronics company,¹⁰ it has been applied at academic institutions to emphasize their multifaceted goals.¹¹

The boxed text called Balanced Scorecard Approach to Annual Reports shows an example of how the balanced scorecard approach can be used to evaluate a core facility. Categories in an annual report were scored and plotted as a spider diagram providing a snapshot of the core's strengths and weaknesses. Comparing spider diagrams year-to-year can

provide a quick visual representation of the evolution of strengths and weaknesses over time. This in turn can be the basis of a rolling dialog between facility leadership and core administrators as they work together to improve the facility.

Balanced Scorecard Approach to Annual Reports—

This approach shows how one could use a balanced scorecard approach to generate a spider diagram, reflecting the relative strengths and weaknesses of the facility across different categories (Fig. 1).

Core facility name

Annual report

General management: Outstanding—facility had faculty director (10% effort) and operations director (research assistant professor, 100%); operations director (OD) published 2 papers, 1 patent application, presented 2 talks at conferences, reviewed 2 external grants; financial assistant (50%) provided administrative support; advisory committee met once (notes provided with action items); research safety certifications up to date; business continuity plan updated March 24, 2015

Research and technical staff: Very good—facility employed 3 research associates (all with PhD degrees, 100% effort each) with proven expertise in relevant technologies; good professional development for two (published papers, presented at national and regional conferences)

Financial management: Very good—prior fiscal year recharge/expense ratio = 50% (fourth quintile among 40 peers); 1 NIH equipment grant awarded; 1 internal equipment grant awarded

Customer base and satisfaction: Excellent—facility had a small, diverse base; user survey = 4.62 (of 5.00; ranked 6 of 40)

Customer publications and grants: Outstanding—users published 15 research papers in past year; users grant activity: 8 submitted, 3 funded, 3 pending

Educational and outreach activities: Very good—a) Education: OD lectured in chemistry 415 graduate course, b) outreach: staff presented 2 workshops, 5 posters at internal events, 3 tours of facility

Communication of services: Excellent—a) Facility website: beautiful design; equipment list needs updating with new items, b) Research office website: up to date

Self-assessment: Very good—basic SWOT analysis that could use more discussion of weaknesses; IT problems mentioned by no long-term solution proposed; excellent long-range planning

It is worth noting that evaluating annual reports must be done carefully and strategically because emphasis on certain measures could influence behavior of core directors in trying to focus on getting the best scores. Thus, it is

essential to partner with the core leadership team and stakeholders to determine what is important to your institution and align goals and assessments with those priorities. A mix of core-specific metrics along with a set of measures common to all core facilities is a good approach. However, if the goal is to simply measure financial bottom line performance, the effort involved in the balanced scorecard approach may not be worthwhile.

Lessons Learned

1. Clear mission and a strong leadership team are the key predictors of core facility success.
2. Program review can be an excellent means for obtaining expert advice and direction for core facilities, especially when there is internal disagreement.
3. Annual reports provide important feedback for core administrators on the health and effectiveness of core facilities.
4. Partner with core leadership and stakeholders to design an appropriate annual report.

ASSESSING RESEARCH AND TECHNICAL STAFF

The research and technical staff are the heart and soul of a core facility. Consequently, ensuring they have the necessary expertise and experience in the relevant technologies is essential. At most institutions, the faculty or scientific director is responsible for recruiting the core director (or manager), and their expertise, experience and professional connections will drive this process. Hiring the right people requires a careful needs assessment and a rigorous recruitment process that ensures that vision, needs and staffing are in alignment. It also requires continued training and professional development of facility staff to ensure continued success.

