Which books? Where? ...

Enhancing an academic library renovation project with creative open stack print collections services

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Abstract

This paper describes how Arizona State University Library used creativity and novel approaches to collections design and implementation processes to select open stack print books for a newly renovated academic research library. Using results from a workshop focused on rethinking the future of print within educational learning and research environments, the Collections Services and Analysis unit within Arizona State University Library performed a series of experiments to better understand the purpose and use of print collections within 21st century library design. The authors describe the creative processes used in collections design and three types of selection approaches that invited engagement with open stacks. These three types were: small browsing collections co-curated with community members, a medium-sized print collection selected for student engagement, and a large research collection selected using a novel data analysis of four factors affecting the likelihood of potential use. Using more than one million volumes as the basis for selection, approximately 185,000 volumes were installed in the renovated library through a complex implementation across four library locations. The authors discuss the key role that creativity played in the approaches, methods, and results of these efforts and offer recommendations for collection management teams seeking to maximize their pursuit of community engagement with print collections within contemporary academic library spaces.

Keywords

collection selection, creativity in libraries, print book collections, open stacks, data analysis, collection development, library spaces, library shelving, library planning, open stacks, library renovation, collection design, design process, collections engagement

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Introduction

In 2017, Arizona State University (ASU) embarked on an approximately two-year, $90 million reinvention project to transform Hayden Library, a flagship library focused on humanities and social sciences, to support 21st century learning and discovery. Senior ASU Library leadership reconceptualized the library's spaces and services through a massive building renovation, which opened the door to a fresh approach to the design of library collections within this building.[1] This paper describes how the ASU Library Collections Services and Analysis team used creativity to address the design challenges inherent in planning and implementing physical collections for a reconceptualized, contemporary, 252,600-square-foot academic library, in time for its reopening in early 2020.

The scholarly literature of the past two decades elucidates a sea change in library design that significantly reduces or eliminates print collections in libraries in favor of repurposing space to accommodate the changing social needs of teachers, learners, and researchers (Bennett, 2003; Somerville & Brown-Sica, 2011; Sandy, Krishnamurthy & Scalfani, 2014; Yi, 2015). While choosing to follow this design trend, senior leaders, including University Librarian Jim O'Donnell, also recognized the value in retaining print collections within academic libraries (O'Donnell, 2017). Keeping print materials within a user-centered dynamic space called for the exploration of new strategies for using print materials as a method to engage, educate, and inspire users in a contemporary educational context. Print books are no longer "pleasant furnishings and backdrops for quiet study," but may function as active objects of engagement for a new generation of students and researchers (McAllister & Laster, 2018). Grant funding supported a project team tasked with the design and selection of inclusive and engaging print collections for library visitors in the newly renovated facility. As part of this "future of print'' initiative, library staff were empowered to use their creativity to develop and implement workflows to select, acquire, stage, relocate, and manage open stack collections that aligned with the reinvention project. The project team subsequently developed three approaches to selection of materials. Developing a clear vision and narratives about the purpose of collections on each floor of the library and then employing these approaches facilitated designing collections for a massive, empty library. This paper describes the creative design process and approaches to open stack book selection methods, including a novel data analysis process for a large research collection. The authors communicate the results of these processes, along with an overview of the complex three-phase implementation, resulting in the relocation of around 830,000 circulating volumes among four library locations over a twelve-month

1 Design can be used in a myriad of ways. Here, we use the word "design" to mean the "activity of imagining the future, setting goals, and finding ways to achieve those goals," as described by Jackson (2009).

period. The discussion describes the role of creativity in library collections work and the lessons learned regarding the three approaches to selection, implementation, and initial reception of the collections. The authors also provide recommendations for collections leadership in using print as an engagement tool within contemporary library spaces.

University Library context

At the point the project planning began in 2017, Arizona State University served nearly 73,000 students in its full-immersion programs on four campuses in the Phoenix metropolitan area, and an additional 30,500 students in its online programs; for Fall 2023 these numbers are nearly 80,000 and over 66,000, respectively.[2] The university's decades of growth is the result of President Michael Crow's expansive vision to significantly broaden access to high quality public education while also contributing to meaningful societal impact (Crow & Dabars, 2015; 2020). ASU Library operates within this conceptual space, seeking to align its services and practices with the New American University concept by expanding its online services while intentionally designing flexible campus library spaces that support a variety of academic and intellectual engagements, as well as quiet study and reflection (McAllister & Laster, 2018a). ASU Library serves all students in the 800+ academic undergraduate and graduate programs and majors available at the university, along with the teaching and research needs of the faculty. The Library now hosts eight library locations, four of which are on the Tempe campus, including the largest library on this campus, Hayden Library. Prior to the renovation project, Hayden Library was home to 1.1 million volumes, including Library of Congress (LC) classes for all disciplines except the arts, music, and science and technology. The second-largest library, Noble Library, was constructed in 1983 as the campus science and engineering library. The other two locations on the Tempe campus, the Design and the Arts Library and the Music Library, offer spaces and services for engagement with these disciplinary communities. In total, ASU Library locations have more than two million visitors to our buildings annually and house millions of print books, in addition to extensive online holdings. Library collections play an important role within the expansive concept of the New American University, which informed the design approach to collections within the Hayden Library reinvention project.

Hayden Library reinvention

Hayden Library, named for Charles Trumbull Hayden, a colonial settler, businessman, and judge who helped found the city of Tempe and Arizona State University, was originally built in 1966 by the architectural firm of Frederick Weaver and Richard Drover. The building consisted of a four-story "tower" and housed 600,000 printed

2 For enrollment trends, see: https://www.asu.edu/facts/#/facts/enrollment/campus-major.

volumes that were transferred from the old Matthews Library to serve the needs of humanities and social sciences learners and scholars at the growing Tempe campus (Arizona Board of Regents, 2024b). The library was subsequently expanded in 1989 to meet the needs of the growing student population at ASU. The scope of the 2018-2020 Hayden Library renovation included only the 1966 portion of the building. The 1989-era lower concourse and lower level remained open throughout the renovation project, with staff workspaces, University classrooms, and a small collections space. The lowest floor of the 1966 building was the last section of Hayden to close for renovation in early 2018, and the first to reopen post-renovation, with University classrooms scheduled for use in Fall 2019 and subsequent floors scheduled to open early in 2020. The closing and reopening timelines for these building sections necessitated the development of a complex collections relocation plan and staggered collection development planning that matched the building's renovation timeline.

The University sought to update Hayden Library and reinvent it as "a hub of 21st century discovery, innovation and learning" that would help "materialize the vision of ASU as the New American University and the leading center for global interdisciplinary scholarship and discovery" (Arizona Board of Regents, 2024). This reinvention project offered an opportunity to rethink how physical collections may be used to meet the contemporary needs of researchers, scholars, and learners who largely work within digital scholarship contexts.

Starting in the summer of 2017, well over one million books were dispersed among other library locations to clear the 1966 building for the renovation project. The 1989 building addition remained open as a service point and to accommodate a limited number of readers and classes. The collections materials that were cleared from Hayden Library included federal, state, and local government documents, microforms, and specialized holdings, including rare books and archival materials, which were sent to other libraries or off-site storage facilities, depending on collection's preservation and access needs, content focus, LC subclass, and/or loan frequency. For example, books that fell into the higher-circulating LC subclasses, such as Language and Literature, were sent to Noble Library, just a short walk from Hayden, while the bulk of the STEM collections that had been housed at Noble Library were sent to temporary storage on the Polytechnic campus for processing into the library's high-density storage facility. Books that fell into less-circulated LC subclasses were also processed into high-density storage. The extensive microforms collection was relocated to a temporary space on the Polytechnic campus to facilitate microform retrieval and digitization services. State and local government documents that had records in the library catalog were processed into high-density storage, while federal documents were relocated to the West Valley campus in Glendale and housed at Fletcher Library to facilitate retrieval. Library staff also inventoried and moved the vast majority of specialized collections holdings from

Hayden Library to a new, permanent storage location. In all, more than one million books and more than 2,300 linear feet of special collections were removed from Hayden Library. It was a period of massive change for ASU Library, Tempe campus, and the local ASU community.

Reinventing Hayden Library collections

University Librarian Jim O'Donnell secured a planning grant from The Andrew W. Mellon Foundation to support intra-institutional dialogue about "the future of print" in academic libraries. Lorrie McAllister, Associate University Librarian, served as project manager for this grant, developing the collaboratively authored white paper "The Future of the Academic Library Print Collection: A Space for Engagement," released in October 2017 (ASU Library, 2021; ASU Library, 2017). With the knowledge gained from these conversations, McAllister drafted a three-year, $381,000 implementation grant titled "The Future of the Arizona State University Library Print Collection: A Collaborative and Data-driven Approach to Stack Design and Curation" in coordination with O'Donnell, which was also funded by The Andrew W. Mellon Foundation. The subsequent project work necessitated experimentation with collections as an engagement tool, conceptual work regarding how to conceive of physical collections within a large 21st century academic research library, and creative design and process work to inform which collections would reenter the newly renovated library.

Following the white paper, and with the implementation grant funding, McAllister began assembling a team to successfully carry out the collections portion of the Hayden Library reinvention project. In January 2018, Shari Laster joined ASU Library as the Head of Open Stack Collections, a new unit that united operations and strategic program implementation for all of the library's open stack collections in print and digital formats. Laster then served as the project coordinator for the Mellon Foundation-funded "future of print" grant under McAllister's leadership. Tammy Dang, Data Analysis Specialist, and Emily Pattni, Curation Specialist, were hired in the summer of 2018. With this team, and with the collaboration of many other library staff members across the organization, we began our work.

First, we experimented with reconceiving open stack collections as an engagement tool through small-scale browsable collections. The team developed eight collections, pairing a library user group with a potential space, a subject matter or concept, and a method to select materials for the collection. For example, Pattni led the creation of a collection of health resources in collaboration with faculty members in the Health Sciences for the Downtown Library, using a shared list-making approach to selection. The team then spent almost a year in collaborative processes to select books and materials for these small browsing collections and learn from the methods used, lessons learned, and impacts on users, while understanding the

resources needed to continue this "high touch" collections service past the grant period.[3] This experimentation resulted in our later development of the Sun Devil Reads collection for Hayden Library, as mentioned later in this paper.

With our project team in place and some community engagement underway, we embarked on the conceptual work of designing Hayden Library collections for the reinvention project. The architecture firm for the reinvention, Ayers Saint Gross, and the project manager for ASU Library, Associate University Librarian Tomalee Doan, provided McAllister with initial floor layouts, shelving diagrams, and approximate linear foot counts for each of the five floors. Due to deep experience with contemporary learning space design, Doan led space planning for the library, specifying flexible, reconfigurable classrooms and collaboration spaces, a makerspace, a geospatial hub, a data science instruction space, and several other updates to the library that brought the space use into an updated research context.

McAllister, meanwhile, conceived of the collections design, working within the project specifications, overall vision for the reinvention, and time constraints. The biggest challenge was that the reinvented Hayden Library would re-open with only one third of the volume count previously supported. The larger percentage of collections managed by ASU were to be stored off-site or made available through online platforms. McAllister realized that developing a guiding concept and purpose for each collection area specified in the space design was key to selecting the highest-priority materials for the reinvention project. In addition, because only a percentage of materials would re-enter Hayden Library, effects on all other collections locations needed to be considered in the design, process, and implementation timelines. In addition to design constraints, McAllister was also interested in refreshing the print collections with new updated volumes. With these ideas in mind, the project team aimed to answer the question: Within a contemporary educational environment, where online resources are readily available, how should you go about selecting print works for a reinvented and inclusive library space? One of our answers was to work with our user communities to understand which types of tangible materials needed in-person engagement, and of those, which were the most important to have present in Hayden Library. In pursuing this vision, McAllister also wanted to empower the project team to seek creative and novel ways to solve problems during all phases of the project. Taken all together, this design approach was informed by McAllister's extensive experience as a curator and librarian working with faculty and students within academic architecture, landscape architecture, city planning, and design programs.

