Materials Characterization and Processing Facility

Five-Year Strategic Plan || Period: 2025-2030

December 2025

Figure 1: The landmark Stieff Silver building in Baltimore, where the JHU's MCP is housed

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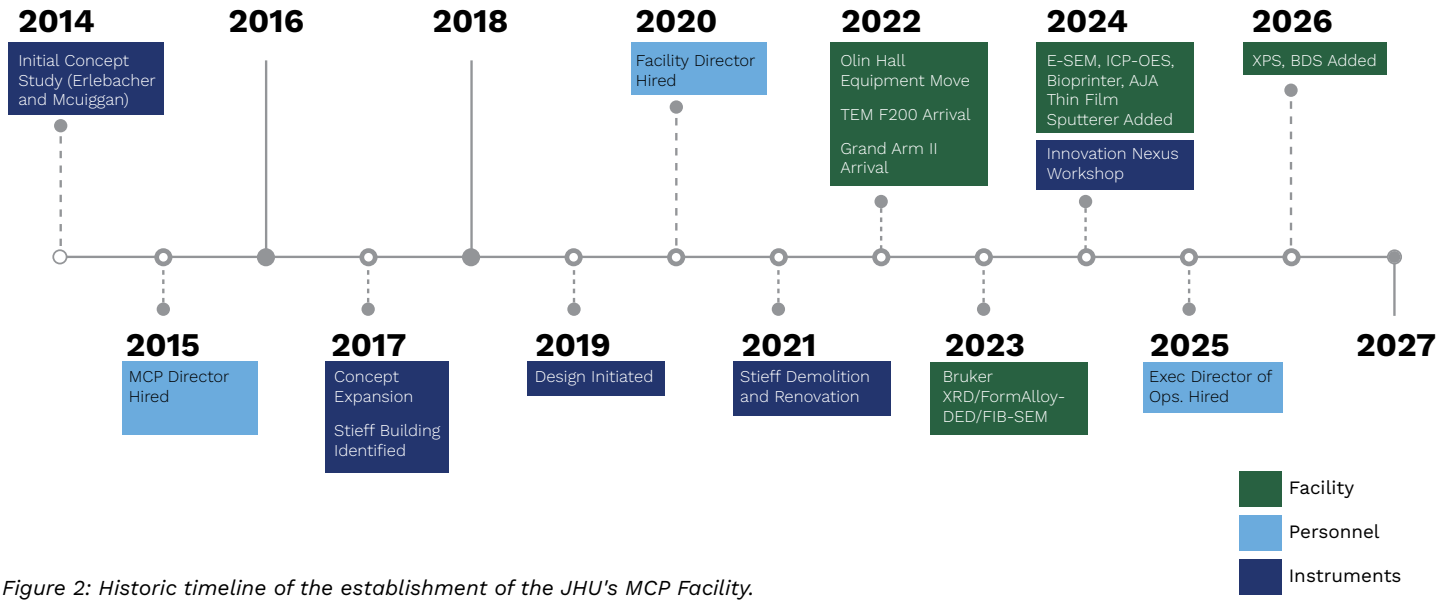


Figure 2: Historic timeline of the establishment of the JHU's MCP Facility.

Executive Summary

Established in 2017, the Materials Characterization and Processing facility at Johns Hopkins University has rapidly evolved into a leading research hub, advancing interdisciplinary innovation in materials and life sciences through state-of-the-art instrumentation and expert technical support. With over $50 million invested, the MCP provides sophisticated capabilities, including electron microscopy, x-ray diffraction, micro-CT imaging, spectroscopy, and advanced materials processing tools.

Significant achievements over recent years include extensive interdisciplinary collaboration, comprehensive educational initiatives, strong community outreach, and substantial user engagement across multiple schools and divisions at Johns Hopkins. Despite these strengths, the MCP faces challenges such as the need for enhanced centralized data management, optimal staffing levels, improved infrastructure, and financial sustainability amid fluctuating funding environments.

Opportunities for strategic growth include integrating artificial intelligence and machine learning into characterization processes, expanding the number of users, including external collaborations, and diversifying revenue streams. Immediate priorities include implementing robust centralized data and computing infrastructure, formalizing safety protocols, hiring new technical staff, and enhancing external outreach.

In the medium term, the MCP aims to strengthen strategic partnerships and introduce additional specialized instrumentation. Long-term objectives focus on significant revenue diversification, physical expansion, and strengthened institutional commitment and support. By addressing these strategic opportunities and proactively managing potential challenges, the MCP is poised to solidify its position as a premier, self-sustaining national user facility for materials science research, education, and innovation.

Introduction

Since 2017, the MCP facility—located in the historic Stieff Silver Building in Baltimore—represents a significant investment in materials science and engineering, providing state-of-the-art instruments and fostering an interdisciplinary research environment. Initiated in 2014 by Jonah Erlebacher, professor of materials science and engineering at Johns Hopkins, and Patricia McGuiggan, associate research professor, the MCP evolved from a concept to a fully operational facility housed in the renovated Stieff Silver Building by 2022 (Figure 1), despite significant logistical challenges posed by COVID-19. Figure 2 shows the historical timeline of events since the original concept was discussed. From inception to today, the MCP continues to expand its capabilities, fostering interdisciplinary collaboration, educational outreach, and innovative research, solidifying its position as a leading user facility for materials research. Since 2019, principal investigators utilizing the MCP as a research resource have collectively secured over $590 million in funding from a range of sources, including federal agencies such as the NSF, NIH, ONR, NASA, ARL, DARPA, DTRA, DOE, and more, as well as the private sector and philanthropic foundations. Over the same period, the MCP user community has expanded to include more than 410 unique users.