Annual assessment of research and technical staff is an important part of the annual report (Table 1). The report should include a brief description of each person's qualifications, areas of expertise, and accomplishments over the past year. Most institutions engage in an annual performance evaluation process; leverage this for as much information as possible, and also be sure to align core facility needs with the overall human resource (HR) process. For some personnel, serving as a coauthor on papers and coinvestigator on grants may be appropriate. Attendance at scientific conferences is an effective way for staff to improve their knowledge and keep abreast of technological advances in their field (note: the NIH allows reasonable conference/membership expenses to be built into the service rate charges). In addition, meeting attendance promotes networking among core scientists that can be invaluable for problem solving and identifying best

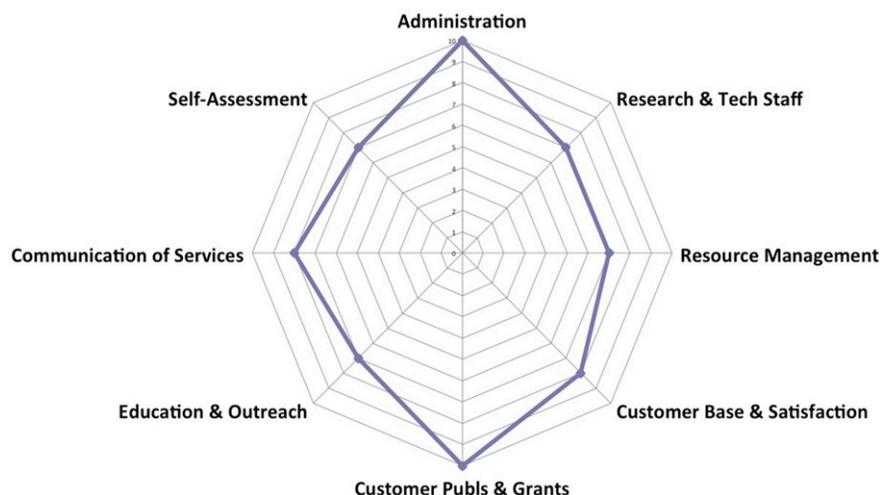


FIGURE 1

Spider diagram for the hypothetical core facility whose annual report is evaluated on p. XXX

practices. The ABRF supports annual regional and national meetings specifically focused on the professional needs of core facility scientists, as well as on the administration and management aspects of core facilities. These meetings are an excellent opportunity for directors and staff working in biomedical core facilities, as well as administrators overseeing them, to catch up on the latest developments in their disciplines.

Business skill is another area that needs attention for effective management of a core facility. Directors and managers running facilities often have advanced degrees in science or engineering but little or no formal business training. These skills are essential for interacting effectively with the institution's business and financial administrators as they work together to evaluate the operation, growth, productivity, and research impact on the facility. Recently, some universities and the ABRF have started offering education courses specifically for directors and managers of core facilities (http://www.kellogg.northwestern.edu/execed/nonprofitprograms/np-core.aspx#Ctab_2, <https://conf.abrf.org/sw1-abrf-business-skills-workshop>, and <http://madsci.abrf.org/>). These courses provide opportunities to examine a facility's value proposition, the basics of managerial accounting and pricing strategies, people skills and team building, marketing strategies, and intellectual property. The encouragement of business skill development opportunities for core facility professionals reinforces institutional commitment to employees and enhances job satisfaction. It also increases the likelihood that the facility will be able to sustain its role of facilitating and supporting the needs of the research community.

Lessons Learned

1. Hiring the right people requires a careful process to ensure that facility needs and staffing are in alignment with institutional vision and needs.

2. Annual assessment should encourage and reward continued professional development of staff, and leverage existing processes as much as possible.

3. Encouraging managers and technical staff to learn business skills enhances effective team management as well as communication with business and core administrators.

ENSURING SOUND FINANCIAL MANAGEMENT

Financial management is a critical aspect of core facilities because it sets operational boundaries. Without sound financial management processes, facility operations will never reach the level of effectiveness and efficiency needed to make them sustainable. Financial management is multifaceted and brings into play the laws of supply and demand. It is important to know who uses the services being provided, how much it costs to provide them, and what resources are available to cover these costs. Operational controls embedded in the management processes will ensure that federal guidelines and policies are being met. Lastly, a mechanism that ties all of these aspects together will facilitate successful financial management by tracking core facility activities.