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3 As of May 2024, an article manuscript describing this process, "Experimental approaches to transforming academic library print collections," is in submission.

Selection

Traditional good practice for selection of library materials utilizes well-crafted collection development policies that inform selection decisions made by library workers. Prior to the Hayden Library renovation, McAllister led the development of an overarching collection philosophy that governs policies in focused subject areas, such as those guiding collection development in Psychology, Government Information, or Geospatial Information. The collection philosophy guides collection decisions through a mission-aligned commitment to student success, excellence and innovation in research, and social embeddedness in Arizona's communities.

When selecting for the Hayden Library reinvention, there were many challenges in broadly conceiving of the physical collections that re-entered the building. We had millions of volumes across our collections from which to select, and the selections needed to align with the building reinvention concepts set forward as part of the project. In addition, the project team sought to utilize what we learned as part of the eight collections experiments and other "future of print" grant-funded research and work. The reinvention articulated a vision for contemporary teaching, learning, and research spaces that were flexible and supported a range of activities and technology integrations.

Using these starting points, McAllister synthesized the inputs and constraints into a design problem and then led a design charrette with a group of library personnel to develop user-centered collections concepts for each floor and shelving area. The group brainstormed about possibilities for each floor, noting areas of potential and possible challenges. Then, each person participating in the charette spent some time individually working through their ideas by drawing on copies of each floor plan. When satisfied with their proposed ideas, each person presented their favorite ideas for each floor to the broader group. The group collectively discussed each one, pulling the favorite ideas and drawings up to pin on the wall. The discussions in the charette helped the team develop a collections narrative for each floor. With our draft in hand, we presented these designs for discussion with library administration, librarians and archivists, and user services staff. McAllister and Doan also gave poster presentations at various faculty events to get input on our proposed directions. With positive feedback and some adjustments, the final collections design satisfied all of the criteria set forward in our design problem and still adheres very closely to the following narrative:

- Concourse level: This level hosts eight new University classrooms. With shelving and soft seating areas adjacent to each classroom, the books on the concourse level are selected in conjunction with faculty and students to enhance the curriculum taught in these classroom spaces. This necessitates a team approach to curation as an extension of our engagement activities. ASU Library's curation team aspires to work collaboratively to present

featured collections that change and grow in concert with coursework and the activities slated for this floor.

- First floor: The first floor of Hayden Library presents a grand entrance to the library that is also an introduction to ASU Library's collections. The lobby is flanked by two grand reading rooms: the formal Wurzburger Reading Room for distinctive collections and the Luhrs Arizona Reading Room, which is a reading room that is open to all. The open stack collections in the Luhrs Arizona Reading Room feature books and materials related to Arizona and the southwest region. The collections were selected from what were previously the closed stacks of the Greater Arizona Collection, the Chicano Research Collection, and the Labriola National American Indian Data Center. An interactive collections exhibit space and a small local zine collection also invite visitors to explore the scope and variety of print collections pertaining to Arizona.
- Second floor: The second floor was designed primarily for student study, so it is home to ASU Library's community-curated collections, many of which are selected by and for students. Eye-catching and browsable collections are presented by utilizing display strategies and arrangements not traditionally found in academic library stacks. Using print materials as tools for engagement is intended to encourage reading and foster lifelong learning. Students can explore topics of interest, organized by thematic categories, in our Sun Devil Reads collection, and browse themed book displays located next to several of our seating areas. This floor also hosts collections of the Labriola National American Indian Data Center as part of a space that supports enactment of ASU Library's Indigenous land acknowledgement of the twenty-three Native Nations that have inhabited this land for centuries, including the Akimel O'odham (Pima) and Pee Posh (Maricopa) Indian Communities, whose care and keeping of these lands allows us to be here today (Arizona Board of Regents, 2024a).
- Third floor: Hayden Library's third floor was conceived of as home to a maker space, a geospatial hub, a data science team, presentation practice spaces, silent study for graduate students, and a workspace for visiting scholars. This floor demonstrates the expansion of research collections far beyond the book. The Map and Geospatial Hub provides access to thousands of cartographic resources while supporting geospatial technologies. The Unit for Data Science and Analytics offers numerous ways to explore and transform vast digital collections and resources to discover new insights. The Makerspace displays samples and specimens for exploration and to invite inquiry. Small, focused featured collections complement the services available.

- Fourth floor: This floor was conceived of as a space for individual study, focused research, and small group work. The open stacks on Hayden Library's fourth floor are research collections designed to change and grow with our community. They include highly used and recently acquired items of relevance and interest to researchers in history, humanities, literature, and related disciplines. This floor also features the Scholars Enclave, a curated set of volumes that redefines the traditional reference collection to feature works that are suited for in-person research. The perimeter shelves house featured collections that highlight scholarship and offer insight into our book collections over time.

With our draft narratives in hand, our next challenge was to engage in thoughtful selection of the materials to include in the new Hayden Library collections. Encompassing nearly four and a half million open stack resources across all ASU Library locations from which to choose, the reinvention of Hayden Library allowed our team to be curious and creative in the overall approach to collections design.

Materials and methods

In this section, the project team lays out the approach and reasoning methods used in the selection of volumes for the Hayden Library reinvention project. We purposefully chose to limit our selection of materials to print volumes only, continuing to provide access to microforms, audiovisual materials, government information, and newspapers from other library and storage locations. We transformed our microforms services to primarily an online fulfillment model and migrated most periodical subscriptions to online formats. We also decided to store many serials in high-density storage, providing scanning services to fulfill article-level content requests to users through web-based document delivery. In leveraging existing online services, the project team limited selection of print volumes for Hayden Library to those that would be most engaging to users of the library spaces.

Based on the floor-level collections designs and draft floor narratives, the project team began a more detailed process of working with the architects and furniture design teams to specify each shelving area. The team worked through various furniture options regarding shelving type, height, configurations, and usability issues. Using this feedback, the architecture firm developed a modified set of plan and elevation drawings of shelving on each floor, which we used to estimate volume counts in each area. Planning for each collection location and each shelving section of the renovated Hayden Library was complex and required three different approaches and methods for selection and implementation. We will describe them in this section as 1) small featured collections, 2) a medium-sized, student-focused collection titled "Sun Devil Reads," and 3) a large-scale open stack research

collection. First, however, we will describe our overall approach to planning how to use available shelving to determine the volume count for each area.

Overall approach to shelving

The shelving elevation drawings (Figure 1) depicted shelving units of varying heights on the first, second, and fourth floors, with perimeter shelving that is interspersed with study desk nooks and display areas. This arrangement presented several challenges, including usability, accessibility, and ensuring that users understood how the LC call numbers used in our collections could flow around the space and around these desks, seating areas, and displays.

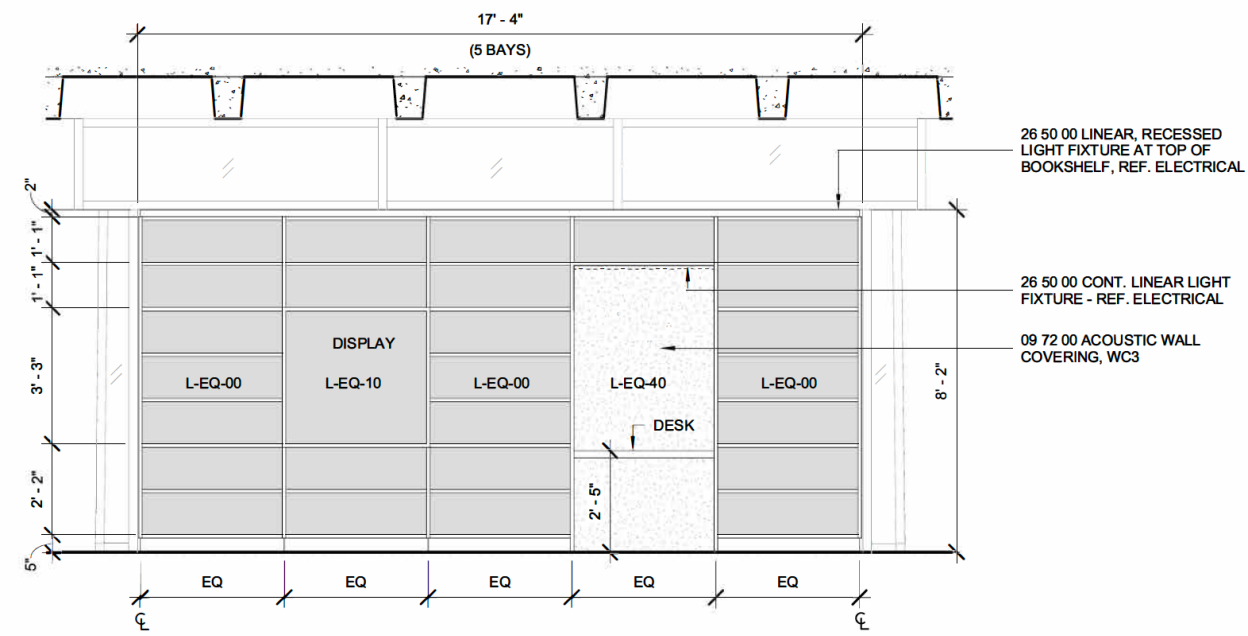

Figure 1: Sample elevation drawing of perimeter shelving

To understand how to best design collections to fit the shelving in each space, we reviewed possible ways that our collections could "flow," or be shelved in logical order, throughout the new spaces to achieve a satisfying user experience. The project team researched other libraries' floor plans to investigate if there was an "ideal" flow of call numbers around a library floor to maximize usability of the collections. The team also sought to understand if and how other libraries incorporated perimeter shelving in their floor plans and, if so, how the call numbers flowed between shelving areas. As a benchmarking exercise, we gathered a sample of publicly available floor plans from other libraries and modeled how our collection might look using similar layouts and flows, noting that perimeter shelving is most typically used only when it is parallel to closely adjacent rows, which would have excluded nearly all of the perimeter shelving in the layout intended to house the fourth floor stacks. In most of our test design iterations, the presence of desks,

displays, and built-in seating areas within perimeter shelving units made it difficult to incorporate them within a flow of call numbers in a given area. The project team determined that the continuous interruption of call numbers due to these desks, displays, and seating areas would make it unclear to users which direction to turn when trying to retrieve a particular book, and staff would also find it confusing to reshelve and retrieve particular call numbers. Ultimately, this investigation led the team to dedicate the "interrupted" sections of perimeter shelving containing desks, benches, or displays to house featured collections, with the "uninterrupted" sections of perimeter shelving incorporated into the collections flow.

Small featured collections

"Featured collections," within this project context, are small collections of open stack volumes designed to invite browsing and community participation, with the books or themes chosen by our communities to reflect the diverse needs and interests of users. For the Hayden Library reopening, we planned a series of featured collections of around fifty to two hundred books each. The Curation Specialist, Emily Pattni, collaborated with student groups and faculty to co-design browsable collections that created learning opportunities for such topics as teaching diversity through children's literature, environmental awareness, and representing marginalized voices. We encouraged collaborators to suggest book titles regardless of whether or not we already owned them. Although it meant purchasing a large number of new books, we saw this as an opportunity to identify gaps in our holdings and encourage our communities to participate in the collection development process.

