Tracking Unicorns: A Multi-Institutional Network Analysis of Library Functional Areas

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Libraries and Library Positions in a Period of Change

Libraries have experienced a sustained period of change. Factors including globalization and technology have caused a reconsideration of the research library in terms of physical environment, services, and pervasive technology.¹ Per Barbara Dewey, the global research library must “address sweeping changes in technology transforming all aspects of creating, disseminating, and accessing scholarship in a multi-cultural world.”² John Seely Brown advises that we are now in “an era of equilibrium to a new normal that is an era of constant dis-equilibrium.”³ Regarding technology, Lori A. Goetsch states:

Technology has significantly influenced how students and faculty use the services and collections of academic libraries. In response, libraries are identifying new roles and responsibilities for librarians by both reinventing more traditional positions as well as creating new job roles that require different skill sets and mind sets.⁴

In response to these factors and others, library leaders are recruiting and reshaping their “workforce through creative approaches to defining and organizing roles, hiring personnel, and deploying and retraining existing staff.”⁵

The work of libraries has always been complicated and a comprehensive set of technical, support, and public services must be represented and effectively delivered in order for it to effectively function. But the wave of changes in recent history, along with financial constraints faced by research libraries, has created the phenomenon of the “unicorn job,” where a variety of functions and associated requisite skills and knowledge coexist, potentially unrealistically, in one position.

Position Descriptions

A position description is “an orderly record of the essential activities involved in the performance of a task that is abstracted from a job analysis and used in classifying and evaluating jobs and in the selection and placement of employees.”⁶ These commonplace business documents are important for academic libraries on multiple levels, as they reflect “the culture, priorities, and changes within an organization... not only to employees and their departments but also to the academic institution within which the library functions and the profession beyond.”⁷

Position descriptions—and their close relative, the job advertisement—are often a basis for analysis in research, both practical and scholarly, seeking an understanding of library work types, traditional and emerging. The results of these studies appear frequently in library and information science literature.⁸ Some studies focus on the evolving nature of libraries and the requisite skills for new work types: digital librarians; scholarly communication librarians; social science data librarians; instructional design librarians; and emerging technologies librarians.⁹

Therese Triumph and Penny Beile sought to examine “the current state of the academic library job market and identify emerging trends,”¹⁰ and found that “academic library jobs are becoming increasingly specialized—and many require new job skills.”¹¹ Lori Goetsch studied job advertisements over a 10-year period and reports:

Drawing on the core roles and responsibilities of positions such as systems librarians (high-level technological expertise), reference librarians (user assistance and education), and subject librarians (collection development and management and liaison work), a re-envisioned and interrelated set of four new core responsibilities emerges: consulting services; information lifecycle management; collaborative print and electronic collection building; and information mediation and interpretation.¹²

As new responsibilities blend with traditional library functions, the perception emerges that position descriptions are less circumscribed by narrow job functions and instead tend to describe hybrid roles. In considering these hybrid roles, studying the frequency of functional areas, like cataloging and preservation, coexisting within one position (and represented in a single position description) is a reasonable approach. An examination of the occurrences, frequencies, and relationships between these functional areas is akin to studying a social network of multiple groups with overlapping membership. As such, the application of established network analysis methods might provide insight on a field in flux. To the knowledge of the researchers, the principles of a social network analysis have yet to be applied to a large data set of position descriptions. This research could contribute to tracking the emergence of “unicorn jobs” in response to shifting roles and responsibilities in academic libraries.

ARL PD Bank: Background

In March 2012, the ARL (Association of Research Libraries) Board of Directors authorized the establishment of the ARL PD Bank.¹³ ARL contributed a significant portion of the programming cost for the system, which was developed by a team at the University of Florida (UF) with broad input from other institutions, including over 20 ARL member institutions, via surveys, focus groups, and beta testing. In February 2013, the ARL PD Bank was officially launched. Initially, the PD Bank was only available to ARL members. In order to sustain the community, maximize the collection use, and create an even more comprehensive collection, access was expanded. Beginning in 2014, library consortia that included at least one ARL member institution were permitted to join the ARL PD Bank as a group and, as a result, extend access to their non-ARL members. The first consortium to join was the Association of Southeastern Research Libraries (ASERL). The Canadian Association of Research Libraries (CARL) followed suit in 2015.