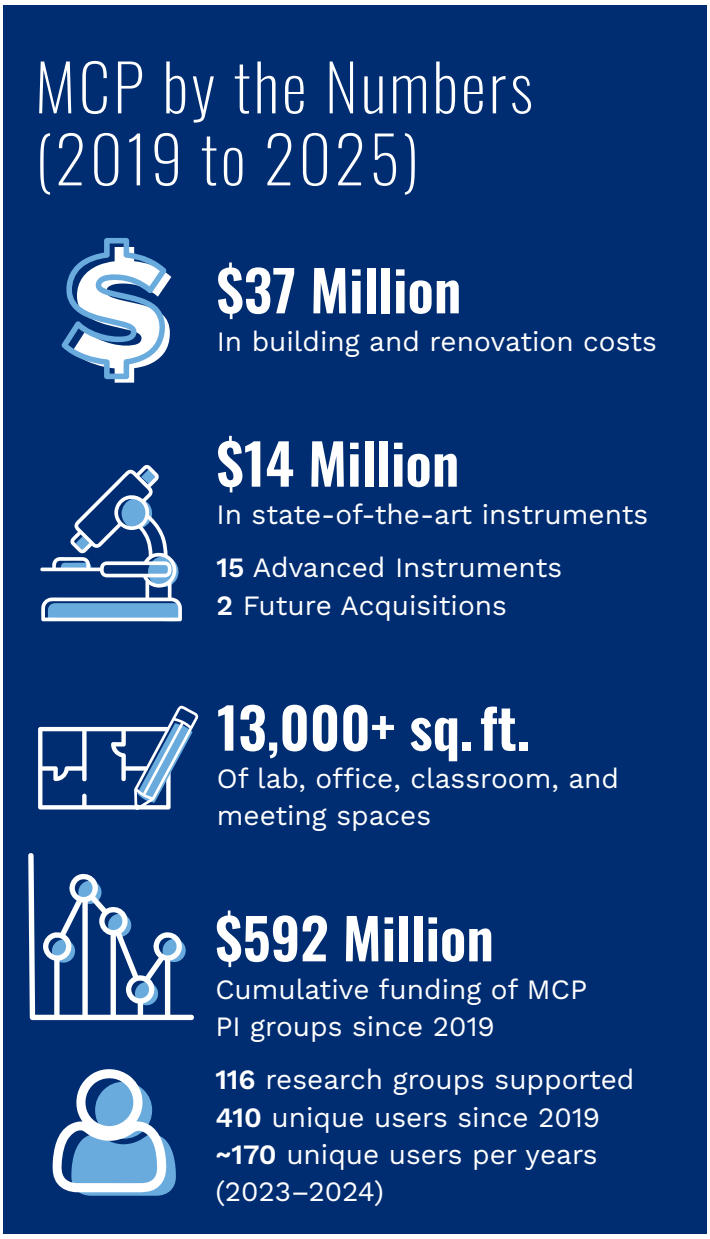


Figure 3: Key MCP numbers from 2019 to 2025.

Mission and Vision

The MCP is dedicated to becoming a premier national core user facility, advancing the frontiers of materials science research. We envision a vibrant, collaborative environment that supports transformative discoveries and innovations—both within Johns Hopkins and across the broader research community—by leveraging cutting-edge, AI-ready instrumentation for materials characterization and processing.

Figure 4: Depiction of MCP strategic goal to empower materials discovery for the benefits of society.

The MCP's mission is to accelerate materials research by offering access to advanced instrumentation and expert technical support. By harnessing the combined capabilities of the MCP and the broader Johns Hopkins ecosystem, we aim to advance materials discovery and drive the development of groundbreaking technologies and methodologies that generate impactful knowledge for society. Equally important, the MCP is committed to educating and preparing the next generation of scientists and engineers, while also engaging in meaningful outreach to serve and inspire the wider community, as depicted in Figure 4.

The core values guiding MCP staff are represented by the acronym CARE:

CARE

Collaboration among staff and with users

Accountability in daily responsibilities and service

Respect for colleagues and the user community

Excellence in all aspects of research and performance

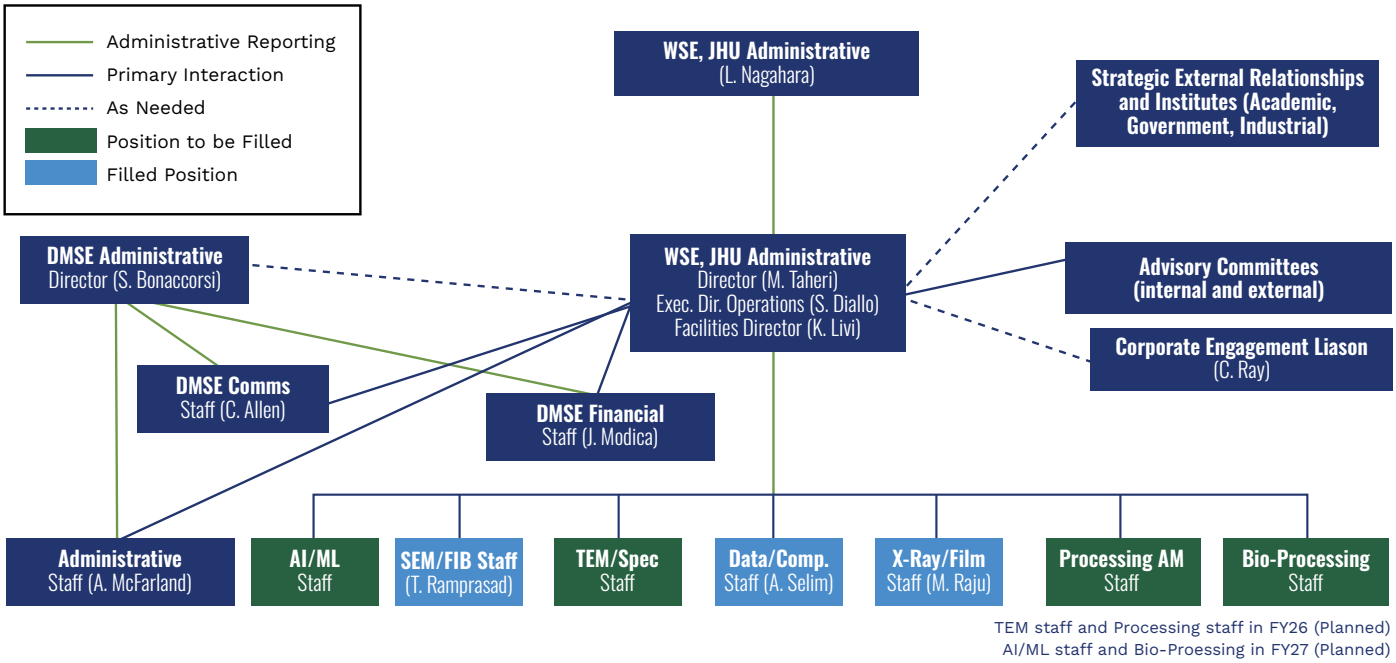


Figure 5: MCP organizational structure (as of Sept. 2025).

Organizational Structure

The organizational structure of the MCP facility is shown in Figure 5, which illustrates current and anticipated staffing lines, planned hires, and lines of interaction. This structure supports the MCP's mission by promoting technical excellence, interdisciplinary collaboration, and effective institutional coordination.

As highlighted by the chart, the top-level oversight of the MCP is led by the Whiting School of Engineering dean's office under the leadership of Larry Nagahara, the vice dean for research and translation. In this role, Nagahara relies on the MCP leadership, the MCP advisory committees, and other strategic offices in the WSE dean's office in charge of external engagement (government, academic, and industry). The Internal Steering Committee advises the MCP and WSE leadership by providing scientific guidance to support resource allocation, prioritization, and strategic and operational decision making. The External Advisory Committee offers independent external insights to the WSE vice dean for research and translation and the MCP leadership, helping to guide strategic and operational decisions.

The MCP has a relatively flat organizational structure with an integrated leadership team comprising a faculty director, an executive director of operations, and a director of facilities. Together, they oversee the program's scientific direction, personnel, instrument and facility operation. The MCP has four key technical roles currently unfilled, with two—a senior level transmission electron microscopist and processing scientist—prioritized and approved for FY26, and two artificial intelligence/machine learning and bio-processing staff members for FY27. These hires are essential to supporting the MCP's core capabilities in instrumentation operation, advanced data integration, and processing expansion.

MCP Operations

The MCP operations budget comes from the WSE dean's office and covers the salary and professional development of MCP staff, and the costs associated with running the MCP's instruments. This budget is supplemented by user fees to cover additional expenses such as service contracts, and instrument and software upgrades.

The MCP houses sophisticated instrumentation, including electron microscopy (SEM/TEM), x-ray diffraction, micro-CT imaging, spectroscopy, and materials processing equipment, including a 3D metal printer, bio-printer, and sputtering system (Figure 6).

MCP INSTRUMENT CATEGORIES

Characterization Instruments

A. Electron Microscopy Suite:

- Scanning Electron Microscopes: IT700 (JEOL), FIB/SEM (Thermo), E/SEM (Thermo)
- Transmission Electron Microscopes: F200 (JEOL), GRAND ARM: II (JEOL)
- Atomic Force Microscopes: ScanAsyst (Bruker)

B. X-Ray Instrument Suite

- MicroCT (RX Solutions)
- XRD D8 Advanced (Bruker)

C. Spectroscopy Suite

- Optical Emission Spectroscopy (Agilent)
- X-Ray Photoselectron Spectroscopy (PHI)

Processing Instruments

- Thin Film Sputtering (AJA)
- Atomizer (Amazement)
- BioPrinter (2D Regen)
- 3D Metal Printer (FormAlloy)

Figure 6: The two categories of instruments available at the MCP.

