Preparing the Engineering Library of the Future: Changing Services, Structures, Staffing, and Resources - A Case Study

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Abstract

Engineering libraries have been transforming spaces for the last 20+ years by moving collections to a digital environment, having more collaborative learning spaces and integrating innovative resources like maker spaces. This has led to changes in the long-standing interactions with the College of Engineering (CoE) and the library as more content is available online, and library users no longer have to come to the library in person to access the library collections. Librarians are engaged in new service models, and staff are no longer visible in locations like reference and information desks. The library is also adjusting to organizational changes brought about by the pandemic as well as planned transitions, such as Engineering subject liaisons becoming organizationally aligned as HS-STEM, spanning the disciplinary boundaries of Health Sciences and Science, Technology, Engineering, & Mathematics, within the new Research Division.

Organizational changes have allowed not only the closer examination of library services and resources but also the re-envisioning of how the library engages with the campus and how collaboration works within the team of HS-STEM and the Research Division. HS-STEM has requested and acquired new positions such as the Biomedical Engineering librarian, the Council of Library and Information Resources (CLIR) Fellow, and the new management position of Associate Director, Engineering Librarian. Re-engagement was established with the Engineering Library Faculty Advisory Committee, and an engineering librarian has been appointed to the CoE Curriculum Committee. This transformation facilitated innovative, team-based collaborations at HS-STEM for Collections, Grant Funding, Research Impact, and Informatics, serving our HS-STEM clientele.

The process began with a series of questions about how to organize the library structure and services to increase their relevancy and how to engage with the user communities to maximize the impact. How are the changes affecting the library's services and resources? What are the library's vision and plans for the future? This case study will address these questions and talk in detail about the changes that have been implemented, how they have been accomplished, the obstacles that were faced, and how the library is moving forward.

Introduction

This paper is a case study on transformational changes underway at the University of Michigan's Art, Architecture and Engineering Library (AAEL). These changes reflect forces impacting the broader institutional and higher education landscape. Libraries are a unique entity in academia,

encompassing four core areas: space, collections, services, and expertise. Engineering libraries have been transforming spaces for the last 20+ years by moving collections to a digital environment, having more collaborative learning spaces and integrating innovative resources like maker spaces. This has led to changes in the long-standing interactions with the College of Engineering (CoE) and the library as more content is available online, and library users no longer come in person to access the library collections. At the same time, CoE is experiencing growth in enrollment (8,823 students in 2011 to 10,655 in 2021) and programmatic initiatives by adding new departments and absorbing some established ones like Robotics, University of Michigan Transportation Research Institute, Integrated Systems and Design, and MCity. The library is responding by exploring ways to increase partnerships and collaborations and to further integrate library services into the engineering educational and research enterprise.The library is examining the traditional roles and responsibilities of liaison librarians and identifying opportunities for new ways of engaging with the library's user communities to better meet their information needs and to increase the visibility and relevancy of library services.

For the past two years, the library has been adjusting to organizational changes brought about by the pandemic, including implementing new and different modes of service delivery by utilizing information and communication technologies for socially distanced interactions, such as the following:

- moving to virtual library services
- introducing contactless delivery of library resources
- establishing remote and hybrid work agreements
- providing reference consultations online
- teaching online library classes and workshops
- attending webinars, professional conferences, and other professional development via Zoom and other video conferencing platforms

Prior to the pandemic, the library was engaged in a series of organizational structure changes, coming together as a new entity, bridging the disciplinary areas of Health Sciences and Science, Technology, Engineering, & Mathematics, called HS-STEM, within the new Research Division. The new Research Division further aligns the disciplinary areas of Arts and Humanities and Social Sciences, along with Health Sciences and STEM. Organizational changes have allowed for the examination of library services and resources and the re-envisioning of engagement within the broader campus community. Realignment of the library's structure has also strengthened collaboration between the teams of HS-STEM and the Research Division.

Preparing for the future requires strategic planning in examining core library areas including services, spaces, collection resources, and staffing models. The library has introduced new positions supporting programmatic initiatives and collaborative partnerships with academic

colleagues. Engineering librarians have also accelerated collaborative engagement with faculty colleagues through faculty governance and appointments to core academic structures. In addition, engineering librarians have actively engaged in new approaches to collection management, aimed at providing a more sustainable system for disseminating research and scholarship. All these changes within the library are in keeping with current trajectories and directions for research institutions, including an accelerated pivot to STEM programs and growth strategies [7].