The ARL PD Bank was designed as a digital collection of position descriptions and related documents, such as annual assignments and position vacancy announcements, which describe the work of library employees, interns, and other affiliates. The users of this system include library administrative staff involved in personnel management and those who rely on the documents for managerial activities and planning. As a collective work of academic and research libraries in the United States and Canada, the ARL PD Bank provides not only an aggregated source for current PDs, which shows the varied ways in which institutions organize and define functions, but also for archived documents which depict the evolution of positions and library functions and services over time.

Metadata

The ARL PD Bank was implemented based on a conceptual model of a “repository” or “archive.” Its success has relied on the experiences of the UF team with longstanding digital collections. As a shared community platform, the system relies on descriptive metadata for the position records which is submitted and maintained by each institution. Position records are searchable and accessible by the following elements of metadata which the users provide:

- Full-time equivalency (FTE) level;
- Position status (filled, open, or discontinued);
- Position type (professional librarian; support or paraprofessional; other professional; or other);
- Appointment type (regular; tenure accruing or permanent; temporary/time limited; or residency/fellowship/internship);
- Library type (medical library; law library; non-university library; or all other); and
- Functional areas (see Appendix A).

When a record is initiated by an institutional user, each element of this descriptive metadata is required for submission.

For this study we are focusing on the functional areas which serve the system as classification metadata, supporting “the systematic identification and arrangement of business activities and related records into categories according to logically structured conventions, methods and procedural rules.”¹⁴ For each position record, the submitter identifies, from the controlled vocabulary, all of the functional areas that relate to the substantive duties and responsibilities of the particular position. Depending on the duties of the position, the associated ARL PD Bank record will include one or more functional areas. As a result, functional areas either appear in isolation, for a narrowly focused position, or co-occur with other functional areas. In this research, we assert that the frequency of the co-occurrence or the lack of co-occurrence of functional areas offers a unique perspective into the ways in which library work is organized and the ways in which types of work relate to each other. This capacity is enhanced because the available choices for functional areas are focused and reasonably discrete, and seemingly representative of the full range of library work types. The strength of the metadata and the number of records contained in the system creates a unique data set.

Methodology

Applying strategies used in social network analysis, we approached the data set as if each position record was an individual who belonged to various social groups. Each position record included in the analysis was associated with any number of functional areas between 1 and 37, and this attribute paralleled a network affiliation. Understanding the functional spread (i.e., how many functions were included in each position record) and measuring the frequency of job functions co-occurring (i.e., how often any two functions occurred together within one position record) was of great interest to the researchers.

Before performing the analysis, we removed any discontinued positions. Next, by using the Position Type and functional area data, we separated the remaining position records into three groups: professional positions, support positions, and management positions. This process is depicted in Table 1:

Table 1: Breakdown of position records into analysis groups

Group	Included	Excluded	Total position records included in analysis
Professional Positions	Position Type = Professional Librarians or Other Professionals	Any record with Branch/Unit/Department Management or Senior Management indicated in the functional area field	564
Support Positions	Position Type = Support or Paraprofessionals (non-exempt) or Support or Paraprofessionals (exempt only)	Any record with Branch/Unit/Department Management or Senior Management indicated in the functional area field	713
Management Positions	Functional area = Branch/Unit/Department Management or Senior Management	Any record where Branch/Unit/Department Management, Senior Management, or both is indicated in the functional area field	165

The data were prepared for input into Gephi using all potential functional areas as nodes and listing out each position record's connections one by one (automated with Excel). This process resulted in two files, one describing the data set's nodes (functional areas) and one describing the data set's edges (connections between functional areas). Once the nodes and edges files were uploaded to Gephi, we ran a multimode networks projection, resulting in a visualization of the functions and their relationships to each other as represented in the data.