When considering whether or not to offer a service, first steps usually include determining both the demand and cost for that service. It stands to reason that financial health of a facility will be promoted when the cost of a service can be spread across a large number of customers. Surveys are a good way to assess demand. An accurate cost study is used to set rates for different services. Rates should be reviewed and adjusted regularly. Federal guidelines require that rates be based on allowable, allocable, and appropriate direct costs of providing a service in the context of projected utilization. It is common practice to create rates for different categories of users (internal, external, subsidized),

but rates should abide by the principles outlined in the *FAQs for Costing of NIH-Funded Core Facilities*⁸ as well as other federal regulations.¹²

In short, the financial goal for a core facility is to break even over time. An accurate cost study is necessary to ensure that the facility operates within these boundaries. It is also necessary to avoid generating deficits that force managers to raise rates above what customers are willing to pay. Once this occurs, the facility may become unsustainable and force the institution to consider unpleasant options.

What if it is determined that demand will not be adequate to cover the cost of delivering the service? This is where the strategy of leveraging resources can be applied. In our experience, the most effective means to ensure a core's financial stability is to obtain support from as many sources as possible. In addition to recharge revenue, this may include supplemental support from core grants (such as NIH P20 and P30 funding mechanisms), internal subsidies from departments, schools, and other stakeholders. In the absence of core grants and subsidies, recharge revenue will need to generate a greater percentage of total operating costs, putting increased pressure on principal investigators (PIs) and their grants to carry the load. Core leadership can keep rates down by working together to obtain external support either through core grants or philanthropy. Recharge revenue from external users paying a higher rate may also help ensure stability.

Another facet of financial management is developing mechanisms to capture data associated with use of core facility services. Automated, web-based, institution-wide core facility financial management systems are becoming increasingly popular tools for this purpose. Without such a tool, it is difficult (labor intensive) to obtain an accurate assessment of a facility's finances on a regular basis. Because research activity has an inherent ebb and flow across disciplines, a financial management system can provide data that allow core leadership to identify these oscillations and take advantage of this information for planning purposes. It can also help relieve some of the stress that accompanies such oscillations.

An ideal financial management system offers a diverse set of features for facility managers, users, PIs, business, and core administrators. It is ideal that such a system should allow managers to track reservations and usage of instruments and services; accept different payment methods (university account, purchase order, credit card); facilitate billing and reconciliation of accounts; and export usage data for reports. Users need a system that provides a way to reserve instruments and order services online with different payment options. PIs need electronic notification of who is

TABLE 3

Web-based core facility financial management system features and functionalities

Financial Management System Features and Functionalities

OS compatibility

Apple OS X
Microsoft Windows
Linux
Google Android
Apple iOS

Users can

Reserve instruments in advance
Use instruments on a walk-up basis
Begin a reservation early if the instrument is available
Request training/access to restricted instruments
Order services
Order items (consumables)
Order bundles (preset combination of instruments, services, and items)
Add quantity and time-based accessories to reservations
Use available accounts across all of the facilities in the system
Split charges for a single facility order across multiple accounts
Pay external invoices with a credit card through the system
Track all orders placed by the user across all facilities in the system
Access a facility calendar to view other user's upcoming reservations
Electronic laboratory notebook
Scientific data management system
Laboratory information management system

Facility managers can

Order on behalf of users
Place orders in the past
Create new users and accounts
Track and report on all facility orders
Restrict access to sensitive instruments with an access list
Create rules to allow super users access to instruments in off-hours
Set minimum and maximum instrument reservation windows
Set a minimum instrument reservation cost
Setup a single instrument in multiple modes with different costs
Charge for actual instrument usage or by the reservation window
Offer time-based discount windows for instrument reservations
Setup subsidized price groups to offer compliant subsidies to users (e.g., cancer center subsidy)
Setup price groups for different classes of external users (academic, commercial, local consortium)

Continued

TABLE 3

(Continued)

Financial Management System Features and Functionalities

- Assign orders to facility staff
- Change the user-viewable order status as a project progresses
- Setup order forms to gather non-financial data related to a service
- Attach user-accessible documents to orders
- Upload charges for services rendered but not managed in the system
- Send invoices to external users
- Specify effective date for future pricing changes

PIs and business administrators can

- Track and report on all orders placed on accounts
- Add and remove user access to accounts
- Dispute facility charges during the billing process
- Manage account access
- View and manage invoices in bulk

Integrates with university enterprise systems to

- Validate internal users
- Validate account information
- Automatically transmit charges to the primary financial systems

Implementation

- Out of the box use (does not require customization or coding for use)
- Implementation and on-going support resources