As part of this strategic planning and case study, a series of questions are being explored which are designed to help us prepare for the future of the library: How are the changes affecting the library's services and resources? What are the library's vision and strategic directions? This case study will address these questions and discuss in more detail the changes that have been implemented, how they were accomplished, the obstacles that were faced, and how the library is moving forward.

Literature Review

Planning for the future, as noted by Staley & Malenfant, involves making a serious commitment to "observation, intuition, interpretation, creativity, and imagination" [14]. This case study is purposefully reorienting how the engineering librarians are engaged in planning, aimed at futures-focused research, to inform decision-making about academic library services and to be forward-facing as the library adjusts to a changing educational and research environment [3]. Libraries of the future have an opportunity to become a primary location for fostering cross-disciplinary interactions, to promote partnerships and other academic community engagement, to become centers for research data and centers for student experience, and to coordinate open educational resources, among many other contributions that can be made to research and scholarship [3]. Academic library planning must be influenced by the broader institutional perspective, according to Bail & Bragdon, and in order to be truly knowledgeable about campus strategic initiatives, librarians must have a "'seat at the table' on key committees and working groups" [2].

Maron and Smith ask "How are we to understand new forms of scholarship and scholarly works in their own right?" [11] which is also brought up by Carpenter et al. who inquire about important needs associated with preservation of scholarship [4]. Schonfeld & Housewright describe the current dilemma for academic librarians as a sort of balancing act between, on the one hand, performing more traditional services facilitating discovery, access, and preservation of resources, while on the other hand, introducing more innovative roles and services which seek to provide solutions to unmet needs that may be "newly relevant and even essential" to scholars who have become distanced from the library [12]. The risk for the academic library is that in

embracing new roles and services, it may lose "the support of its most ardent supporters" for the traditional services [12].

Several authors in the literature highlight the importance of collaborative partnership building in academic libraries, emphasizing the importance of liaison library services [1, 5, 6, 8, and 9]. Church-Duran references the value-add of liaison librarians in partnering, innovating, and developing distinctive library services [5]. Creelman et al. state that "constant change and adaptation" are part of the role of liaison librarians [6]. Allee et al. and Eskridge also call attention to the centrality of liaison roles in building academic partnerships [1, 9]. Eskridge asserts that "positive relationships are the primary deliverable for liaison librarians, meaning that the nuances of building positive relationships – the personality traits and interpersonal dexterity called "soft skills" – are some of the most important parts of the job" [9].

HS-STEM and Research Division Alignment

In November 2017, three formerly separate libraries and staff were brought together under a University Library organizational restructuring that sought to align the disciplinary areas of health sciences, sciences, and engineering. The three libraries had physical locations on Central Campus, the North Campus, and Medical Campus. The reorganization grouped libraries into the disciplinary areas of Arts and Humanities, Social Sciences, and Health Sciences and STEM (HS-STEM) as part of a new Research Division on campus. The rationale for the HS-STEM regrouping reflected the interdisciplinary and programmatic features of the pre-professional programs of the health sciences, engineering, and sciences; the research intensive emphasis and focus of the areas; the cross-pollination of joint faculty appointments and joint degree programs; similarities in collection development and acquisitions with a particular emphasis on electronic resources, databases, and journals; as well as librarian expertise in curriculum and research integration, partnership building, and high performance teamwork. The rationale for the Research Division realignment positions the disciplinary departments as a cohesive entity for future-oriented, innovative, collaborative, and user-focused integration with campus-wide research initiatives and programs, fostering the library's emphasis on and engagement with the university research community.

To facilitate the merger of the health sciences, engineering, and sciences staffing, the library partnered with a consultant in planning and conducting a workshop retreat, entitled "Moving Forward as a Powerful Combination," that brought together leaders from HS-STEM libraries and staff to conceptualize and articulate the strengths of the libraries and to define a shared vision, mission, and goals. The merger was scaffolded by the establishment of a leadership team with representatives from the three libraries, including the director of HS-STEM, two associate directors for the health sciences, and associate and assistant directors for STEM, with one

associate director focused on STEM/Engineering and one assistant director focused on STEM/Science.