Findings

The graphical output from Gephi shows a complicated web of relationships, in the forms of co-occurrences between job functions (ARL PD Bank functional areas). The size of the node (circle) represents the number of position records associated with that job function. The most common job functions result in the largest nodes. The thickness of the line between nodes represents the frequency of co-occurrence between any two job functions. The greater the instances of co-occurrence, the thicker the line connecting the job function nodes.

Professional Positions

Figure 1 displays the graphical representation of the network of the functional overlap among the 564 professional position records included in our analysis.

Figure 1: Gephi output of professional position records

Co-occurrence is the measure of how frequently any two functions were associated within the same position record. The top 5 co-occurrences by count among all 564 professional position records were:

- **Reference/Research** and **Subject Specialist**, co-occurring in 86 positions and with this co-occurrence relationship representing 49% of reference/research positions and 48% of subject specialist positions.

- **Liaison** and **Subject Specialist**, co-occurring in 85 positions and with this co-occurrence relationship representing 79% of liaison positions and 47% of subject specialist positions.
- **Instruction** and **Reference/Research**, co-occurring in 74 positions and with this co-occurrence relationship representing 67% of instruction positions and 41% of subject specialist positions.
- **Liaison** and **Reference/Research**, co-occurring in 62 positions and with this co-occurrence relationship representing 57% of liaison positions and 35% of reference/research positions.
- **Instruction** and **Subject Specialist**, co-occurring in 59 positions and with this co-occurrence relationship representing 53% of instruction positions and 33% of subject specialist positions.

In 50% of the 564 professional position records included in our analysis, only one job function had been selected. In other words, half of the professional position records analyzed for this study had a singular job focus and half had multiple job functions coexisting (see Graph 1 below).

Graph 1: Professional functional spread

For the professional position records, the job functions in Table 2 were more likely to occur in isolation than to coexist with other functions.

Table 2: Job functions in professional positions more likely to occur in isolation

Function	% of professional positions with functional isolation	Total number of professional positions associated with function
Clerical	100%	1
Information Technology	69%	42
Cataloging	56%	61

Function	% of professional positions with functional isolation	Total number of professional positions associated with function
Assessment	54%	13
Archiving/Curatorial/Rare Books	53%	70

Notably, no professional position records were associated with the off-site storage function.

Support Positions

Figure 2 displays the graphical output of the functional overlap among the 713 support position records included in our analysis.

Figure 2: Gephi output of support position records

Co-occurrence is the measure of how frequently any two functions were associated with the same position record. The top 5 co-occurrences by count among all 713 support position records were:

- **Access Services** and **Circulation**, co-occurring in 32 positions and with this co-occurrence relationship representing 43% of access services positions and 31% of circulation positions.
- **Access Services** and **Document Delivery**, co-occurring in 15 positions and with this co-occurrence relationship representing 20% of access services positions and 54% of document delivery positions.
- **Access Services** and **InterLibrary Loan** co-occurring in 14 positions and with this co-occurrence relationship representing 19% of access services positions and 54% of ILL positions.

- **Acquisitions** and **Cataloging/Bibliographic Control/Metadata** co-occurring in 12 positions and with this co-occurrence relationship representing 18% of acquisitions positions and 15% of cataloging/bibliographic control/metadata positions.
- **Document Delivery** and **InterLibrary Loan**, co-occurring in 12 positions and with this co-occurrence relationship representing 43% of document delivery positions and 25% of InterLibrary loan positions.

In 75% of the support position records included in our analysis, only one job function was indicated. In other words, three quarters of the support position records analyzed for this study had a singular job focus and one quarter had multiple functions coexisting (see Graph 2 below).