Reporting

- Cancer Center Support Grant reporting
- Dynamic reporting across charge and use data
- Aging reports (accounts receivable)

Additional functionality to support specialized workflow

- Storeroom management and inventory resale
- Animal care protocol management
- Run manager for multiple samples and requests
- Long-term study/project management
- Instrument access control through hardware interlock

using their accounts and monthly account summaries. Business administrators need a system that allows verification of payment and account reconciliation. Core administrators would like financial information across multiple facilities, with system documentation that complies with institutional policies and procedures. The most useful and frequently requested features have been collated for consideration (Table 3). Identifying which ones meet your institution's needs is well worth the time and effort required to make the right choice.

With a sound financial management system in place, one can begin to assess a facility's financial health. The

system should be able to track expenses and revenue on a daily, weekly, monthly, and yearly basis (see Table 1). Metrics for expenses should include personnel, service contracts, supplies, and professional development (travel to conferences, training) and may include other costs associated with running the facility such as equipment depreciation. Metrics for income should include recharge revenue (instrument usage and services), grant support, external income, program income, and institutional subsidies. An effective financial management system should be able to track each of these different metrics as well as other metrics (*e.g.*, ratio of recharge income to total operating costs, ratio of internal to external income, ratio of recharge income to subsidy, percentage change in recharge income over time). With these metrics in hand, a facility's leadership team will have the tools necessary to make adjustments during the year and to plan accordingly year to year.

Lessons Learned

1. Core facilities are subject to the forces of supply and demand.
2. Sound financial management requires an effective management tool that satisfies the needs of facility managers, users, PIs, business, and core administrators.
3. An accurate cost study is necessary to ensure that the facility follows federal guidelines and does not create a financial burden on the institution.
4. Multiple sources of financial support facilitate financial stability.
5. Financial metrics offer an effective way to assess the financial health of a facility, make ongoing adjustments, and enhance long-range planning.

GROWING THE CUSTOMER BASE AND EVALUATING SATISFACTION

Besides revenue, another measure of core facility vitality is its customer base. This is especially fertile territory for metrics as growth can be measured by the size, breadth, and trends across internal and external customers (see Table 1). Size gives a basic measure of the need for services, breadth indicates the utility across disciplines, and trends (changes) indicate a shift in faculty research directions. Tracking the growth or decline of repeat customers may be an indicator of customer satisfaction. Growth in the amount of external usage can be a lucrative way to subsidize internal users without raising rates. Each of these measures provides important insights into the research activities of the institution and may be useful to core administrators trying to gauge areas for additional

investment or identifying cores in need of reorganization or sunseting.

Breadth is a particularly important metric as institutional demographics can be a valuable asset when seeking internal subsidies and developing partnerships for funding initiatives. Identifying and supporting cores with a broad user base can be an effective way to maximize research dollars and encourage interdisciplinary research. The latter offers the opportunity for cores to help faculty compete for large research center grants and philanthropy aimed at addressing some of society's bigger health problems.

Surveys of customers are useful for gauging the effectiveness of a core facility. Ideally, these should be carried out regularly by core directors or administrators by use of a standard template along with some core-specific questions. Centralizing the process ensures uniformity and confidentiality and avoids asking researchers to complete multiple surveys. There are simple tools for generating surveys (*e.g.*, SurveyMonkey) as well as more sophisticated tools (*e.g.*, Qualtrix, REDCap). Both provide an effective format for creating questions and soliciting responses, although the latter provides better analysis and reporting functions and allows one to create a single survey for the institution's entire research community.

Analysis of surveys is always a tricky task from a statistical perspective. The larger the number of respondents, the more meaningful the data will be. Large numbers of respondents will also minimize concern that only disgruntled customers completed the survey. Tracking survey responses over time can be another means for evaluating the reproducibility of results. If the same issue is raised year after year, it probably is not simply a disgruntled user.

Regardless of the number of respondents, the most useful aspect of any survey is the opportunity for customers to provide feedback. A comment section included after each section (personnel, instrumentation, services) allows for collection of additional input. This serves the dual purpose of allowing customers to raise legitimate complaints (*e.g.*, wait times are too long) while allowing managers to consider an appropriate response (*e.g.*, capacity has reached a maximum, and additional equipment or personnel are needed). Interactions such as these are productive and, when included in the annual report, alert core administrators to concerns and potential remedies.