Workforce and Educational Initiatives

The MCP is committed to fostering the training and involvement of early career researchers, including undergraduate and graduate students, postdoctoral fellows, and junior faculty. Educational programs and research opportunities connected to the MCP play a key role in supporting academic and professional development. The resources at the MCP are used as hands-on demonstration tools for undergraduate- and graduate-level courses offered at Johns Hopkins. The MCP offers users structured, hands-on training sessions that provide in-depth experience with advanced characterization and processing tools. These regularly scheduled training sessions cover a diverse range of state-of-the-art equipment, including scanning electron microscopy (SEM), focused ion beam SEM (FIB-SEM), x-ray diffraction (XRD), transmission electron microscopy (TEM), 3D metal printing (DED FormAlloy), and the ultrasonic atomizer (Amazemet), as shown in Figure 7. These training programs are open to students, faculty, and external researchers, and ensure broad access to cutting-edge technologies and foster the development of practical, career-ready expertise.

The MCP supports workforce training initiatives at Johns Hopkins, such as the Promoting Research Opportunities in Engineering Labs (PROPEL) program that prepares undergraduate students for careers in STEM through a combination of research involvement and professional development training. Collaborations with the Johns Hopkins Applied Physics Laboratory create additional pathways for student engagement. Together, these programs immerse students in interdisciplinary research environments, helping them build strong technical skills and broaden their career readiness.

MATERIALS CHARACTERIZATION AND PROCESSING

WORKFORCE DEVELOPMENT

The MCP facility at Johns Hopkins University offers structured, hands-on training sessions on advanced materials characterization and processing instruments.

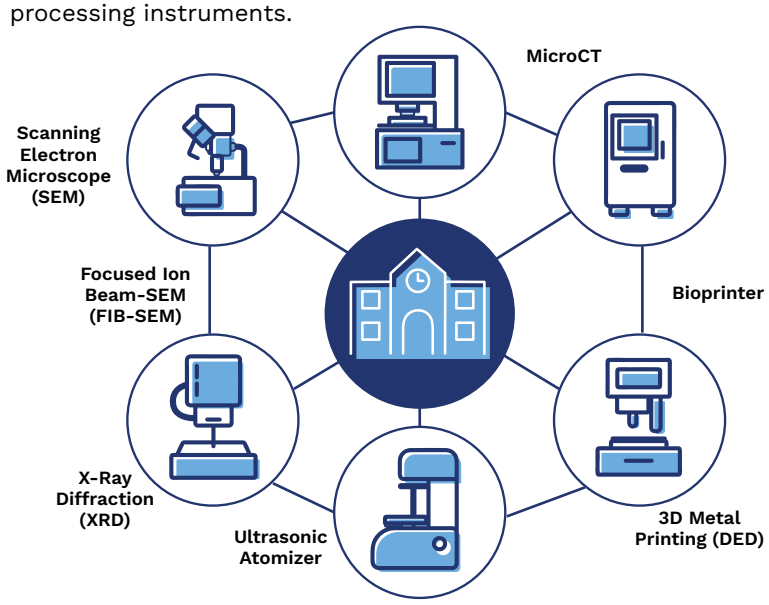


Figure 7: A broad range of advanced techniques available at the MCP for training students and the next generation of materials engineers and scientists.

Outreach and Community Engagement

Community and user engagement are central to the MCP's strategy and are fostered through workshops, seminars, and community events, as summarized in Figure 8. The Annual MCP Users Meeting, scheduled each fall, features keynote addresses, scientific presentations, and networking sessions, providing valuable opportunities for knowledge sharing and collaboration among users. The monthly TEM User Coffee Hour, occurring on the first Friday of each month, offers a casual forum for TEM users to connect, share insights, and resolve technical issues.

The MCP regularly conducts technical workshops, vendor demonstrations, and open house events designed to highlight the facility's advanced capabilities and encourage active user participation. Additionally, the MCP plans to introduce a seminar series designed to complement, rather than overlap with, existing departmental seminars, further enhancing community engagement.

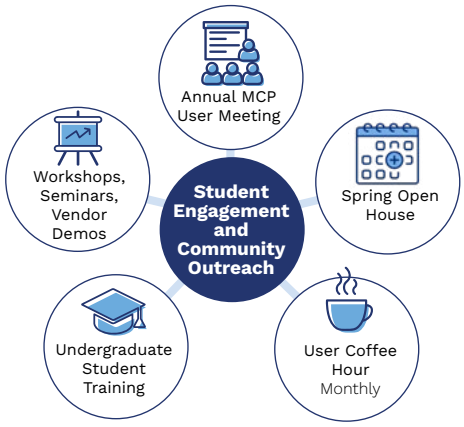


Figure 8: Primary pathways for user and student engagement

Safety Policies

The MCP strives to maintain a strong culture of safety. The MCP provides comprehensive lab safety training through online modules that are available to internal and external users. Opportunities exist to improve safety protocols, particularly through systematic in-person safety walkthroughs and improved record-keeping practices to minimize liability risks. While safety is the responsibility of everyone at the MCP, a formal safety committee, comprising MCP staff members (including the DMSE laboratory safety manager) and a WSE laboratory safety expert, monitors and oversees the implementation of a rigorous safety culture and advises MCP leadership (Figure 9).