The leadership team is responsible for the development and implementation of HS-STEM goals and initiatives, in alignment with the University Library's Strategic Framework [21] and Research Division goals and initiatives, in 10 functional areas: assessment; instruction; engagement - clinical, research, communications & technologies; data; informatics; diversity; partnerships; community outreach; global health; and grant development. Jointly developed goals allow both flexibility for disciplinary differences as well as collective collaboration in boundary-spanning areas such as research impact and reproducibility; data management and visualization services; expert searching; innovative approaches to sustainable instruction; curriculum integration; research integration; and library services mapped to the research life cycle. In addition, the leadership team is responsible for succession planning and the mentoring and professional development of all team members, including individuals who aspire to leadership roles in the organization. Team members interested in future leadership roles are encouraged to participate in a wide variety of library and campus organizational development opportunities and professional library association leadership development programs. The combination of approaches to planned leadership development, plus best practices of working in a team-based environment, allows the library to effectively manage both onboarding of new employees and retirements and departures for other opportunities in order to be prepared for the future.

New Position: Biomedical Engineering Librarian

One facet of the reorganization that showcased the advantages of the health sciences and engineering alignment was receiving new funding from university administration which enabled the library to grow the HS-STEM team. Funding for the position was a priority for the University Library to help address a staffing shortage of engineering liaison librarians within AAEL compared to other libraries on campus. The specific focus on biomedical engineering was in response to the growth of research in this area. The new position was designated specifically to advance the services, initiatives, partnerships, and strategic agenda designed to advance the institution's research enterprise with the goal of recruiting a liaison librarian to engage and collaborate with faculty, researchers, and students primarily affiliated with the university's biomedical engineering communities. The primary liaison responsibilities were to the Biomedical Engineering department (BME), a joint department between the CoE and the Medical School, with strategic focus in the following key areas:

- Cultivating new models of engagement and building partnerships between the library and academic, clinical, and research biomedical engineering communities
- Developing and promoting new value-added library services, resources, and programs

to advance biomedical engineering research, education, and practice

- Providing effective and innovative instruction and consultation on the use of information resources and research practices

- Providing consultations to biomedical engineering faculty, researchers, and students at each stage of the research life cycle, on topics such as research data management, scholarly publishing, grant development, and research integrity

- Partnering with faculty by actively contributing to research proposals and projects, curriculum development and delivery, and evidence-based decision making

The size of the Biomedical Engineering program has increased and that has resulted in the BME liaison librarian having an opportunity to focus more on the design of 100 level classes. Connections between the library and the BME department have always been strong, but now the approach is more integrated between instruction and consultations. The BME liaison librarian works in particular with classes that have a research and design component as part of the requirements. There is currently a combination of one graduate and five undergraduate courses meeting these criteria (i.e., BME 211, BME 450, BME 451/452, BME 458, BME 599.002). In addition, the biomedical engineering librarian has assumed liaison responsibilities in other areas to help distribute the amount of work and relieve the workload of three other librarians. The additional departments the biomedical engineering librarian liaises with are Mechanical Engineering, the University of Michigan Transportation Research Institute, and Integrative Systems and Design. Some of the other classes associated with the position are introductory level engineering courses plus courses in mechanical engineering and design science that meet the research and design criteria for liaison inclusion (i.e., ENG 100.500, ENG 100.510, ENG 100.580, ME 311, ME 335, ME 450, ME 505, ME 512, ME 520, ME 557, DESCI 791).

In a relatively short period of time, and in spite of the pandemic and its impact on educational and research environments, the biomedical engineering librarian's contributions have had a significant impact: 1) advancing the development of a variety of instructional resources, including Canvas modules and instruction videos; 2) increasing the number of consultations on research projects; 3) bringing a new perspective to library planning discussions and teamwork interactions; and 4) more equitably balancing the liaison responsibilities and workload of other team members.