Lessons Learned

1. Customer data provide useful metrics for gauging the size, breadth, and trends across core facilities.
2. Breadth of usage is especially helpful for encouraging partnerships for interdisciplinary research initiatives and philanthropy.

3. Surveys are an excellent means to solicit customer feedback and identify problems with facility operations.

4. Sharing survey results in annual reports can be an effective way to alert core administrators of problems and potential remedies.

MANAGING RESOURCES EFFECTIVELY

The successful operation of a core facility requires astute resource management. This includes managing people and projects, applying laboratory best practices, ensuring quality of services, maintaining certifications, outsourcing when necessary, and abiding by institutional and federal regulations (see Table 2). Add to this financial management and professional development, and it is difficult to imagine a core director or manager as a part-time employee. Nevertheless, initial launch may necessitate a part-time position until customer base grows and the core can sustain itself. In short, each leadership team must decide how best to balance these activities with customer and institutional expectations.

Core directors pride themselves in having state-of-the-art instruments and services and the technical expertise to use efficiently and effectively. This is, without a doubt, the defining feature of a core facility. Therefore, it should come as no surprise that core directors spend a great deal of time and effort training and managing personnel, maintaining and troubleshooting existing equipment, writing grants for new instruments, and developing novel services and techniques. As a consequence, an effective assessment strategy needs to recognize, encourage, and reward such behaviors.

A central requirement of resource management is ensuring quality and stability. This includes development of standard operating procedures (SOPs), quality control measures, and certifications [Clinical Laboratory Improvement Amendments (CLIA), Good Laboratory Practice (GLP), etc.] when necessary. Table 2 lists additional measurables that could be used to assess the effectiveness of resource management, including new services, staff turnover rate, availability of maintenance logs for equipment, research safety plans, and emergency and business continuity plans. Assurances of following institutional and federal regulations are also worth documenting.

One of the biggest challenges for an established core facility is maintaining and eventually replacing aging or outdated equipment. Keeping older equipment operational is time consuming and expensive (with or without a service contract). Troubleshooting by staff and equipment downtime are both sources of lost revenue,

especially for instrument-based facilities. To minimize this inevitable cost and the potential for catastrophic losses, facilities need a long-range plan and institutional investment. There are two strategies worth considering: equipment depreciation (provided the depreciation costs are not included in your institution's negotiated facilities and administrative rate) and an institutional loan payback program. Both strategies pass replacement costs along to the users, but they do it in different ways. Depreciation is a surcharge applied to existing equipment over its useful life (but not equipment purchased through a federal grant), and it usually begins when the equipment is first commissioned. The loan payback program is a surcharge applied to replacement equipment purchased by the institution. With an initial upfront investment by the institution and appropriate underwriting policies, the loan program can become self-sustaining and help to ensure enduring operations.

Lessons Learned

1. To flourish, a core facility needs a full-time core director or manager.
2. An effective assessment strategy needs to recognize, encourage, and reward behaviors that promote effective resource management.
3. An effective core facility needs to ensure quality of performance and stability of staff.
4. To achieve long-term stability, a core facility must have a plan to replace aging or outdated equipment.

FACILITATING COMMUNICATIONS

No matter how impressive a facility's resources are, it will be to no avail if researchers do not know that the facility exists. Therefore, it is imperative to get the word out through as many practical means as possible. Evaluation of communication should emphasize the breadth and effectiveness of different strategies, including electronic, print, and outreach activities (see Table 2). Asking questions on user surveys about different communication strategies can provide useful feedback and help guide future investments.

Effective communications these days begins with a robust website listing instruments, services, personnel (and their expertise), fee structure, and contact information. Whereas a simple listing is useful, a more appealing approach is to show pictures of personnel and instruments so that customers have a mental image of what they are dealing with and with whom. Other features that may be useful on a facility website include protocols, presentations, recent publications using data from the facility, and a downloadable description of instruments and services for grant writers.