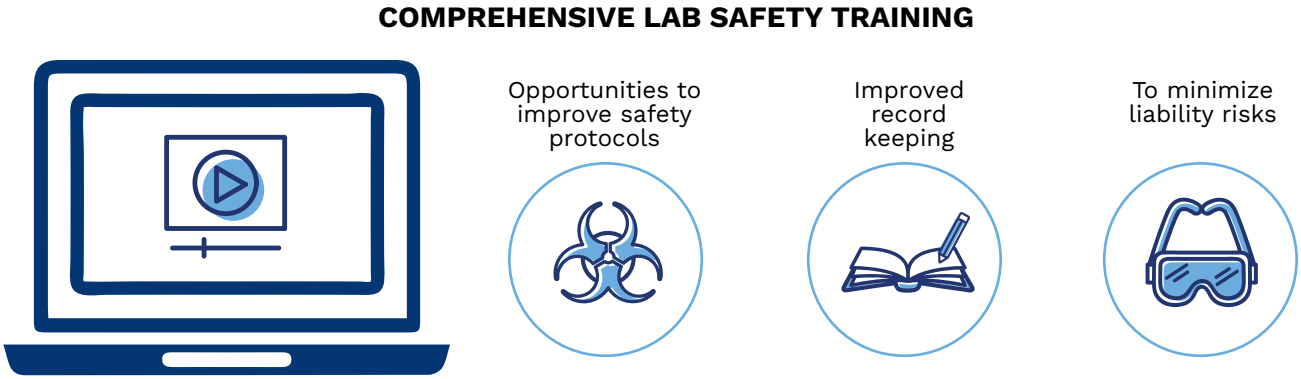


Figure 9: Laboratory safety training and opportunities available at the MCP.

Research Infrastructure, Technology, and Innovation

The MCP benefits greatly from its comprehensive suite of instrumentation and the technical expertise of its staff. These strengths are further enhanced by established partnerships with leading institutions and equipment vendors, which collectively bolster the facility's research capabilities and service quality.

Despite these advantages, the MCP faces several challenges. There is a lack of centralized data storage, leading to inefficiencies in data management. Instrument usage is uneven as it varies significantly per instrument, and staffing levels are insufficient to provide optimal support for all instruments. High operational costs and limited in-situ characterization capabilities also hinder its full operational potential.

There are significant opportunities for the MCP to enhance its efficiency and capabilities. These include forming additional strategic partnerships, developing centralized data management systems, and integrating artificial intelligence-driven processes to automate and optimize workflows.

The facility must proactively address external threats such as uncertain research funding, potential budget reductions, and escalating costs of specialized instrumentation to safeguard its long-term sustainability.

Looking forward, the MCP has considerable opportunities for growth. Key areas include the integration of artificial intelligence and machine learning into materials processing and characterization workflows, expansion of capabilities in magnetic and electrical characterization, and enhancement of infrastructure to facilitate comprehensive and automated workflows across various instruments. Embracing these opportunities will position the MCP at the forefront of innovation and maintain its competitive edge.

Data and Computing Infrastructure

Currently, the MCP is focusing on strengthening its data and computing infrastructure to better support research needs—as shown in Figure 10. A key initiative involves integrating a 2PB centralized storage system backed by the Johns Hopkins Institute for Data-Intensive Engineering and Science Ceph storage cluster, which will provide scalable and secure data storage for all users. Additionally, developing a local buffer or backup storage system at the MCP is planned to ensure data safety and continuity during network or data center outages. Recognizing the complexity of current technologies, like Kubernetes and Docker, efforts are underway to simplify these systems or consider reverting to more familiar computing environments to improve accessibility for users. Furthermore, maintaining and transferring necessary software licenses for the computer lab is a priority to optimize data analysis capabilities without impacting instrument control or acquisition processes.