Collaborative Departmental Internship Partnership & CLIR Fellow

Efforts to increase the library's integration into the CoE's educational and research environments and to support the library's strategic plan to evolve and engage user centered services led to partnering with faculty in the Department of Mechanical Engineering in the recruitment and hiring of a Council of Library and Information Resources (CLIR) fellow to study energy social science, with position support funding from CoE. The CLIR Postdoctoral Fellowship is a mutually beneficial career development program that offers recent PhD graduates the chance to

be an active collaborator at the host institution to work on timely research projects designed to carry out strategic goals; to partner in the development of specialized tools, resources, and services; and to advance research and knowledge production processes while also exploring career opportunities [20].

The CLIR fellow is currently participating in a research project to analyze changes in employment data as the automotive industry is moving from internal combustion engine automobiles to electric vehicles. The position is a dual report to Mechanical Engineering faculty and the Associate Director for Engineering Librarian for a two-year appointment. This arrangement introduces a baseline, allowing us to further build partnerships between the library and departments within the CoE and to pilot different models for funding internships, fellowships, and other types of specialized positions.

Engineering Faculty Library Advisory Committee (EFLAC)

The EFLAC is a long-standing organizational structure component within the CoE, and members have been appointed by CoE for over seventy years. The group comprises one of twenty committees within the college, and it is part of the college's faculty governance structure. The first mention of the group was in the Engineering Library Annual Report for 1954-55, when a committee was appointed to help with selection of the library materials in the Phoenix Library located in the Phoenix Memorial Laboratory established on North Campus, as this was to be the new location for CoE. Subsequent annual reports mention the faculty committee's collaboration with the library in conducting large cancellations of journals, decision-making around library moves, and in providing input and advice on various proposals prior to approaching the college at large. In more recent years, with a variety of organizational changes on campus, both within the CoE and the library itself, the committee had gone dormant.

The faculty advisory committee's role was revived by making a request for its continuance to CoE administration, adding new members, and re-engaging committee members in decision-making by providing opportunities for feedback on specific, timely topics. The EFLAC members convene a few times each semester. Discussions were held on several themes relevant to advancing Open Research and Scholarship initiatives, including open access and transformative agreements, copyright policies regarding digital collections and resources, and institutional repositories. Recently, the EFLAC chair was instrumental in strategic planning efforts to increase the library's integration and engagement in educational initiatives by providing support for the proposal for a librarian to be added as a member on the Curriculum Committee. To strengthen the proposal, the ELDNET-L listserv was surveyed, as well as some colleagues on campus who are on their respective curriculum committees, to help inform the proposal and build the case for the advantages to library integration.

Curriculum Integration

A long-standing goal for the engineering liaison librarians has been to have a representative serving on the CoE's Curriculum Committee. This gap in having such a connection was especially noticeable with the HS-STEM alignment. Librarians and informationists in the health sciences schools have established, sustained partnerships in participating in curriculum development within the Medical School, Nursing School, School of Dentistry, and College of Pharmacy and actively participate on curriculum committees for the health sciences schools and colleges.

In the Spring of 2021, a letter was written to the CoE Associate Dean for Undergraduate Education, requesting to have a librarian representative on the CoE Curriculum Committee. The letter had support from the EFLAC Chair, and received a positive response, based on the case that was made, reflecting the many advantages to the college of including librarian perspectives and contributions, including the following:

- Scaffolding information literacy instruction with the CoE's strategic plan [22] which states, "College leaders aim to ensure the preeminence of a Michigan Engineering education by empowering faculty to innovate teaching methods and tools, online and professional education, and experiential learning – and by helping students navigate the beyond-the-classroom experiences." Examples of integrating information literacy could be:
    - Having engineering librarians be part of the student First Year experience
    - Working closely with Technical Communication faculty and the Center for Research on Learning and Teaching (CRLT) to provide innovative instruction
    - Making instruction a more inclusive learning experience for students
- Being part of the Curriculum Committee, librarians will make sure all the Accreditation Board for Engineering and Technology (ABET) [19] criteria are met, and librarians can also serve as committee members as part of the accreditation process
- Providing a collaborative, partnership perspective, from other related professions which are also engaged in and committed to the education of the engineering student
- Increasing knowledge and awareness of curriculum and student requirements (classes, assignments, projects) in order to better link expertise, provide information resources, and support collection acquisitions. An example of curriculum integration could be:
    - Creating a seamless experience with course resources for both faculty and students such as e-Textbooks and Open Textbooks
- Partnering on curriculum based grants and developing additional teaching and learning engagements with faculty and students

The Associate Director for the Engineering Library was appointed to the Curriculum Committee as a non-voting member, beginning September 2021. Membership on the committee, even after only one semester, has already proven valuable by 1) providing an opportunity to learn about all the new courses and programs being planned for addition to the engineering curriculum and 2) giving librarians time to thoughtfully prepare for further integration of library services and resources in the future to better meet the teaching, learning, and research information needs of engineering faculty and students.