To order the new titles, we worked with the library's Acquisitions team to develop a new process for placing, purchasing, and receiving orders for physical materials designated for featured collections. Books, DVDs, and other physical items to be purchased were listed on a spreadsheet with necessary bibliographic data, such as title, author, ISBN, publisher, and year of publication. Pattni then submitted a request to purchase each title using a form, and Acquisitions staff rush-ordered these materials through approved vendors, such as ProQuest or Amazon. Titles ordered in this workflow were routed through a special physical processing queue that sent the volumes to Hayden Library with work orders routing them to the staff responsible for staging collections to move into the renovated building; this process also retained dust jackets for Preservation Services to attach.

When books were ready for the shelf, library staff updated them to the appropriate location code corresponding with the assigned featured collection. With over thirty featured collections, we needed a systematic approach to display or exhibit locations. Items in an exhibit location are assigned a temporary location code while retaining their permanent location code within their record. Because featured collections are intended to remain in place for long periods of time, many with no

planned end date, we needed a system that would allow staff and users to locate books in a featured collection without an endless proliferation of temporary location codes. Rather than request the creation of a new location code for each collection, we designed groupings of shelving areas based on their proximity, giving these areas names that corresponded to assigned location codes. The library's online strategy team adapted a practice already in use for course reserves to temporarily append call numbers in Alma, the library's catalog service platform; eventually, this team created an API for staff to add and remove the names of featured collections.

For example, an item belonging to the "Utopias and Dystopias" featured collection in its new temporary library location would have the following data in its record:

- Permanent call number and location: **HX810.5 .E54 2001** in Noble Library Stacks
- Temporary call number and location: **HX810.5 .E54 2001 Utopias** in Hayden Library Lobby

We also worked with the library's graphic design and communications team to design and incorporate clear and pronounced signage that distinguished featured collections from the continuous stacks. Consistent graphic communication, along with displaying books with their original covers on bookstands, resulted in a series of visually appealing featured collections that can be easily moved from one location to another. This allows the collections teams flexibility in customizing featured collections and adapting library spaces for events and special initiatives.

Student-focused collections - Sun Devil Reads

"Sun Devil Reads" is an open stack collection developed specifically with undergraduate students in mind. Due to the student-study design focus of the second floor of the Hayden Library reinvention project, the project team aimed to present an open stack collection that would engage students and encourage reading and exploring books beyond the classroom. We gathered feedback from our eight collections experiments, along with our staff's knowledge about the interests of student communities that use library spaces, with an intentional focus on making spaces designed to meet student preferences for study and relaxation into welcoming areas for traditionally underserved communities. By providing books that appeal to a wide range of self-identified areas for academic and personal growth, we sought to equip our communities with resources to support the development of lifelong learning and enjoyment.

Library administration approved one-time funding to create an opening day, shelf-ready collection. Based on the available options from our contracted vendor, ProQuest, we chose to model our collection after the Dixon leisure reading collection at Princeton University, which focuses on contemporary works, both fiction and

nonfiction, for general and leisure reading.[4] Working with a vendor was desirable for an "opening day" collection because they agreed to provide us with cataloged, shelf-ready volumes, and they could potentially provide new volumes on an annual basis. We specified publishers, genres, subjects, interdisciplinary themes, and reading levels, and the vendor completed the selection process on our behalf. Reviewing sample lists and providing feedback led to the selection of 11,000 fiction and nonfiction books published from 2017 to 2019.

Our original intent was to organize these materials following BISAC subject headings,[5] but the vendor was unable to provide classification services within our budget, and the number of volumes involved was too great for our metadata specialists to classify each one using a system unfamiliar to them. This led to the decision to create our own approach to organizing books for browsing. By sifting through sample lists, grouping together subjects and genres, and looking for patterns, we eventually identified a list of around twenty-two browseable categories that integrated fiction and nonfiction into thematic clusters.[6] We chose category names that invite exploration and describe a wide range of subtopics. For example, we grouped books about food, fashion, artists, and art forms in the Lifestyles and the Arts category. Working from a vendor-generated spreadsheet that provided titles, authors, and subjects, we sorted the majority of the books into such categories as Identity, Mystery, and Popular Culture prior to their arrival. There were, however, a number of books that we left unassigned due to a lack of information. As books began to arrive, we manually sorted these remaining books into categories and rechecked assigned categories for other books, reassigning them as we saw fit.

To address the volume of shipments required to accomplish this project (over a thousand books received per week for ten weeks), staff at our high density storage facility on the Polytechnic campus handled receiving and checking in these books, following guidance from the Acquisitions and Metadata teams. Books were then sorted and staged based on the assigned category. These books remained on staging shelves until they were moved into the newly renovated Hayden Library, at which point they were installed on the second floor, shelved in LC call number order within each category section.

Designing test-fits based on shelving capacity

In designing the layout for Sun Devil Reads, our goal was to incorporate elements of retail bookstores that invited library visitors to browse print books and discover something new to read among varying display layouts. We also recognized that we

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4 https://library.princeton.edu/collections

5 https://bisg.org/page/bisacedition

6 For the full list, see: https://lib.asu.edu/collections/open-stacks/hayden/2nd-floor/sun-devil-reads

needed to design this section to be easily adjustable over time, as usage data will inform the addition of a small number of books annually to keep the collection fresh for students.

Using the floor plans provided by the architects, and with estimated counts of books per category based on the pre-arrival category assignments, Tammy Dang, Data Analysis Specialist, created a layout for categories to fill the shelving sections. Using playtesting, Dang determined potential shelf fill rates and capacity. Visual mockups of shelves allowed the project team to compare traditional shelving styles with display-only shelving and also with blended shelving options. Eventually, we chose five style configurations (Table 1) at different levels of aesthetic fullness to provide estimates for ways in which categories could take up more or less space in a shelving area.

	Option 1: Standard Shelving	Option 2: Classic Shelving and Display	Option 3: Shelving Split and Display	Option 4: Minimal Display	Option 5: Display Combo #1
Est. Volumes Needed	19,278	13,770	6,885	2,034	6,364
Standard Shelving					
This is traditional standard shelving, often found in academic library stacks. All books are shelved flush to the left with spines out.			**Est. Volumes Needed:** 19,278		
Classic Shelving and Display					
This shelving mixes standard shelving with 1-3 books displayed on bookstands with book covers facing outward.			**Est. Volumes Needed:** 13,770		
Shelving Split and Display					
This nontraditional approach encourages browsers to scan titles on both the left and right sides of the shelf.			**Est. Volumes Needed:** 6,885		
Minimal Display					
This shelving style uses the fewest books to appear "full," but it requires some interspersed shelving with more books so that a selection is available to replenish the empty spaces when books are taken.			**Est. Volumes Needed:** 2,034		
Display Combo					
These mixed display options depend on shelf height. For example, this combination varies the Shelving Split and Display option with Minimal Display.			**Est. Volumes Needed:** 4,832 - 6,364		

Table 1: Shelving style configurations and estimated volume counts for Sun Devil Reads category sections.

Once we established capacity estimates based on the display style options, Dang was able to work with an editable surrogate for the shelving layout to incorporate each of the categories onto the shelving. In an example configuration (Figure 2), we placed categories in sections based on where they fit by linear feet of space and subject cohesion.

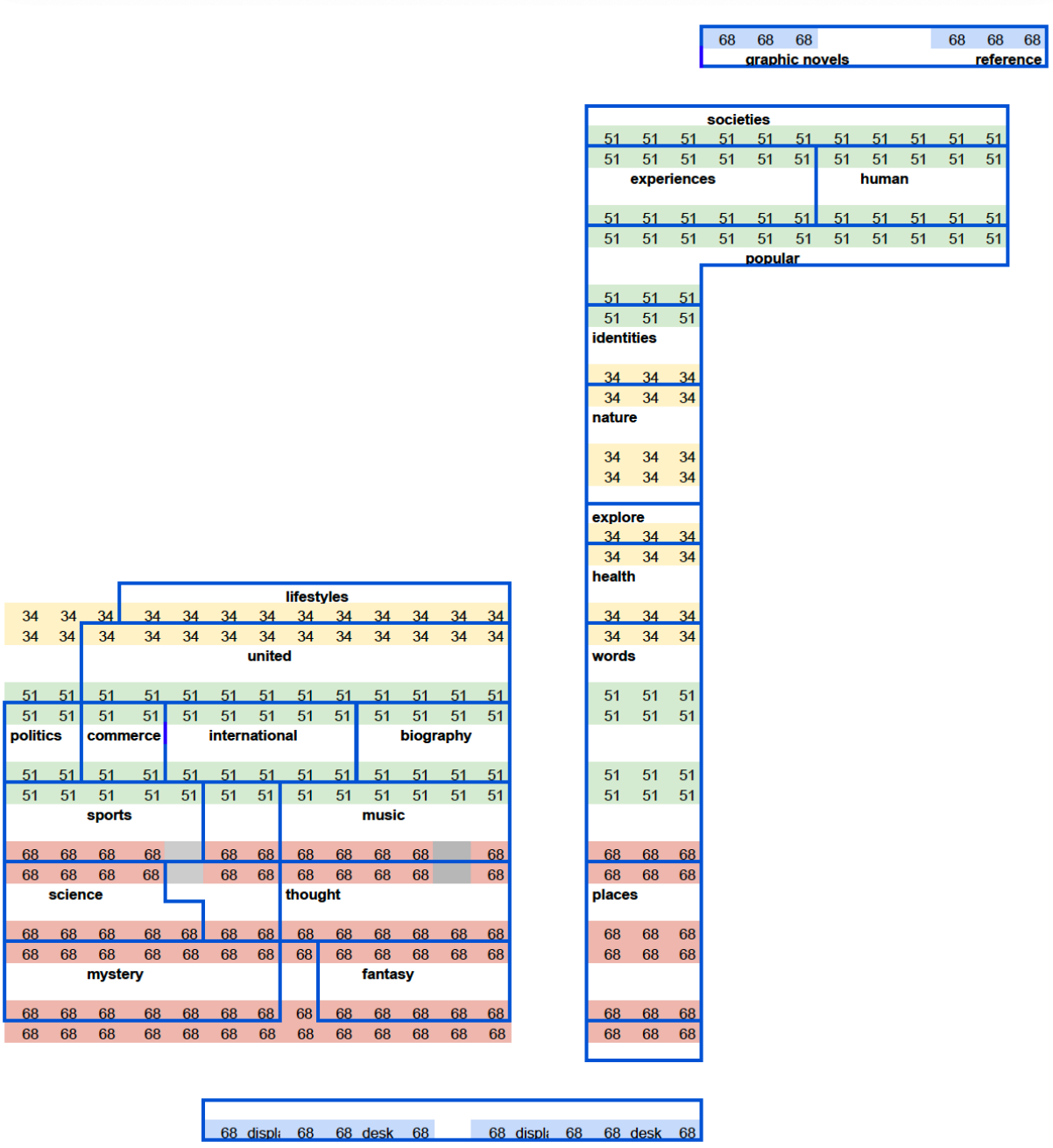

Figure 2: Sample category layout for Sun Devil Reading shelving.