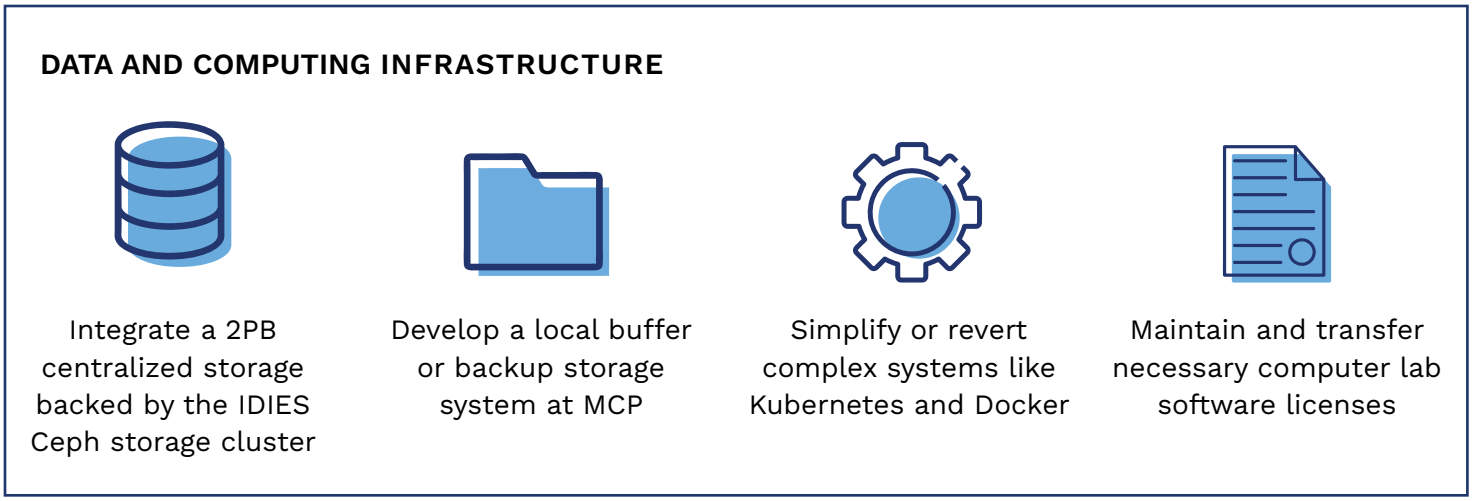


Figure 10: : The MCP's data and computing strategy.

Communication Strategy

The MCP plays a critical role in promoting science across diverse fields. Its communication strategy (Figure 11) aims to inform the public about the facility's value and to keep internal Hopkins users updated on MCP developments and access. The MCP plays a vital role in advancing science across diverse fields and places equal emphasis on effective communication and community engagement. As outlined in Figure 11, its communication strategy is designed to highlight the facility's value to the broader public while keeping the Johns Hopkins community informed about developments, resources, and access opportunities. This is achieved through active digital outreach—including social media, newsletters, videos, and an informative website—along with transparent communication about pricing and access.

The MCP can improve external engagement by building partnerships beyond JHU and boosting visibility at conferences. Streamlining contact management and planning events more strategically will also help. Collaborating more closely with WSE Marketing and Communications and linking with the academic departments' wider campaigns could raise awareness.

Marketing efforts need to be cost-effective. Investments such as paid advertisements or newsletter services must be evaluated carefully to ensure they align with the MCP's goals and deliver strong returns.

Strengths

Active digital outreach—via social media, newsletters, and a transparent website—keeps the internal community well-informed.

Opportunities

Improved external outreach, event planning, and collaboration with MarCom could expand visibility and partnerships.

Figure 11: Strengths and opportunities for improving communication with stakeholders.

Partnership and Collaboration

Collaboration lies at the heart of the MCP facility's mission. As an open user facility, the MCP fosters interdisciplinary research by providing access to cutting-edge instrumentation and expert support, creating opportunities for cross-disciplinary interaction and innovation. The MCP supports strategic research and user partnerships across Johns Hopkins University to enable shared planning around equipment acquisition, operation, and maintenance to support interdisciplinary research.

The facility also actively engages with regional partners—including academic institutions and industry—to build meaningful collaborations that extend its impact well beyond Johns Hopkins (Figure 12).

To support and sustain this collaborative ecosystem, the MCP has implemented a user charter that clearly outlines the rights and responsibilities of all users. This charter reinforces a culture of mutual respect, ethical research practices, and a collective commitment to scientific excellence.