Ideally, the facility's website should be linked (along with other core facilities) on the institution's research-related websites (Office for Research, schools, centers). The more links there are, the better. Including links to social media accounts such as those hosted by Facebook, Twitter, LinkedIn, and Research Gate allow core facilities to target a younger demographic of potential customers, namely graduate students and postdoctoral fellows. According to the Pew Research Center's Internet Project survey, more than 80% of Internet users aged 30–49 years and nearly 90% of those aged 18–29 years use social networking sites (<http://www.pewinternet.org/data-trend/social-media/social-media-user-demographics/>). Before starting a social media campaign, the core should contact their institution's administration to be sure that they comply with all institutional policies regarding social media.

Another useful feature for institutional websites is a searchable database for instruments, services, and personnel found in core facilities. This can be achieved by using simple navigational search tools (e.g., Google Search Appliance) or more elaborate faceted search engines (e.g., Apache Solr). Recently, searchable databases for core facilities have been established. These sites allow scientists anywhere in the world to access specialized expertise and services from core facility laboratories listed in the database. The ABRF Core Marketplace and Science Exchange represent two examples of such shared resource search tools.

Traditional print media (brochures, news articles, posters) continue to be useful and have the added advantage of being digitally accessible as well. Other forms of communication to consider include tours, meetings with prospective customers, departmental presentations, and community outreach activities (pizza parties, laboratory demonstrations). Corporate seminars and workshops describing new technologies and services are especially useful ways to attract new customers and remind existing customers that your facility remains at the cutting edge of science.

Lessons Learned

1. Effective communication of services uses many different means.
2. Social networking allows cores to remain engaged with customers.
3. Websites with searchable database for instruments, services and core personnel increases the likelihood of being found by potential customers.
4. Traditional print medium remains an effective means for communicating with customers.
5. Corporate seminars and workshops on new technologies and services can be especially effective.

MEASURING INSTITUTIONAL IMPACT

The impact of core facilities on an institution's research enterprise has both obvious and subtle aspects. The obvious benefits are the cost effectiveness of sharing high-end equipment and expertise, importance for faculty recruitment and retention, opportunities for researchers to engage in research outside of their area of expertise, and fostering new collaborations and partnerships. The less obvious benefits include enhancement of the educational mission of the institution, the opportunity to build bridges between disciplines, and opportunities for institutions to help each other and the private sector meet the needs of the broader research community.

How to capture these benefits in a quantitative way has perplexed core administrators from the start (Table 2). If they focus on traditional research metrics (*e.g.*, number of publications and grants of staff and customers), they run the risk of ignoring many of the benefits mentioned above. Thus, although counting publications and grant awards is important (especially high-impact publications and large center grants), there are additional metrics that can be considered to capture the broader benefits. This might include recognition of patents (applied and awarded), inventions, or software development. It might also include less lucrative accomplishments such as technique development.

Another fertile area for metrics is acknowledgment of core facility participation in the institution's educational mission. This might include counting courses or hours in which core directors participate as lecturers or as facilitators of laboratory courses (note: use of core facility professionals in courses must be paid by the institution and not subsidized by researchers using federal funds through user service fees). One might differentiate between for-credit and non-credit courses, graduate and undergraduate courses, seminars, workshops, tutorials, and laboratory presentations. The important point is to recognize that these activities contribute in a substantive way to the mission of the institution.

Lessons Learned

1. There are obvious and subtle ways in which core facilities contribute to the mission of the home institution.
2. It is important to acknowledge the importance of the less obvious contributions such as technology development and education.

ALIGNING STRATEGIC GOALS AND ENSURING SUSTAINABILITY

The need for strategic planning is driven by two factors: 1) aligning institutional strategic goals with investment in core facilities and 2) ensuring that this investment is sustainable.

The former is the purview of central administrators usually combined with strong faculty input. An advisory board composed of senior faculty and administrators from schools, centers, and the Office for Research can be an effective means for ensuring an alignment of institutional goals with core facilities. Such goals may include enhancing research capabilities in targeted areas, facilitating faculty recruitment and retention, creating regional and national centers, and fostering university-industry partnerships.