Following a practice similar to what we developed to manage featured collections, we included the assigned category at the end of the call number in the catalog

record.[7] Within each category, books are shelved by call number, but the final layout relies on signage to separate each group and make browsing easy for users.

Large-scale open stacks for research

To fill the newly renovated fourth floor of the Hayden Library, while also designing a complementary stacks collection for Noble Library, the project team collaborated with staff from throughout the organization to design and implement novel methods for selecting and identifying books to be moved, using data to inform a large-scale analysis.

The methods needed to accomplish the following:

- They needed to generate a layout design for the stacks collection that invites a logical approach to browsing sections of the collection or locating known books.
- The resulting collection should also provide a balance between responsiveness to usage patterns or other indicators of potential interest in works and a proportional representation of the library's overall holdings.
- The methods needed to be responsive to the varying book storage locations in which volumes were temporarily held.
- They also needed to be feasible to implement with available staff, student workers, and contracted movers.

The staggered relocation of hundreds of thousands of volumes was a three-phase, twelve-month, large-scale collections project, requiring the involvement of over fifty staff members and around ninety moving truck trips. The major stages of planning used to execute this project are outlined in the following sections.

Assessing ASU Library's collections

The Data Analysis Specialist, Tammy Dang, began surveying the existing print collections by creating an internal report summarizing books in each library by collection location and comparing collections by percent of distinct loans. Out of 1.2 million volumes remaining in public-facing library locations as of mid-2018, 59% had been borrowed at least once. Over 600,000 items had already been moved to Noble Library from Hayden Library prior to renovation, most of which were in the Literature and History subject areas. Through the report, the team gained a better understanding of the content and scale of items in these public-

7 In Alma, temporarily appending a call number can only be done for holdings in temporary location codes, so these books are assigned their permanent location as a temporary location.

facing collection locations. This information later helped us create targeted volume counts in proportion to the collection size and usage, as well as determine which LC subclasses would return to Hayden Library and which would find a new home at Noble Library.

Next, the project team wanted to better understand circulating collections that fall within the Arts and Humanities subject areas. To create an internal report for this analysis, Dang selected the LC classification ranges of A-BT, N-NX, and P-PZ as high-level markers, resulting in a grouping of nearly 900,000 items. This second report focused on the loan trends of LC classification ranges by date of last circulation and by publication year, and it separated audiovisual materials from non-audiovisual materials. Dang also used narrower LC subject headings, down to the subdivision level, in order to view the collection through finer lenses. Both the general internal report and the report on the Humanities subject areas allowed the project team to test different filters and views of the data by most recent loan date, percent of items loaned, percent of items loaned by recent 5-year increments, subject area, material type, publication year, year added to the collection, and assigned location. With this data, we could highlight important factors within a volume's loan history, including recency of loans and proportion of recently loaned items within an LC subclass. Later, we incorporated these factors into the selection criteria.

In a third internal report, Dang compared how selected subclasses in the Humanities and Social Sciences varied in distinct loans within the last five years, distinct loans within the last ten years, and loans counted in all available circulation data (going back to 1996). We eventually determined that books that had been borrowed in the last ten years (2009-2019) should be moved back to Hayden Library to seed the contemporary research collection, because the difference between the number of items borrowed in the last five years and the number borrowed in the last ten years was negligible and the project team realized that circulation data from the past few years (2017-2019) represented a period of exceptional disruption, with major collection moves beginning prior to the building renovation, coupled with the library's transition to the Alma library service platform. Including books circulated within the last ten years provided a more stable representation of collection usage over time.

Flowing, scaling and selecting

To determine how many books we needed to select for the initial fill of shelving, the project team started with a shelving analysis based on the architects' floor plans and elevation drawings. While we knew the estimated capacity of the shelving based on its dimensions, we agreed that we could address an important design element by matching the collections to the visual breaks present in the space to enable easier browsing and findability. Determining the layout and order in the flow of call numbers was essential in calculating the final available collection size for each LC subclass.

Based on the benchmarking exercise discussed above, Dang created preliminary sketches (Figure 3) of potential flows within the stacks.

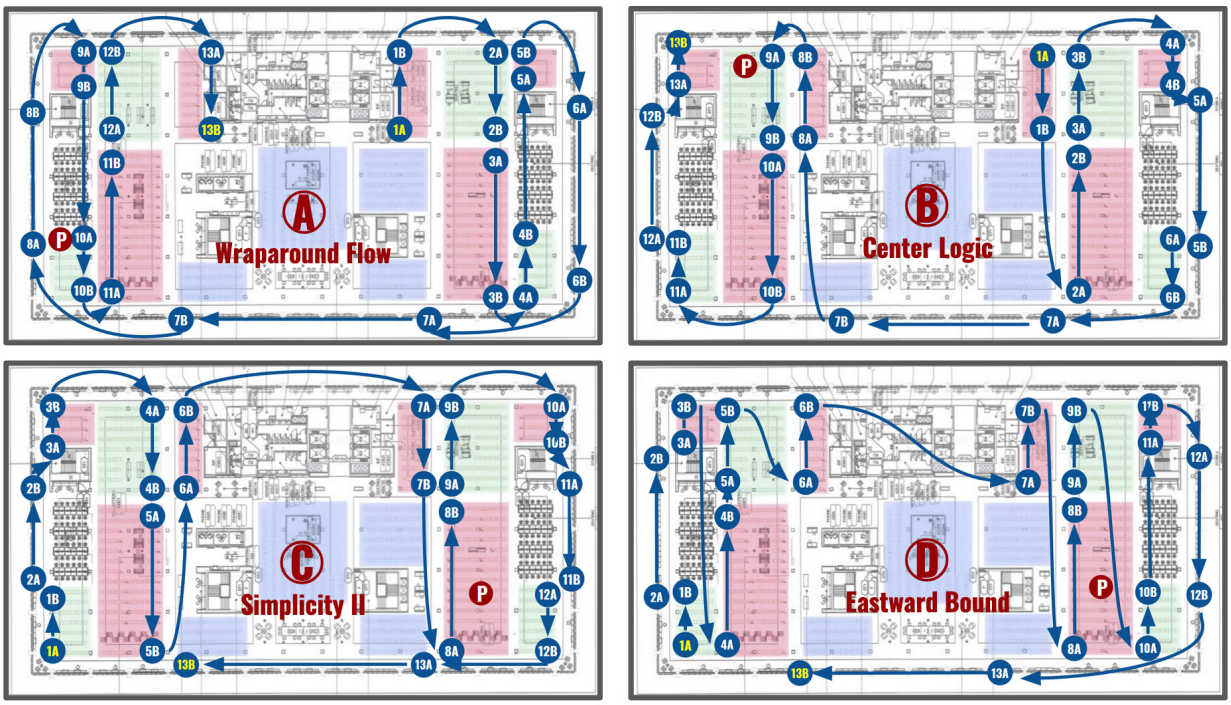

Figure 3: Examples of potential flows for putting LC call numbers in order in the fourth floor stacks. Note that these diagrams are in reverse to the final layout.

After modeling flows using sample floor plans, we sought the expertise of library staff to refine the floor plan. With a significant amount of trial and error, and several rounds of feedback from stakeholder groups, including staff responsible for shelving and frontline reference, as well as students and staff accustomed to browsing the stacks, we agreed on the final collection flow. This design (Figure 4) takes a counter-clockwise, or left-to-right, and head-to-tail pathway through the floor, from the elevator entrance perspective. Four perimeter quadrants consisting of shelving interspersed with seating and display spaces are reserved for featured collections.

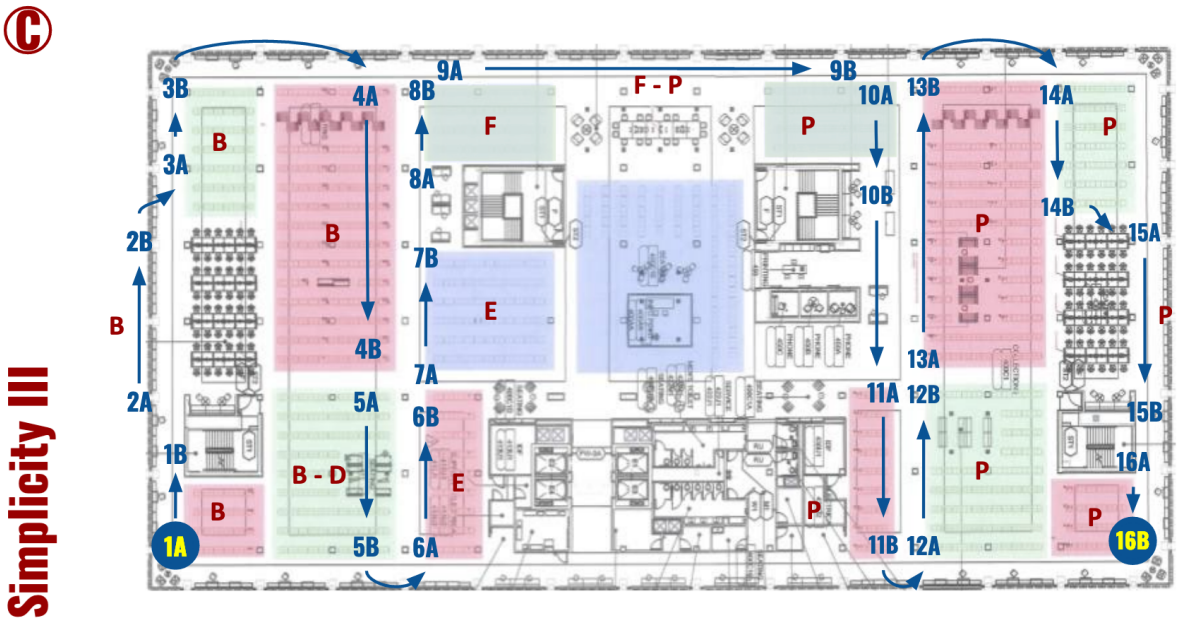

Figure 4: Final flow for putting LC call numbers in order in the fourth floor stacks.

While we later made minor adjustments to start and stop points for LC subclasses, we continued to follow the overall principles of keeping the banks cohesive to minimize user confusion over where to look next when seeking a specific call number.

In order to determine the total space available for the fourth floor research collection, we combined the measurements provided for new shelving units with an estimated average book depth. Traditional bibliographic description only provides the height and width of books, not the depth or thickness. Fortunately, academic books tend to fall within a fairly close range of possible thicknesses. Our initial hypothesis was that it was most efficient to use the same conversion factor (12 books per linear foot) for each subclass. By sampling linear feet measurements for books on existing shelves by subclass and taking the averages, Dang gleaned a more accurate estimate of how many volumes per linear foot of each subclass to include. We later found that in practice, this method resulted in some miscalculations in the largest LC subclasses (e.g., those with 20,000+ books); however, it served as an improvement on the original 12 books per linear foot metric.

To build an engaging collection at scale, the project team wanted to select books that were most borrowed by our users. Applying the percent of items loaned in the last ten years to the total count of volumes for each subclass, we selected a proportional amount in each targeted subclass to bring back to Hayden Library. Rather than construct our selection plan solely on what we had in our collection or what we had loaned, this allowed us to base our selection on the intersection

of existing items and relative demand for those items. Dang assigned each subclass a weight based on the proportional usage of books in the subclass, and this weight was then applied to the percentage of total holdings in the subclass. This allowed us to stretch and shrink footprints based on overall holdings and current usage.