One of the emergent programs is the new undergraduate degree in robotics. The program is one of the first of its kind in the U.S. [18]. As a member of the Curriculum Committee, the Associate Director for the Engineering Library has already begun liaising with the Director of the Robotics Department with plans for working together to develop a series of Open Educational Resources [17] that can be used locally as well as shared with other robotics programs at other institutions.

Liaison Services & Engagement in Instruction

Current Instruction Support Provided   *(created by J. Niehof)*

In recent years, engineering librarians have developed relationships with Technical Communication faculty who are involved in most of the research classes that have communications and research components associated with them. This, in turn, has had a positive result in liaison librarians being invited to provide library instruction for more design and

engineering 100 level classes. Liaising with a large engineering school has inspired the four engineering librarians to apply creative solutions for meeting the increased demand and to begin planning for more sustainable approaches. Engineering librarians have created several Canvas modules and asynchronous videos for student learners. Engineering liaison librarians have also increased the number of consultations they provide, especially for the design classes.

In addition, during the pandemic engineering librarians received requests from post-docs for a workshop series, and since the series was offered online, the content was made available to a wider audience. Increased emphasis was placed in developing workshop resources which are more applicable to graduate students and postdocs. Before the pandemic, minimum emphasis was placed on doing open workshops as in-person attendance had dramatically declined. The transition to offering workshops online via Zoom made the workshops independent of location, and attendance has increased. For the foreseeable future, open workshops will be offered online as long as attendance levels are met. Workshop sessions are also recorded, and the information is available to students, registrants, and attendees if they want to review the content or if individuals could not attend because of a scheduling conflict, now making the workshop sessions independent of time factors as well as location.

In 2021, engineering librarians provided support for 27 curriculum-related classes, offered 17 open workshops, answered 244 reference questions, and held 89 research consultations. These numbers represent an increase over previous years.

Research Services in HS-STEM

HS-STEM librarians and informationists provide a wide-array of library services in support of the research lifecycle. These efforts represent an organic alignment of expertise to collaborate with campus partners, some of which predates the HS-STEM merging of services and resources. HS-STEM librarians and informationists work together as a partnership team on projects such as Finding Funding, the Research Experts Library Representatives Group, the Informatics Interest Group, and Research Data Services. The project groups have a large percentage of members from HS-STEM in addition to members from other parts of the University Library, particularly within the Research Division.

- The Finding Funding group offers workshops, develops and maintains a research guide on grants, and triages reference questions related to these activities.
- The Research Experts Library Representatives Group works together in promoting Michigan Research Experts along with providing expertise on issues related to research impact. One collaborator, a senior strategy manager in the Medical School's Office of Research, has stated, "In many ways I look at our librarians as the true stewards of Michigan Research Experts and what it can become" [13].

- The Informatics Interest Group meets regularly to discuss informatics initiatives. The group has also conducted projects such as research on use of lab notebooks, and they coordinate and promote National Center for Biotechnology Information (NCBI) informatics workshops and training.
- A group of HS-STEM librarians and informationists have responded to research funders' data management plan (DMP) requirements by developing library support services, becoming involved in data education opportunities, participating in DMP review groups, and maintaining current awareness of new or revised regulations around data management.
- Recently we have done collaborative work on SciENcv for NSF (National Science Foundation) and NIH (National Institutes of Health).