Sustainability of a core facility is a challenging endeavor that requires the coordinated effort and support of key stakeholders, core directors, and their advisory committees. A common method for assessing sustainability in any organization is rigorous self-assessment [*e.g.*, strengths, weaknesses, opportunities and threats (SWOT) analysis] (see Table 2). Asking core directors for a SWOT analysis in the annual report is an excellent way to gauge whether they are aware of these factors and how they are addressing them. Evaluating a SWOT analysis will depend upon the quality and extent of the analysis, but alas it is likely to be quite subjective. Nevertheless, an analysis that addresses the needs of key stakeholders, feedback from prior years, and program review (if appropriate) will provide a good indication of whether the facility aligns with institutional strategic goals and is on the path to sustainability.

Long-term sustainability of a core facility will depend upon many factors, some of which can be influenced by the institution (*e.g.*, by addressing topics covered in this article) and some that cannot (*e.g.*, changes in the direction of research, federal R&D support). Regardless, if managed effectively, efficiently, and strategically, core facilities are likely to be around for a long time. Recent publications by senior scientists at leading institutions have acknowledged the importance of core facilities in the research enterprise and in contributing to the future of the biomedical workforce.^{7, 13, 14} Indeed, if done well, it can be a rewarding career path with a bright future. Core administrators need to do their part to nurture and support this effort.

Lessons Learned

1. Encouraging best practices and evaluating core facility performance in the context of institutional goals will improve the likelihood of sustainability of both core facilities and personnel.
2. A SWOT analysis can be an effective means for assessing the strategic value and sustainability of a core facility.

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REFERENCES

1. Sargent JF. Federal Research and Development Funding: FY2013, in Congressional Research Service Report 7-5700, December 5, 2013, Washington DC. <https://www.fas.org/sgp/crs/misc/R42410.pdf>. Accessed September 20, 2015
2. Publication NAS (2010) *Rising Above the Gathering Storm, Revisited*. The National Academies Press, Washington, DC. <http://www.nap.edu/catalog/12999/rising-above-the-gathering-storm-revisited-rapidly-approaching-category-5> Accessed September 20, 2015
3. FASEB Publication (2015) Sustaining Discovery in Biological and Medical Sciences: A Framework for Discussion, The Federation of American Societies of Experimental Biology, Bethesda MD. <http://washingtonupdate.faseb.org/?p=1159>. Accessed September 20, 2015.
4. Berns KI, EC Bond, FJ Manning, eds. (1996) *Resource Sharing in Biomedical Research*. The National Academies of Sciences, Washington, DC. <http://www.nap.edu/openbook.php?isbn=0309055822>. Accessed September 20, 2015
5. Westwick PJ (2003) *The National Labs: Science in an American System, 1947–1974*. Harvard University Press, Cambridge, MA, USA.
6. Farber GK, Weiss L. Core facilities: maximizing the return on investment. *Sci Transl Med* 2011;3:95cm21.
7. Chang MC, Birken S, Grieder F, Anderson J. U.S. National Institutes of Health core consolidation-investing in greater efficiency. *J Biomol Tech* 2015;26:1–3.
8. U.S. National Institutes of Health (2013) FAQs for Costing of NIH-Funded Core Facilities. In *NOT-OD-13-053*. The National Institutes of Health, Washington, DC. <http://grants.nih.gov/grants/guide/notice-files/NOT-OD-13-053.html>. Accessed September 20, 2015
9. Chitty A, Schilling J, Scott V. Core administration session abstracts. *J Biomol Tech* 2013; 24(Suppl):S14
10. Kaplan RS, Norton DP. The balanced scorecard—measures that drive performance. *Harv Bus Rev* 1992;70:71–79.
11. Ballentine H, Eckles J. Dueling scorecards – how two colleges utilize the popular planning method. *Plann High Educ* 2009; 37:27–35.
12. Hockberger P, Meyn S, Nicklin C, Tabarini D, Turpen P, Auger J. Best practices for core facilities: handling external customers. *J Biomol Tech* 2013;24:87–97.
13. Alberts B, Kirschner MW, Tilghman S, Varmus H. Rescuing US biomedical research from its systemic flaws. *Proc Natl Acad Sci USA* 2014;111:5773–5777.
14. Daniels RJ. A generation at risk: young investigators and the future of the biomedical workforce. *Proc Natl Acad Sci USA* 2015;112:313–318.