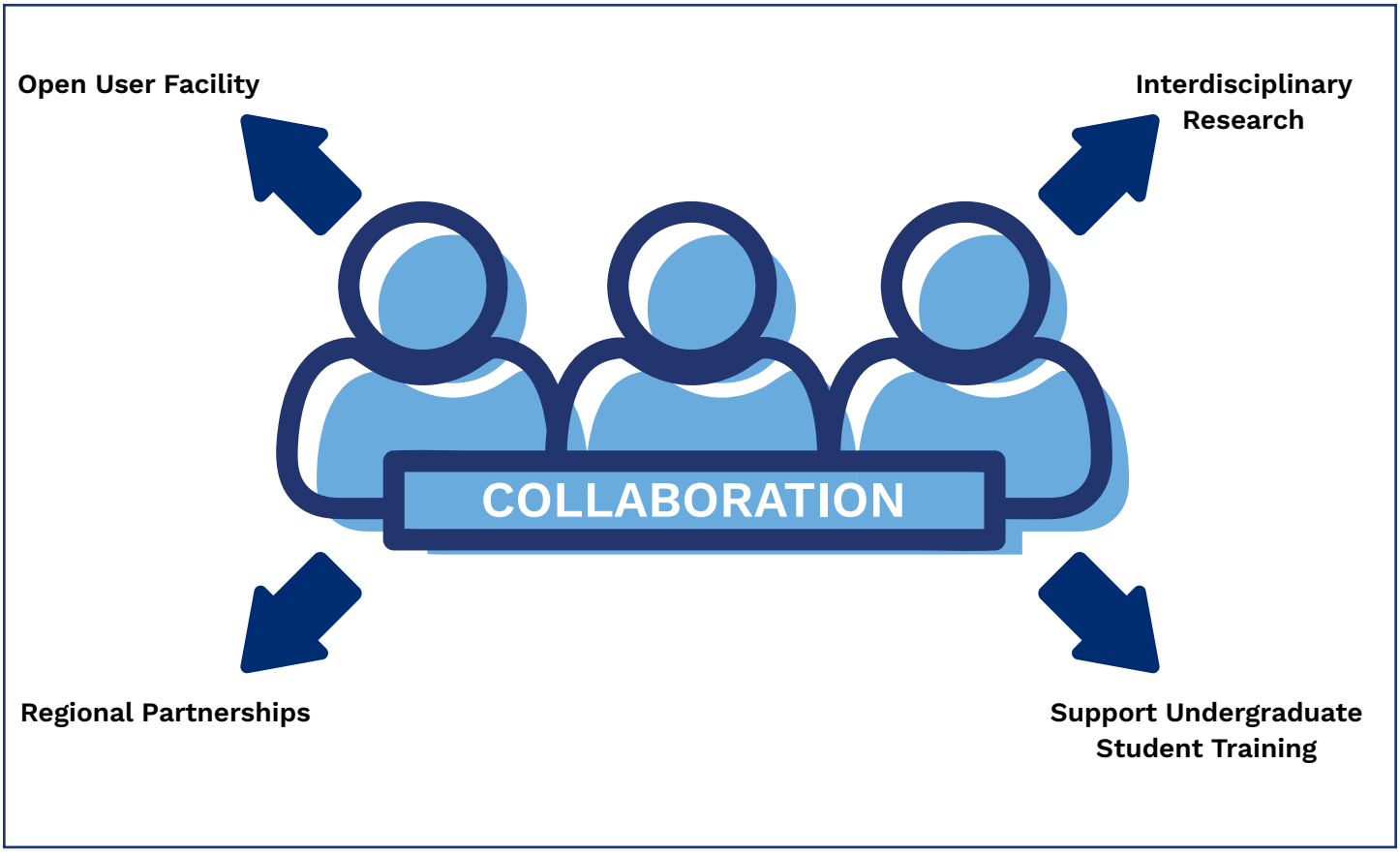


Figure 12: Strategic partnership is an integral part of MCP's collaboration strategy.

Long-Term Sustainability and Expansion Strategy

Sustained success will depend on the MCP's ability to reinforce institutional support and enhance user satisfaction. This can be achieved through strategic alignment with the mission of the various schools and new university initiatives, regular surveys/feedback from stakeholders, rigorous quality control, and improved communication channels.

Operational efficiency should be optimized by implementing strategic procurement practices and scheduling preventive maintenance to ensure equipment reliability and minimize downtime.

Developing unique capabilities, particularly those driven by artificial intelligence, will position the facility at the forefront of materials characterization and processing.

Stakeholder engagement must be increased by conducting regular reviews, hosting user meetings, and maintaining open dialogue with all parties involved.

Revenue diversification is critical, and can be expanded through industry partnerships, securing grants, philanthropy efforts, and consulting services.

Finally, maintaining flexibility in operations, staffing, and space management will be necessary to adapt to evolving research demands and support future growth.

Figure 13: Key essential ingredients for long-term sustainability, and strategic planning.

Looking Ahead

The MCP is a vital hub for materials research at Johns Hopkins, characterized by robust instrumentation, interdisciplinary collaboration, and comprehensive user engagement. While its strengths are evident, sustained growth requires strategic actions in infrastructure development, staffing optimization, external communications, and financial diversification. Immediate priorities include establishing robust data storage, optimizing equipment utilization, and enhancing operational efficiencies through automation and preventive maintenance. The action plan in Figure 14 summarizes the strategic roadmap over the short, medium, and long terms. The MCP executive director of operations, working closely with the MCP faculty director, the MCP director of facilities, and the Internal Steering Committee, will oversee the implementation of this strategic roadmap. An annual action plan (as detailed in Table 1) defines benchmarks for success, establishes performance metrics, and guides the execution, monitoring, and control of progress toward achieving the MCP's strategic goals.

To expand the MCP's user base—both within and beyond Johns Hopkins University—and enhance its visibility in the research community in the short term, several key activities outlined in Table 1 should be implemented and reviewed annually. These include:

- Publishing a quarterly newsletter
- Hosting an annual user meeting and a spring open house
- Engaging in outreach to local communities and professional societies
- Promoting MCP's distinctive instrumentation and scientific achievements

Additionally, data storage and management initiatives will be monitored under the broader category of technology and method development.

While not exhaustive, the activities in Table 1 are essential for raising awareness and demonstrating the value of the MCP's capabilities. They also provide a foundation for setting and evaluating annual performance goals.

The MCP External Advisory Committee will convene annually to deliver an independent assessment of the facility's performance to the WSE vice dean of research and translation.

Strategic Action Plan

Short-Term (1 to 2 years)

- Implement centralized data management/storage end computing infrastructure
- Strengthen existing partnerships
- Strengthen safety culture
- Improve external outreach strategies and visibility

Medium-Term (3 to 5 years)