Using the new floor plans, we adjusted the proportion of footprints as needed to create clean subclass breaks between each physical bank of shelving. With the average number of books per linear foot by subclass conversion derived from sampling above, Dang calculated the estimated total number of volumes needed to fill the shelving space, leaving room for future growth within the collection. In most cases, we sought to achieve a fill rate of around 70%; later, adjustments were made based on the final count of books that could be selected and moved for a given subclass.

With target counts determined, the project team needed an approach to select which volumes would appear on the shelves. While we experimented with several options, we had a consistent challenge finding clean and consistent data fields in open data sources that we could connect with our bibliographic data; for example, we were unable to effectively join our collections data with book reviews. Instead, we eventually settled on an indexed approach, which leveraged existing, consistently available data from Alma, such as loan history and general item record information, to build a selection methodology that we could use and reuse at scale.

The indexed approach we ultimately selected leveraged the expertise of library personnel who had deep experience working with the communities we serve. The project team started by interviewing staff and librarians with varying perspectives, experiences, and relationships with library stacks to gain insight into what is valuable in the data. We already knew that a new book with many loans would be preferable to an old book that has never been checked out, so we sought to identify criteria margins and determine where thresholds and cutoffs might be. To determine appropriate thresholds and weights for various factors, Dang conducted a simple version of A/B testing (Table 2), offering interviewees choices between two items from the same subclass with comparable loan statistics. Along with their choices, they also provided reasoning behind their decision-making in each case, as well as explanations for why they gave weight to any particular field under certain conditions.

	Choice A	Choice B
LC Subclass	[GV1580-1799.4] Recreation. Leisure – Dancing	[GV1580-1799.4] Recreation. Leisure – Dancing
# of Loans	11	6
Last Loan Date	Dec 2014	May 2015
Publication Year	1964	1997
Creation Date	1996	1997

Table 2: Example of an A/B testing choice.

Based on our small choice experiment, we found that one of the most important factors in every case was the most recent year an item loaned, representing the last time an item was relevant to a user, which we categorized as the "Last Loan Date Year." The total number of loans per item also weighed heavily in these tests. Ultimately, Dang created a formula to select books based on blending four criteria:

- Absolute Newness - when the item was published
  - » Publication Year (2019, 2018, ...)
- Recency of Loan - how recently our users were interested in it
  - » Last Loan Date Year (2019, 2018, 2017, ...)
- Number of Loans - how popular it is
  - » Num of Total Loans (from highest to lowest)
- Relative Newness - how new it is to our collection
  - » Creation Date[8] (2019-01, 2018-12, 2018-11, ...)

To see an applied example, consider a sample of five books, four of which had been recently loaned and one of which had been recently published. The five books (Table 3) are ordered based on these criteria and then receive an overall rank within the set based on the order. The bolded entry indicates the data point that best determines the ranking for the item within the set.

8 In an example of the learning curve we encountered with this project, many of our early analyses relying on the item's "Creation Date" as an indicator of newness to the collection were upended when we realized that a concurrent bibliographic remediation project conducted by the library's metadata team meant that many older books had brand-new records in the system.

Rank	Publication Year	Last Loan Date Year	Number of Loans	Relative Newness	Reasoning for Ordered Sort
1	**2020**				New book (usually published within the last few years)
2	2010	**2019**	**3**	2010-08-01	Recent Last Loan Date Year: 2019
3	2018	2019	**1**	2019-01-01	Same as above, but lower in sort due to fewer total loans
4	2015	2019	1	**2015-07-01**	Same as above, but lower in sort due to more time since acquisition
5	2010	**2018**	**10**	2011-04-01	After all books for one Last Loan Date Year are ranked, the books from the previous year follow, in order first by number of loans and then relative newness.

Table 3: Example demonstrating how criteria are applied to order and rank books in a set.

Based on these criteria, Dang was able to calculate a numerical rating for each book. Initially, we attempted to use approximately ten data points to establish markers in the data to create one catch-all formula to rate individual books based on the four criteria. Our index values needed to be of great magnitude to handle the granularity we required between layers of criteria, so this method was ultimately unsuccessful. Thus, in the interest of time, we ultimately used a stepwise formula that incorporated the four quantitative factors for each LC subclass, which provided the necessary granularity to achieve a target list. The exact cutoff values for each criteria expanded and contracted on a subclass-by-subclass basis. Therefore, these values fluctuated to fit their designated volume targets and subclass characteristics. For example, we might expect an item in subclass BF Psychology would have a different Publication Year cutoff than an item in PN Literature.

Sample criteria for a single subclass

A sample output of stepwise criteria (Table 4) demonstrates how Dang generated a balance of Number of Loans to Last Loan Date Year, thereby allowing items that

were more recently added to the collection to have sufficient time on browsable, public-facing shelves. In this example, which follows these adjusted stepwise criteria, items with any Creation Date from 2016 or later and Publication Year from 2000 or later were selected. Items with a Last Loan Date of 2020 and a Creation Date of 2010 or later required two or more loans to be selected; if the item's Last Loaned Date was in 2020 and the Creation Date was earlier than 2010, then it would require three or more total loans in order to be selected. This stepwise pattern repeats for every Last Loan Date Year, where earlier years require higher numbers of loans for items to be selected.

Last Loan Date Year	Num of Loans	Creation Date 2016+	Publication Year 2000+
2020	3+ 2+	any year 2010 +	
2019	3+ 2+	any year 2010 +	
2018	3+ 2+	any year 2010 +	
2017	4+ 3+	any year 2010 +	
2016	5+ 4+	any year 2010 +	
2015	6+ 5+	any year 2010 +	
2014	7+ 6+	any year 2010 +	
2013	8+ 7+	any year 2010 +	
2012	9+ 8+	any year 2010 +	
2011	10+ 9+	any year 2010 +	
2010	11+ 10+	any year 2010 +	
any year	0+	any year	2015+
any year	1+	any year	2014+

Table 4: Sample output of stepwise criteria. These criteria were adjusted for each LC subclass to produce the approximate count of items corresponding to the estimated capacity of the desired location within the overall layout.

Our selection process did not solely abide by this ordered criteria methodology. Other factors considered included topics of local and regional interest (e.g., Arizona and the Southwest) and the language of the work. We also manually reviewed multi-volume sets when different volumes received different rankings based on usage or publication date.

Selection in practice

After establishing how many books of each subclass we needed and determining how to select the "best" books based on ordered criteria, it was necessary to identify efficient methods for physically tagging or removing these books from their current locations and preparing them to move into Hayden Library.

There were several interrelated challenges involved in addressing this question. As discussed above, while some books remained in open shelving on Tempe campus, others were transferred to Polytechnic campus, and some of these subclasses had since been fully accessioned into the high-density storage facility, while others were packed tightly (and not always in order) in closed temporary shelving. The realities of library shelving practices over time further complicate the selection process. Books accessioned into a high-density storage facility are extremely likely to be exactly where they are expected to be, as they have a unique storage location identifier added to the item record that pinpoints a location in a specific tray on one of thousands of shelves. Books in other shelving systems, however, may or may not be present, as they may be missing, mis-shelved, or on the shelf but lacking a catalog record.

In our selection practices, we also needed to accommodate the fact that books that are accessioned into high-density storage can only be selected with an item-by-item pick list. Library staff developed a high density deaccession (or "de-processing") workflow in which books were pulled from trays, storage location identifiers were transferred to incoming books of the same size and thickness, and the selected books were staged in call number order for moving to public-facing shelving. Because of the intensive labor involved in this process, we had to limit selection to the top-ranked "best" books for subclasses that were already fully accessioned into the storage facility. At the same time, a pick list would clearly not be effective for books held in open shelving. Although some sections had long ranges of "best" books, they were often scattered all throughout the shelves. It was clear from the start that we did not have the staffing to individually flag or pull every "best" item from the list (it likely would have taken more than 3,000 hours for staff to pull 120,000 books).

Dang ran a series of trials using Alma and Alma Analytics to see if it would be possible to determine exactly what is in a given section of books, down to the LC subclass or even by LC call number. If so, it would be possible to select books from

a collection on a shelf-by-shelf basis. However, this method would require staff to record all start and stop barcodes for each range in the stacks; after conducting trials of this method, we determined that the potential for error, especially in mis-shelved books at the end of ranges, would prove too costly and inaccurate for the meticulous effort needed to get all the data.

Needing another approach, we conducted a series of four informal interviews with library staff who had significant prior experience in preparing and conducting book moves. Based on the discussion in these interviews, we settled on a "chunking" approach, where sections of books on shelves would be flagged to move. This approach requires fewer books to be separately identified and flagged. Moreover, we considered these "chunks" as a way to preserve some browsing serendipity, when a book that is shelved next to a sought-after book may be of interest to a browser.[9]

"Cascading Windows of Sets"

The technical challenge then became programmatically identifying sections where the most "best" books reside in clusters close to one another, and then select the best sections based on available space. Dang consulted with Professor Phillip Miller from ASU's School of Computing, Informatics, and Decision Systems Engineering, who advised us on the logic and efficiency of our algorithm. With his help, Dang wrote an algorithm in Java using the free Eclipse tool.

The algorithm needed to provide a simple solution to an optimization problem: how to pull as many "best" books as possible using the fewest instances of physical item searches within the shelves while under the constraints of limited programming sophistication and time. Dang developed a workable, naive[10] algorithm that found concentrations of "best" books on the shelves. Dubbed "Cascading Windows of Sets," the resulting algorithm identified sets of the highest-indexed books within a given population, while allowing for the adjustment of acceptable gaps of non-indexed books to include in an output "chunk" (section of books in order on a shelf) to achieve a desired target count of items with a locally minimized count of items that would be designated as the "start" or "stop" for each section that needed to move.

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9 One downside of the "chunking" approach turned out to be the lack of precision in updating locations for selected books; while we made significant efforts to maintain a parallel listing of flagged groups of books and item records in call number order, shelving mistakes and errors ultimately meant that some books were incorrectly updated (or not updated). Post-move, we continue to remediate these issues through shelf-reading and other cleanup projects.

10 A naive algorithm relies on computing many simple calculations rather than a few sophisticated ones. Since the computing power required for simple calculations is minimal, the algorithm takes relatively little time to run even with millions of lines of input data.

Results

Preparing books to move

In late January 2019, we coordinated the movement of around 125,000 open stack volumes from temporary shelving in the high-density storage facility to another nearby temporary storage facility to begin to stage books for Hayden Library. At the same time, we began to plan in earnest for the collection moves needed to populate Hayden Library with a collection synthesized from all the selected volumes at all of the various storage locations. We created a method to identify the books on public shelving that we had selected for Hayden by printing colored flags to show the contracted movers where each “chunk” started or stopped. Each flag had a call number, a direction to either “start” or “stop,” and a note for library users to inform them about the upcoming book moves.