Library Support for the Research Lifecycle   *(created by J. Niehof)*

Developing an HS-STEM Approach to Collections Management

The alignment of HS-STEM libraries has created a new structure for collections and resource management. The new model defines a lean structure for collection development and leverages personnel, resources, and funding to optimize library support for teaching, learning, and research engagement in the disciplinary areas of health sciences, engineering, and science. The new model consists of seven roles: Director of Collections, Research & Scholarly Communication; Associate Director; two Collections Specialists, one for Health Sciences and one for STEM; and three Collections Managers, one each for health sciences, engineering, and science. Operating as the HS-STEM collections group facilitates the leveraging of resources for larger purchases that have interdisciplinary appeal and are boundary spanning.

Engineering librarians have changed how they do collection work as most of the engineering resources are bought in online packages. A move toward purchasing bundled subscriptions has resulted in a limited amount of time engineering liaisons spend doing collection work due to the implementation of a more centralized approach for collections management and the freeing up of liaison time to focus more on integration of library services into educational and research initiatives. The Associate Director for the Engineering Library, who is also the Collection Coordinator for Engineering and Science, manages the engineering specific packages, approval plans, and on-demand title purchases. Many of the general packages are managed centrally by the University Library's Electronic Resources Officer. Engineering librarians still have authority to make on-demand purchases in response to faculty and student direct requests, while the Collection Coordinator manages licensing renewals for the larger subscription packages.

Like most other university libraries, the library is preparing collections strategies and considering the implications of moving toward transformative agreements [16]. Being a highly productive research institution means a change to transformative agreements has the potential to substantially increase the collections budget. Journal packages have been purchased where the cost for transformative agreements involves a minimal increase, and the library is also participating in consortial arrangements to support open access publishing through group licensing renewals for some of the larger publisher agreements. For some packages, where transformative agreements are cost prohibitive, discounts have been negotiated at renewal if the authors publish online. In addition, the library is exploring alternative approaches to sustainable funding such as increasing consortial licensing of resources and looking at multi-payer models for funding author publishing fees. Faculty surveys and focus groups on campus are being administered, as part of the library-wide Open Research and Scholarship initiatives, in order to gain faculty input and capture perspectives on open access publishing to have an informed decision-making process.

Future Plans

For many years, library services have been provided to the CoE community with limited staffing resources. During more recent years, expansion of staffing and services has been made possible by growing the team through the HS-STEM alignment, which has resulted in new funding for recruitment and internship partnerships. Having the additional capacity has resulted in an expansion of liaison services and outreach, even during the COVID-19 pandemic. In planning for the future, and exploring ways for continuing to expand library services, these areas represent priorities:

- Integrating further into design classes, including curriculum development, consultations, and participation in group meetings

- Creating a Canvas course for graduate students, emphasizing building library research skills and promoting increased awareness of liaison librarian services spanning the research life cycle
- Increasing partnerships on research grants and having librarians as part of grant project teams
- Identifying new roles for librarians in new programmatic areas

Two position proposals are currently in development - one for a STEM resident librarian term appointment position, and the other for a Robotics librarian to liaise with the new CoE Robotics Department that includes both graduate and undergraduate programs.

Conclusion

During the past four and a half years, core engineering liaison services areas have increased. These service areas include instruction, consultations, collaborations, and reference questions. All of these increases have been sustained throughout the pandemic, even with adjustments in work schedules, hours of operation for physical library spaces, and utilization of different modes of service delivery, such as Zoom and web conferencing. Going forward, metrics need to be explored for assessing impact and measuring the difference provided, in consultation between liaison librarians and faculty colleagues and collaborators. An example of this is reflected in the blog by Thielen which explores the data-informed question of which instruction delivery format students prefer: in person or online videos [15].

These metrics will be useful in ongoing efforts for defining the library's strategic directions. For the futurist A. Gordon, who writes about forecasting, adaptation, and change management, "the worth of a forecast is in how well it prepares us for an inherently uncertain future" [10]. Gordon advocates that libraries reflect on forecasting and assess "whether it has illuminated the unknown while shaking our assumptions, forcing us to clarify our thinking, stimulating and structuring difficult discussions, and getting us to ask the right questions and face the hard choices required to adapt ourselves and our organizations to manage future change" [10]. This has been a guiding theme for the case study in preparing the Engineering Library of the future by checking assumptions, asking difficult questions, and making the organizational changes and adaptations to best meet the future with well-planned and well-designed library services.

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