Graph 2: Support functional spread

Table 3 displays the job functions that were more likely to occur in isolation than to be combined with other functions in support position records.

Table 3: Job functions in support positions more likely to occur in isolation

Function	% of support positions with functional isolation	Total number of support positions associated with function
Acquisitions	68%	66
Archiving/Curatorial/Rare Books	87%	47
Cataloging/Bibliographic Control/Metadata	65%	79

Function	% of support positions with functional isolation	Total number of support positions associated with function
Clerical/Administrative Support	61%	41
Communications/Public Information	56%	9
Development/Fundraising	75%	8
Digital Services	73%	59
Electronic Resources	71%	24
Exhibits	100%	5
Facilities/Security	84%	31
Finance/Budget/Accounting	75%	24
Grants Management	100%	1
Human Resources/Organizational Development	60%	15
Information Technology/Systems	90%	89
Media/Multi-Media Specialist	65%	20
Preservation/Conservation	76%	21
Press/Publishing	78%	9
Subject Specialist	64%	25

Notably, no support position records were associated with the distance learning function.

Management Positions

Figure 3 displays the graphical output of the functional overlap among the 165 management position records included in our analysis.

Figure 3: Gephi output of management position records

Co-occurrence is the measure of how frequently any two job functions were associated with the same position record in the PD Bank. The top 5 co-occurrences by count among all management position records were:

- **Instruction** and **Liaison**, co-occurring in 14 positions and with this co-occurrence relationship representing 54% of instruction positions and 61% of liaison positions.
- **Instruction** and **Reference/Research**, co-occurring in 14 positions and with this co-occurrence relationship representing 54% of instruction positions and 56% of reference/research positions.
- **Collection Development** and **Instruction**, co-occurring in 13 positions and with this co-occurrence relationship representing 46% of collection development positions and 50% of instruction positions.
- **Instruction** and **Subject Specialist**, co-occurring in 13 positions and with this co-occurrence relationship representing 50% of instruction positions and 45% of subject specialist positions.
- **Liaison** and **Subject Specialist**, co-occurring in 13 positions and with this co-occurrence relationship representing 57% of liaison positions and 45% of subject specialist positions.

In 44% of the 165 management position records included in our analysis, only one function was listed. In other words, 4 in 10 of the management position records analyzed for this study had a singular job focus and 6 in 10 had multiple coexisting functions (see Graph 3).

Graph 3: Management functional spread

Table 4 displays the job functions that were more likely to occur in isolation than to be combined with other functions in management position records.

Table 4: Job functions in management positions more likely to occur in isolation

Function	% of Management positions with functional isolation	Total number of Management positions associated with function
Cataloging/Bibliographic Control/Metadata	60%	20
Media/Multi-Media Specialist	71%	7

Limitations

Separating professional position records from support position records could mean splitting up functional areas that bridge both. Some functional-specific findings will only be found if we look at each functional areas separately with all the position records included.

The data set used in this analysis is limited to what was voluntarily shared in the PD Bank by users. Additionally, the metadata, critically including functional areas and position type entries for each position record, was submitted by users from various institutions. Any bias or self-selection resulting in the inclusion or exclusion of certain types of positions will limit the ability to characterize the state of library positions more broadly, based on this analysis. Similarly, any inconsistency, bias, or self-selection in regards to metadata selection will limit the generalizability of our findings.

Discussion/Implications

Functional Spread

The data suggest that the higher you climb in academic libraries, the more likely you are to be a unicorn. Management positions were associated with anywhere between 1 and 13 functions, with an average of 2.35

functions per position. Professional positions were associated with a narrower range, anywhere between 1 and 9 functions, with an average of 2.07 functions per position. Support positions were associated with the fewest functions, anywhere between 1 and 5 functions, with an average functional spread of 1.32. Further, management positions focus on just one functional area in 44% of position records, compared with professional positions where 50% of position records are associated with only one functional area. For support positions, 75% focused on just one functional area. These results are reflected in Graph 4.