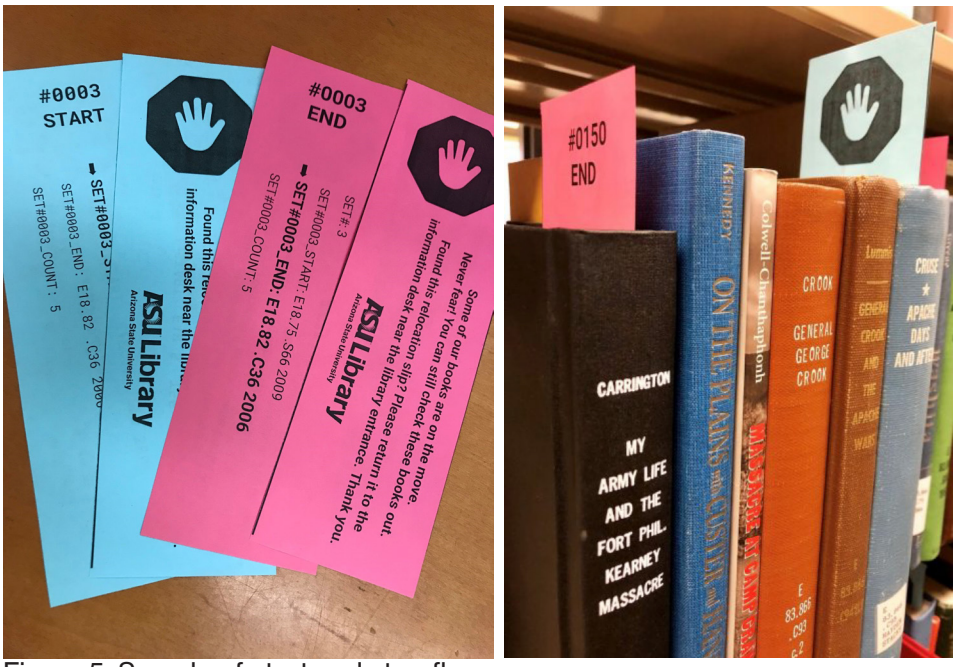

Figure 5: Sample of start and stop flags

Dang developed a tool in Java to print these flags, and teams of student workers placed each flag inside of the correct book. As flags were matched to volumes and inserted, adjustments were made and recorded to account for missing books, monographic series, and other problems as they arose. Immediately prior to the move, sets of selected items (or the non-selected items between selected sets, depending on the final destination of each segment of the move) were flipped spine-down so contracted movers knew which books to take and which to leave. Once groups of books designated for off-site storage were moved from the shelves, staff and contracted movers condensed the remaining books.

Preparing destinations

To prepare to conduct the move, Dang created a Percent Fill spreadsheet that produced estimates for how many books per subclass would fit on the new Hayden shelves. This gave the team a quick method for determining how full to fill the shelves in each LC subclass section, resulting in tape marks added to the shelving to guide the contracted movers in loading books onto the shelves, with the goal to reduce the amount of shifting projects staff would need to complete after the move.

The first task was to identify the smallest reasonable locator unit for the shelving in order to calculate all fill permutations permitted within the space available. Dang developed a system dubbed "BAUS" for Bank, Aisle, Unit, and Shelf. At the shelving bank level, there are a varying number of aisles (single-faced rows of shelving), and there are a varying number of units (single-faced units of shelves) within each aisle. Units themselves vary in height and therefore in number of shelves, and to complicate matters further, some shelving varied in width along the perimeters. The smallest unit of shelf measure thus had to be at the level of individual shelves, each of which is identified by its bank, aisle, and unit number.

We used this BAUS system to precisely identify anticipated starting points, stopping points, and skipping points for each incoming LC subclass section. In an example of the floor map (Figure 6), the area highlighted by a yellow box represents the units of shelving at Bank03 Aisle01. In this particular aisle, there are 10 units, and each unit is 4 shelves in height. When facing the shelves, the far-left, bottom-most shelf is denoted as *B03-A01-U01-S01*.

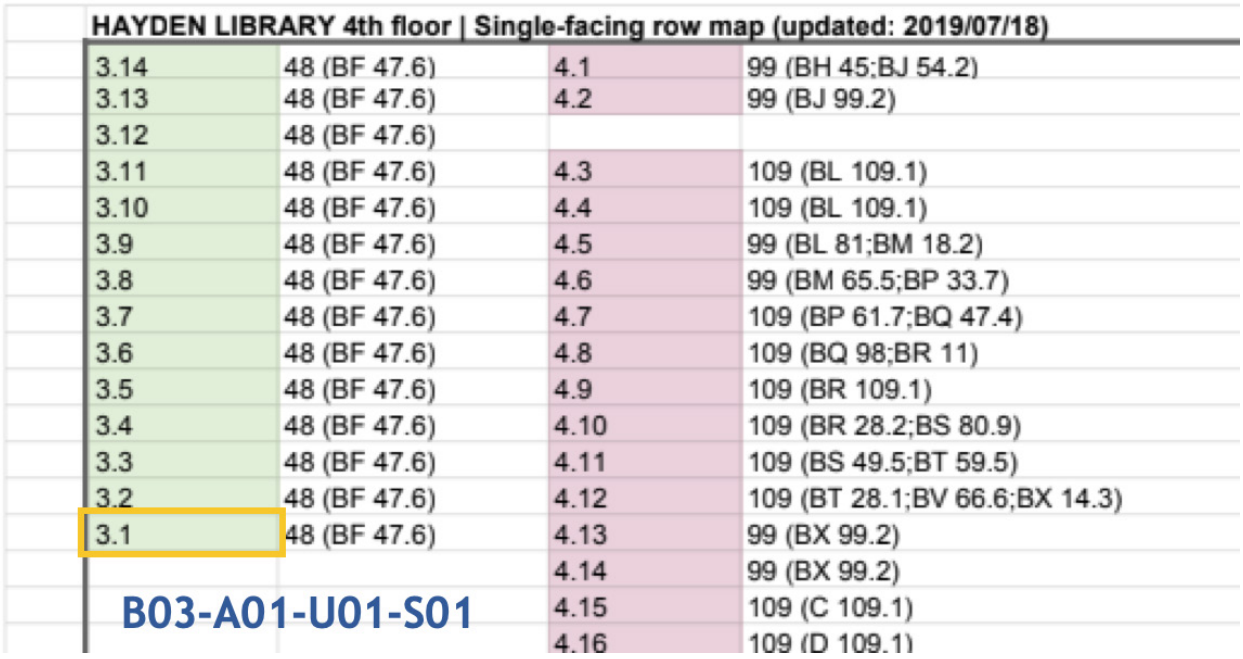

Figure 6: Example of floor map indicating the destination locations for LC subclass sections.

The project team made a custom measurement tool, similar to a yard stick, that had marks for lengths that match various percent fills (15%, 25%, ..., 80%, 95%) for the standard shelf width. Most shelves in the new building are 35 inches wide (although some perimeter shelves are wider), so each tick mark on the measuring stick corresponds to the percent fill of a 35-inch shelf (e.g., 50% is marked at 17.5 inches on the stick, 60% is marked at 21 inches, and so on).

For some sections, we were able to measure the exact linear feet of the incoming subclass. In these cases, we simply applied the measuring method outlined above. If the books were sitting on accessible temporary shelving, we used the method above to quickly measure the shelves to get an accurate linear feet count, by counting shelves based on their approximated percent fill and then using this data to calculate the linear feet. For collections for which we only had the estimated number of books coming in, we used the previously developed books per linear foot estimates to calculate estimated total linear feet.

Once we had a linear foot estimate, the next step was to distribute the books among the designated shelves. We used a calculation stored in a spreadsheet to calculate shelf fill:

- Top Shelves LF Actual = (Top Shelves LF Capacity) / (Top Fill % [manually select desired fill])
- Remaining LF = (Total LF) - (Top Shelves LF Actual)
- Bottom % Fill = (Remaining LF) / (Bottom Shelf LF Capacity)

In some estimated linear feet cases, the books per linear feet conversion rate produced too few books for some subclasses and too many for others.[11] The estimation also did not account for multivolume sets, which created overfill as we sought to avoid splitting them across multiple locations.[12]

For the bulk of items moving back into Hayden Library, our preparations required staging final destinations and posting moving signage. Using painter's tape and the measuring stick, library staff also added a "stop" point to each empty shelf based on the anticipated fill rate and taped an "X" on shelves that should be skipped. Moreover, during an initial walkthrough, we discovered missing or partially installed

11 Our calculation for average books per linear foot measurement by subclass was based on samples conducted prior to the selection process and then used to estimate the width of selected items, meaning that older and less-popular books were overrepresented in the conversion when compared with the materials selected for the stacks.

12 When the contracted movers reached the point of loading items onto the new shelves, library staff kept an eye on how the fill rate was proceeding, making adjustments or authorized overflows as needed. In the weeks following the move, staff and student workers conducted a series of collection shifts to better settle collections into their new spaces.

shelving that offset our calculations. We documented these inconsistencies, reported back to the contractors for fixes, and readjusted our move maps for exceptions. After conducting a final inspection, completing temporary signage, and adding shelf fill tape markers to each shelf, we were ready for collections to move into their new spaces.

Moving phases and process

By the time the move started in late 2019, books were prepared, flagged, or staged at various libraries and storage locations, based on the selection criteria and selection algorithm, for their return to Hayden Library. In all, there were three primary processes developed and used:

- Books that had been temporarily relocated to the Polytechnic campus as part of a final preparatory move in January 2019 were identified and staged based on pick lists. The remaining volumes were queued for processing into high-density storage.
- Books that had already been processed into high-density storage, including those from earlier moves, were deaccessioned one by one from storage, using a workflow that matched the "de-processed" book with another book of the same size to fill the slot in the storage tray. These books were also staged in temporary space at Polytechnic campus, along with newly acquired volumes that fell outside the call number ranges shelved at Noble Library.
- The "chunking" methodology was used to prepare to move volumes remaining on the shelves in temporary locations in Noble Library and Hayden Lower Level.

Beginning in late August 2019, an eight-week project relocated around 229,000 open stack collection books from Noble Library to temporary offsite storage on the Polytechnic campus for eventual accession into high-density storage. This move was the first to use the "chunk" selection methodology described above, with sets selected, flagged, and flipped to aid the movers in pulling what needed to be removed.

An intensive five-week project starting in late November 2019 brought around 187,000 books into the Hayden Library tower as part of the final weeks of post-construction, pre-opening activity. Staged books were first moved into Hayden Library from temporary storage on the Polytechnic campus, then flagged chunks were pulled and moved from Noble Library and Hayden Lower Level, and then Sun Devil Reads was moved from its staging location. This move was largely completed in early January 2020. Staff also relocated and shelved dozens of newly created featured collections, leaving designated spaces for additional collections slated to be acquired in 2020, and spent many hours shifting, arranging, and labeling shelves

throughout the building in preparation for the grand opening celebration, scheduled for March 25, 2020.[13]

The third phase of the move completed the project, sending around 170,000 volumes from Noble Library and Hayden Lower Level to the Polytechnic campus for processing into high-density storage, arranging Social Sciences and STEM call numbers (G-L, Q-T, Z) on Noble Library's third floor, and fully emptying the second floor of Noble Library so its deteriorating electronic compact shelving could later be removed. This move began at the start of March 2020, was halted when ASU temporarily ramped down onsite operations, and then resumed in June for final completion in August 2020.

Throughout these efforts, including during the height of move activity in December 2019 and the temporary building closures from March through August 2020, fulfilling patron print item requests remained a high priority. All of the moves incorporated a process to create lists of barcodes that were projected to be moved at a particular point in time, sometimes down to the day, so the location codes could be updated on a consistent basis using a bulk update process in Alma. Fulfillment staff devised ways of communicating about and checking for volumes that could be at one of three possible locations, and all front-line staff provided additional guidance to patrons on expectations for requesting books and resolved issues as they were raised.

When the building reopened and full onsite services resumed in August 2020, staff and student workers began a months-long project to shelf-read the newly installed Hayden Library and Noble Library stacks collections, reconciling holdings statements with what appeared on the shelves. Staff at the high-density storage facility also continued the long-term project of accessioning volumes from temporary shelving into storage, eventually completing this work in 2022.