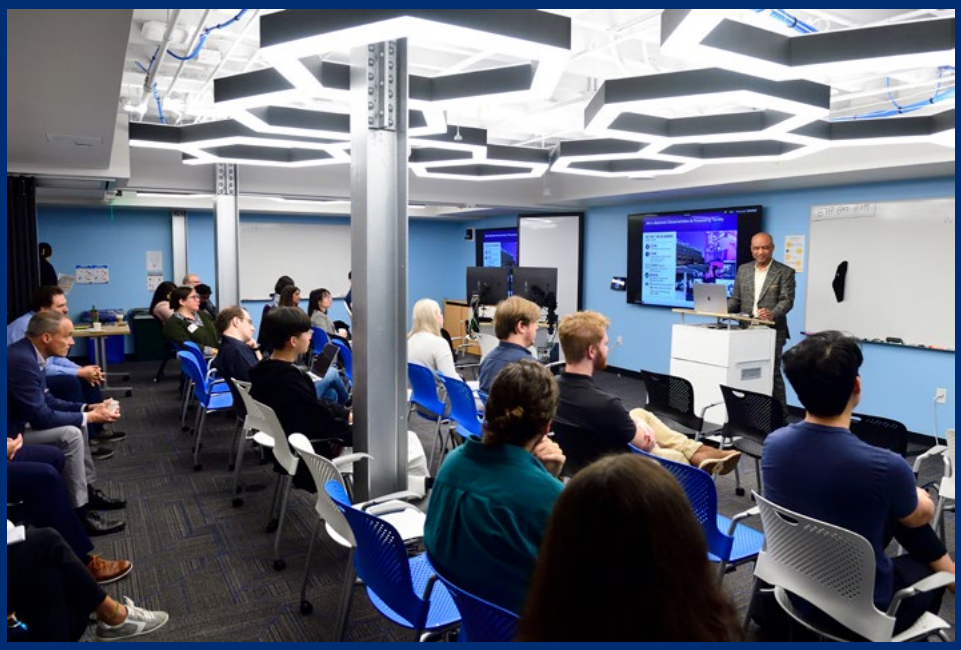
- Integrate AI and machine learning to automate materials characterization and processing
- Expand strategic partnerships and industry collaborations
- Establish additional instrumentation for broader capabilities

Long-Term (5 to 10 years)

- Diversify revenue streams significantly
- Expand physical space to accommodate future growth
- Strengthen institutional support and commitment

Figure 14: MCP strategic objectives for the next 5 to 10 years.

Sustaining strategic partnerships with APL and existing research institutes and centers—such as the Hopkins Extreme Materials Institute, the Ralph O'Connor Sustainable Energy Institute, the Institute for NanoBioTechnology, and Platform for the Accelerated Realization, Analysis, and Discovery of Interface Materials—alongside forging new collaborations, including with the upcoming nanofabrication cleanroom, will further strengthen cross-disciplinary research. These efforts will collectively drive innovation in materials characterization and processing at Johns Hopkins University.



While the MCP has completed the acquisition of all major instruments, additions such as an atom probe and a small-angle x-ray scattering system could further strengthen the research infrastructure at Johns Hopkins. Ongoing institutional support remains essential for future instrument acquisitions and upgrades.

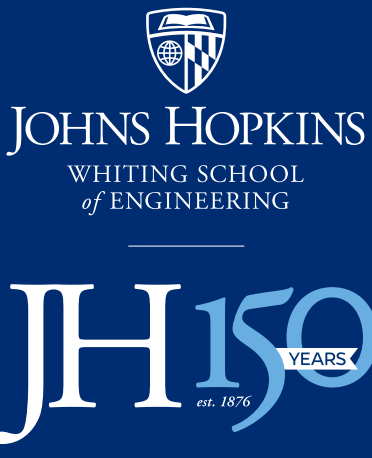
By actively pursuing the goals outlined in Figure 13 and proactively addressing potential challenges, the MCP will be well positioned to solidify its role as a leading, self-sustaining center for materials science research, education, and innovation for years to come.

MCP Annual Action Plan And Metrics

Program Initiative	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Metrics
User Support													
User Training and Support													*Users Statistics and Training Hours*
Instrument Reliability													*Operational Hours, System Failures, and Downtime*
Assisted Support and/or Scientific Collaboration													*Assistance Hours and Publications*
Facility Operations													
Operation Budget													*Operational Funds/ Obligations*
Cost Recovery Plan													*Revenues*
Method and Technology Development													
Sample Environment Deployment and/or Software Development													*Tech. Implementation, Demo, Prototype Details, and Impact*
Workshop and General Project Facilitation through MCP Staff Assistance													*Attendee Count and Feedback*
Staff Professional Development													*Conferences, Meetings, and Staff Training*
Vendor Interactions, Center of Excellence Agreement Support, Industrial Workshops													*Attendee Count and Feedback*
Education and Workforce Training													
Support for Microscopy and Materials Characterization Courses													*Participant Count, Feedback, and Career Path*
REU Support/Mentoring													*Participant Count and Feedback*

Program Initiative	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Metrics
Community Engagement and Outreach													
Annual User Meeting													*Participant Count and Feedback*
MCP Spring Open House													*Participant Count and Feedback*
TEM Monthly Coffee Hour													*Participant Count and Feedback*
Onsite Tours and Site Visits for Local University/ College Classes													*Participant Count and Feedback*
Funding/Grant Support													
Letters of Support for General PI Grants and Collaborations													*Number of Letters, Participant Count, Successful Grants, Amount of Grant Supported*
Public Relations and Communication													
Quarterly Newsletter and Social Media Posts													*Readership Count (contact list) and Feedback*
Professional Organizations Meetings (MRM, M&M, TMS, JHU Events)													*Participant Count and Feedback*

Table 1: MCP annual action plan and metrics.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