Graph 4: Functional spread by position type

Common Co-Occurrences

Management positions, though they have the widest functional spread, are still most frequently associated with traditional librarian functions (e.g., instruction, liaison, collection development/management, subject specialist, and reference/research). For professional positions, the most common co-occurrences blended traditional librarian functions, e.g., reference/research, liaison, instruction, and subject specialist, in various combinations. For support positions, the most common co-occurrences blended traditional support functions: access services, InterLibrary loan, document delivery, acquisitions, cataloging/bibliographic control/metadata in various combinations.

Future Steps

This study relied on the data from the ARL PD Bank on February 28, 2018. As indicated above, we feel the data set was unique and potentially informative. In September 2018, a significant system enhancement was introduced where the job advertisements submitted to the ARL Job/Residency/Internship Listings website began to be ingested into the PD Bank, along with the submitted metadata. As of January 5, 2019, there are 2,119 position records in this system, including 197 that were ingested through this process. The recent enhancement will increase the size of this digital collection and the volume of associated metadata, supporting future research like that presented in this paper and other kinds, including text mining. Additionally, this automated collection process will reduce the impact of bias or self-selection resulting from the voluntary nature of active submissions to the PD Bank, discussed above.

The work presented here has generated what we feel are some interesting findings. Even if they may in some cases simply validate existing presumptions about library work, like higher level positions have broader scopes of responsibility, these presumptions may now be validated and can be built upon. Beyond the current findings, we feel that our work introduces an interesting methodological approach by applying network analysis to types of library work and using co-occurrences as the basis of analysis. We intend to expand on the work presented here. Potential future steps will include comparative analysis relying on additional PD

Bank metadata fields at the position record level, beyond position type which was used here. These potential fields include appointment type (regular; tenure accruing or permanent; temporary/time limited; or residency/fellowship/internship) and library type (medical library; law library; non-university library; or all other). Are there distinctions between the co-occurrence rates for tenure accruing positions compared to other types of appointment? Do frequencies vary between library types, medical versus others? Beyond the position record level metadata comparisons, potential comparisons of co-occurrence could be made based on institutional characteristics, like staff size or public versus private status. Beyond these comparisons, the ARL PD Bank data will afford longitudinal comparisons. In these, one might track how relationships between job functions and the prevalence of unicorn positions evolves over time.

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Notes

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Appendix A

When creating a position record, institutional users are required to identify the main functional area(s) for each position. This user activity not only provides useful search criteria but also important data on the frequency and, over time, the evolution of positions within academic libraries. The following table depicts all functional areas available in the ARL PD Bank and the number of instances of records for which the functional area was selected, as of January 28, 2017.

Table 5: Functional area occurrences in the ARL PD Bank as of January 28, 2017

Functional area	Number of instances within ALL records
Reference/Research	224
Subject Specialist	221
Branch/Unit/Department Management	162
Cataloging/Bibliographic Control/Metadata	162
Information Technology/Systems	150
Digital Services	133
Circulation	130
Instruction	128
Archiving/Curatorial/Rare Books	123
Liaison	117
Collection Development/Management	116
Access Services	111
Acquisitions	94
Electronic Resources	64
Senior Management	57
Outreach Services	45
Preservation/Conservation	44
Clerical/Administrative Support	43
Document Delivery	43
InterLibrary Loan	41
Media/Multi-Media Specialist	34
Facilities/Security	32

Functional area	Number of instances within ALL records
Finance/Budget/Accounting	32
Communications/Public Information	30
Human Resources/Organizational Development	27
Data Curation	26
Shared Collections	25
Scholarly Communication/Copyright	24
Development/Fundraising	23
Assessment	22
Exhibits	19
Staff Development/Training	17
Off-Site Storage	16
Distance Learning	15
Press/Publishing	15
Government Documents	14
Integrated Library System	13
GIS Systems/Data	12
Grants Management	5