With the completion of this major collections design and move project, the Hayden Library fourth floor stacks and complementary collections at Noble Library became a proportional representation of the entire collection, serving as a starting point for growth and development, while the Hayden Library featured collections can be built up, rotated, and repurposed based on usage data.

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13 While the grand opening celebration was indefinitely postponed and eventually canceled following ASU's temporary building closures around March 18, 2020, ASU Library never fully suspended its print collection services. Fulfillment of patron physical item requests continued during the summer of 2020, and document delivery services resumed along with faculty and student building access in August 2020. Physical item ordering also resumed, and the library eventually acquired all of the featured collections selected for the grand opening.

Discussion

The idea of transforming collections to center our users in academic library spaces opens a pathway for library leaders and collections managers to rethink traditional methodologies for the selection and development of collections, including how collections are displayed in library spaces (McAllister & Laster, 2021). Traditional methodologies are grounded in the perspectives and experiences of the people who make decisions about collections, with library practices and methods as an extension of these ways of being and knowing. The design of library collections, then, starts with the people who are making decisions, which is why it is important to have a diverse team and to develop a safe culture within the team's working environment (McAllister, 2021). The approaches to collection selection and development, including the ways in which data are used for collections design, data analyses, and operations workflows, all flow from the world views and experiences of the team. Designing collections requires decision-makers to consider the nature and purpose of print collections within a contemporary academic library context, including library spaces. The Andrew W. Mellon Foundation funding for the three-year project period afforded ASU Library the creative freedom to explore new ideas and methods for the "future of print" as an engagement tool within academic libraries. This project gave our team time to be creative and generate new ways to think about collections methodologies and processes. Traditional processes often used to manage collections in academic libraries may need to be refactored to meet contemporary library needs and user expectations. Creating and implementing innovative approaches to collection management requires a high degree of personnel time to develop new collaborative processes and operational procedures. The support for creative exploration resulted in print collections for Hayden Library that are more inclusive and community-informed than those resulting from prior practice.

Selection and development of collections

Traditional library selection processes typically involve professional librarians working within the scope of their collection development policies to create parameters for selecting materials for a collection, often using approval plans from vendors that result in automatic purchase and shipment of books that meet those parameters. When the books arrive, library workers generally route these volumes to a cataloger or cataloging team. Once cataloged, the volume is assigned to a shelf location, stickered and stamped with its classification number and property markings, and then shelved for circulation by library workers in its designated location. Generally, books are not relocated once shelved unless they are pulled off the shelf for use or check-out by patrons or are removed as part of a stacks weeding project. The selection processes we developed for the small browsing collections at Hayden Library more closely mirror community participatory design work for

neighborhood and housing complexes that arose in the United States in the 1990s. Architects, designers, urban planners, and activists collaborated with residents using an action research approach, which included the people who lived in the housing or neighborhood project area in decision-making about the development of their environment as a mechanism for social change (Day & Parnell, 2003, p. xi). Using community participatory design for library collections brings collections users into the selection space typically reserved for professional librarians, serving to shift power relations within library disciplinary practice.

By opening up traditionally cordoned-off professional spaces, library workers who are not professional librarians or archivists are also empowered to contribute to selection processes. In developing browsing collections, our team worked with community members, students, library staff, and faculty using selection processes that were more community-friendly than traditional vendor-based processes. A variety of list-making strategies emerged from these collaborations that were not necessarily based on the library's current set of books available to use for our reimagined Hayden Library collections. The community and library teams co-developed lists of print books using a variety of means, and in many cases the library purchased titles identified and selected for these small browsing collections, which contributed to the richness of the library's holdings. Removing the requirement that collaborators already know how to use the library's discovery tool to identify books to include in a collection further reduces barriers to collaboration. Easy-to-use list-making tools, such as short web forms, were the foundation of our action research approach to include more people in the design of collections, moving library practice toward a more social and open space of possibility.

Displaying collections in libraries

While the selection approach to the Sun Devil Reads collection used a vendor-based approval plan, the project team designed the organization and display of this collection to be people-friendly. We spent time at the beginning of the project researching spaces where people encounter books, including bookstores, airports, public libraries, school libraries, and take-one-leave-one shelves in community spaces. We developed a plan to present this collection as a departure from the LC classification system, instead organizing the collection by user-friendly subjects, more similar to the ways that bookstores present books to potential buyers than to traditional academic library practices. We wanted the collection to be more easily browseable for students, with the goal that books in this collection would be attractive and highly used.

This collection's design is an example of movement toward a more "whole person" experience within the library, much like the trend in bookstores to open up retail choices for shoppers. In 1999, Alexandra Jardine suggested that emerging

megastores, such as Borders and Waterstones, "offer the consumer much more than just books for sale" (Jardine, 1999). These bookstores co-mingled books with merchandise, and added coffee shops and restaurants within their walls, aiming to create a more rich customer experience. In 2013, the manager of the famous Trident Booksellers & Café in Boston stated that they added food, event space, and sideline merchandise to their book offerings because "people come here for the experience," meaning that bookstores sought to offer an experience for the mind and the body (Rosen, 2013). Like bookstores, libraries have changed over the last few decades to incorporate more spaces for student services, including tutoring and writing support, cafés, meditation rooms, and a variety of study spaces. Section by section, the academic library can become not just a warehouse for books, but a place of experiences created through intentional user-centered design.

Analyzing and using data for collections design

Creative design processes played a significant part in the project team's approach to analyzing and using collections data. The Data Analysis Specialist pursued new ideas and approaches with a technique of quickly mocking up data in Google Slides (as seen in Figure 3, above) and Google Sheets (as seen in Figure 6, above). The resulting diagrams served as effective communication tools for the project team members and other stakeholders, and they were easily modifiable to support low-stakes experimentation and change without the need to adopt and quickly grow proficient in a graphical design program. This iterative approach allowed the team to come to consensus more quickly, and it limited the intermediary steps needed between the generation of an idea and a more in-depth discussion of its implications.

Renovating operations and workflows

This project resulted in many process changes within our collections work, including such operational changes as measuring and adjusting shelving fill rates for collection shifts of varying size. Our team found that creating documentation before, during, and after a project is useful and valuable. As the project progressed, we experimented and worked through design problems, discussing these experiences with colleagues across the library. This feedback process and subsequent time for reflection helped create solutions that fit design problem parameters and, ultimately, communicate decisions and carry out the implementation. As an example, the Curation Specialist developed a Featured Collections Toolkit to outline the process for engagement and outreach to community groups and users, the logistics in curating and maintaining these collections, and best practices in partnering with internal and external stakeholders to communicate a collection that will engage our users. Since the project's conclusion, we have found that reusing the tools that we developed for this project and retrofitting them for future uses is extremely helpful

in response to personnel turnover and for the purpose of training staff not already familiar with these collections processes.

The Hayden Library reinvention project was completed in March of 2020, just as the COVID-19 pandemic caused university campus closures. Pandemic-related closures and service changes impacted library usage that, in turn, stalled our analysis of user engagement with the newly placed Hayden Library collections. Over the course of the project, we learned that keeping an open mind and being flexible was important to surviving a massive library project of this kind. Author Vickie Mix expressed this well in a description of a collections renovation project: “Flexibility is key to surviving the stress created by changing priorities and directions” (Mix, 2012, p.156). Among many profoundly unprecedented challenges, the pandemic caused a major disruption in our plans to evaluate the collections after installation, due to the temporary transition to online operations and subsequent limited facilities access. Our project team instead completed an analysis on preliminary data for the Classroom Collections, combining loan history with user enrollment data for a set of collections that had been launched in Fall 2019 and made available for one semester in a section of Hayden Library, which had opened earlier than the rest of the building. While this exploration suggested a framework for future data analysis, its limited size and scope prevented the team from drawing conclusions that could be extrapolated to inform future collections decisions. We look forward to further analysis projects and hope to share this work to inform the processes of other research libraries seeking to reinvent their print collections.

The New Open Stacks

The use of print collections in academic libraries is changing. The “future of print” project demonstrated that print volumes can be a vital part of contemporary academic library spaces and services. As an implementation of some of the ideas initially set forward in ASU Library’s 2017 white paper, the Hayden Library reinvention may also serve as an example for how open stacks can be positioned within 21st century library space design (ASU Library, 2017).

Innovation serves to move the discipline of librarianship toward more contemporary practice, yet removing books from 21st century library designs comes at a cost (McAllister & Laster, 2018a). When facing a renovation project in this era, when user study and workspaces, maker spaces, student support services, and collaborative spaces are often preferred over collections spaces, it is imperative that collections within library spaces are user-centered and consider the whole person in their design. To achieve this, collections design decision-making should be centered within a diverse team that is supported and empowered to make independent judgements and work in tandem with library community users.

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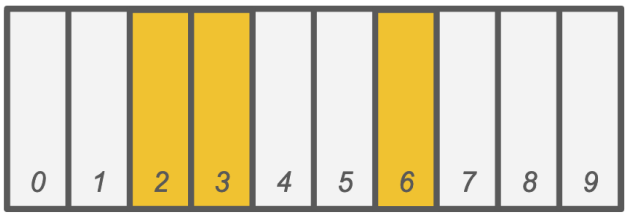
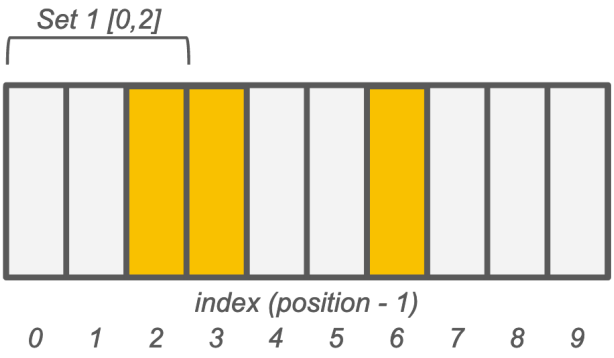
Appendix

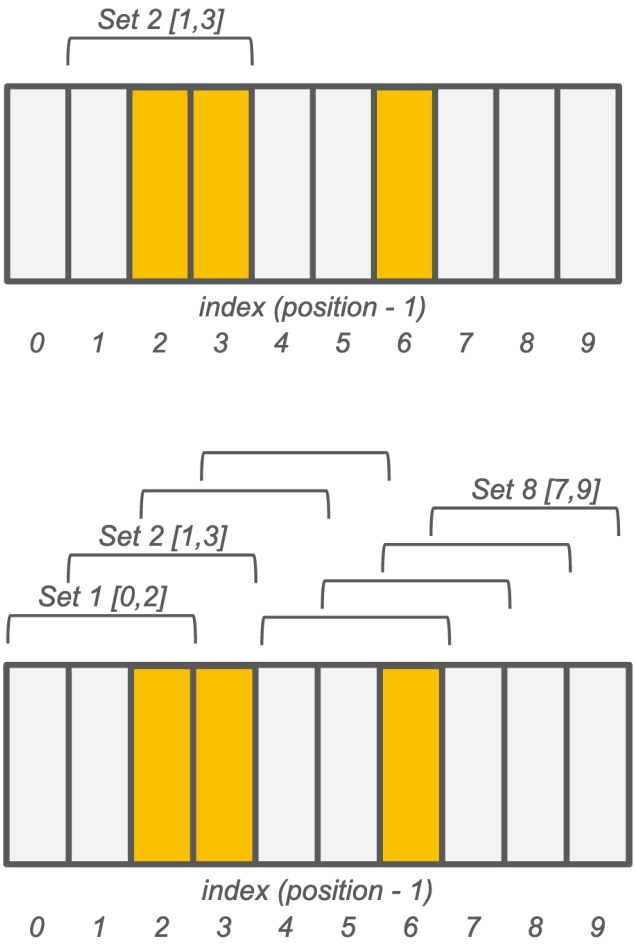
The concept of the “Cascading Windows of Sets” algorithm can be better explained using the following simplified example.

Suppose we have ten items on the bookshelf in perfect LC Classification order. The items marked in yellow are the ones that scored highly using our selection methodology as described in the paper above. Each item has a set position, for which we assign an index number from 0 through 9.



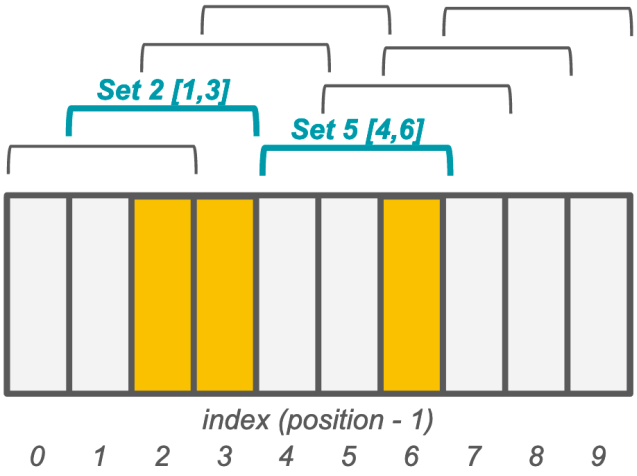
Suppose we wanted to look at every possible consecutive set of three items. The first three items on the shelves would be from index 0 through index 2, the second set of three consecutive items would be from index 1 through index 3, and so on.





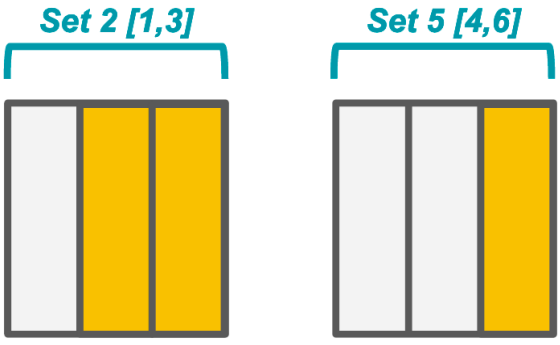
Each possible set of three consecutive items will have a summed score. We then select the highest-scoring set from all possible choices.

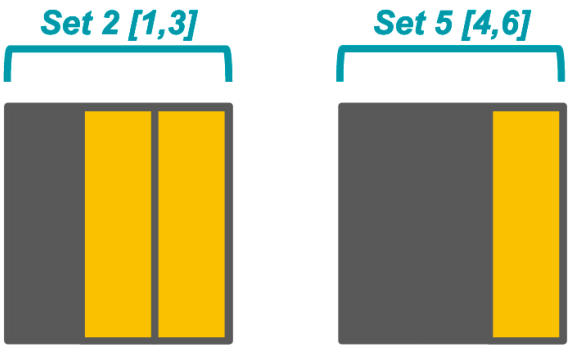
In this example, Set 2 would likely have the highest score. Set 3 (index 2 through 4) may have the same score, but for simplicity we select the first indexed set in cases of matching set sums.



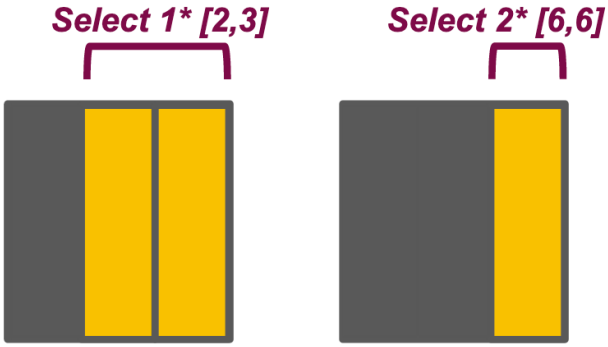
The selected indexes are then removed from the list of available set options. We repeat this process, selecting the top-scoring set and removing those indexes from the available pool, until we reach the total number of books needed for a given subclass.

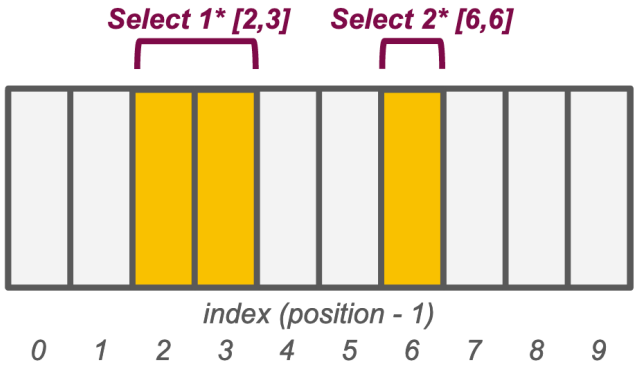
In a second iteration of the algorithm, we sought to increase the concentration of target items from the selected sets by removing leading or trailing non-target items (or lower-scoring items). Continuing this example, both sets have leading non-target items (shown below in gray).





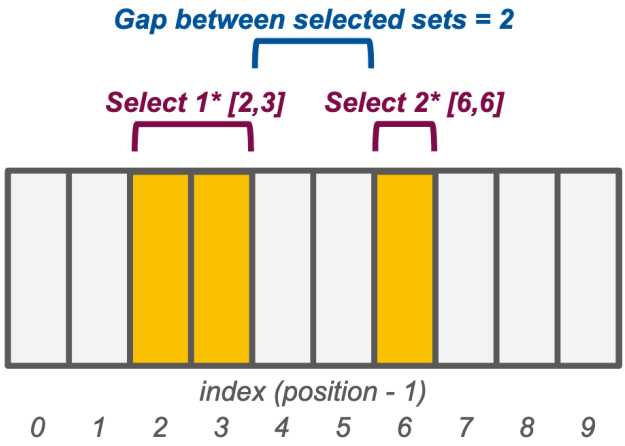
We can remove leading and trailing non-target items from their sets.



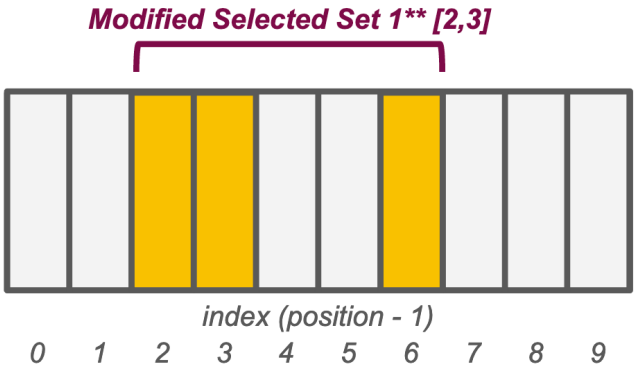


In an effort to increase efficiency and to reduce the number of physical items needing flagging, we then look at only our selected sets and consider the numbers of books in between each set, referred to as “gaps.”

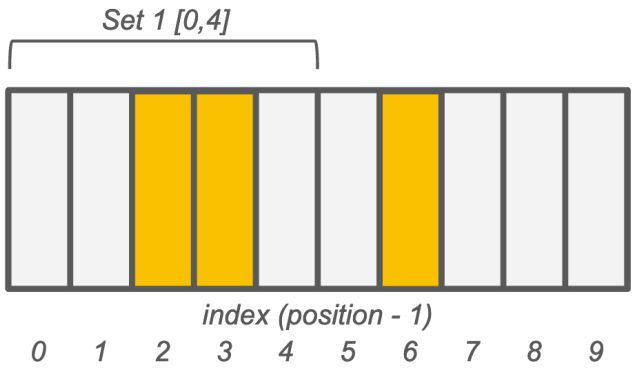
In this example, we join together any selected set separated by two or fewer items (i.e., having a gap size of two or less). In practice, the gap size is a variable.

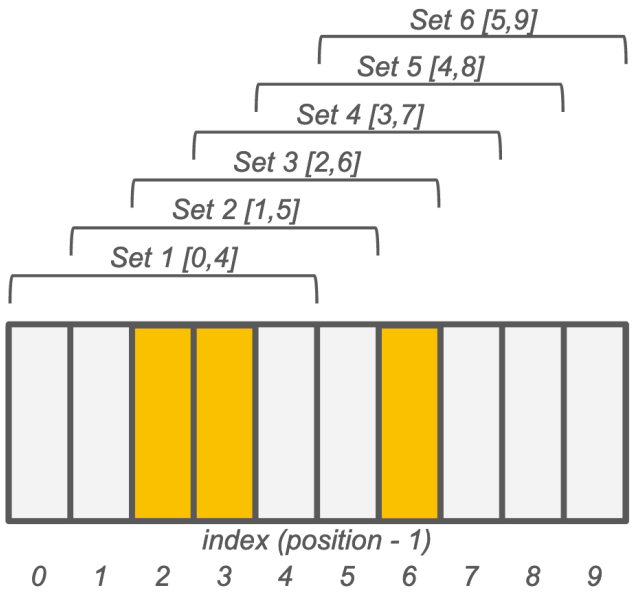


We have now selected five items, three target items and two non-target items, while requiring two physical items to be flagged (one for the start of the set at index 2 and one for the end of the set at index 6).

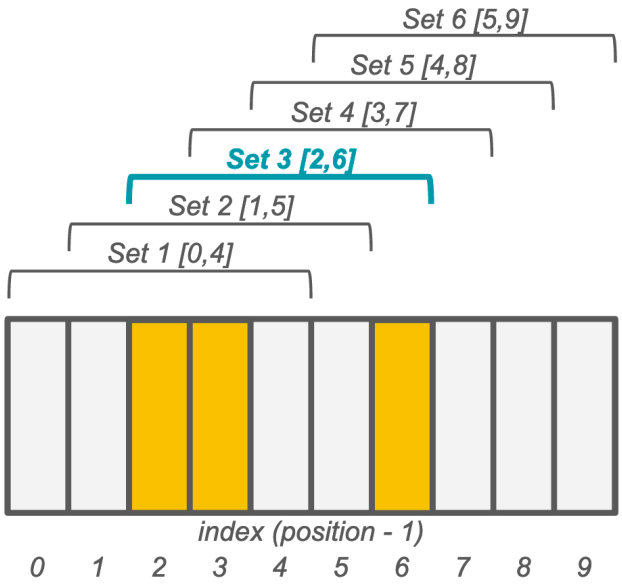


Now suppose we were to consider every possible set of five consecutive items instead of three consecutive items. Similar to sets of three, the first five items would represent set 1, and the sets of five would cascade through all possible items like before.





Without having to trim leading and trailing non-target items or adjoin sets with small gaps of separation, we are able to produce the same highest-score set of five items (index 2 through 6).



Our next task is then to find the optimal values for set sizes (s), gaps sizes (g), and single selections (ss) by comparing the efficiency of combinations of these variables. We consider the percent of target-items being selected (Percent of Single Select) compared to the number of physical item searches for flagging that would need to be conducted (Number of Flags). Combinations landing high on the y-axis (gathering more of our desired items) and left on the x-axis (requiring fewer physical item searches from the shelves) are our ideal choices for selection. Much like the selection protocol, the combination of variables for cascading sets varied for each LC subclass.