

QUANTITATIVE (GIS) AND QUALITATIVE (BPE) ASSESSMENTS OF LIBRARY PERFORMANCE

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Abstract

This article accounts for the methodological approach used in the creation of the Facilities Master Plan for the Public Library of Cincinnati and Hamilton County in the United States. Libraries are undergoing significant changes with regards to their advancing functions. They have become community centers for learning, whether for children, teens, adults, or seniors. This study uses an approach combining GIS- Geographic Information System with BPE-Building Performance Evaluation to score and categorize branch libraries based on their level of performance. A number of recommended strategies are derived to achieve greater cost-effectiveness and improved service.

Keywords

Facilities master planning; library performance; Geographic Information System (GIS); Building Performance Evaluation (BPE); benchmarking.

Introduction

Libraries are "the very souls of their countries, rendered in glass, wood and brick" (Adler, 1997). On a national scale, The American Library Association (<http://www.ala.org/>) publishes topics related to the trends of modern libraries. On a smaller scale, The National Clearinghouse for Educational Facilities (<http://www.edfacilities.org/rl/LibrariesHE.cfm>) has all the resources on library facilities design for higher education on record. Since 1995, there have been several changing trends in library usage and facility improvements. "A common thread in these buildings has been the infusion of technology throughout the facility" (Shill & Tonner, 2003). For instance, there have been a myriad of innovations within the 400 library improvement projects completed since 1995; among them is providing wireless internet access to over 75% of laptop users.

This article recognizes the significant changes that libraries have gone through, locally as well as regionally (Perman, 2004). Libraries have become more than just book reservoirs; they have evolved into a learning center

where knowledge is exchanged. Hardcopy knowledge can be gained through books and electronic knowledge can be gained through computer terminals that benefit those who do not have computers or internet access at home. Other forms of knowledge can be gained through meeting places and library outreach programs. Like in Multnomah County in Oregon (<http://www.multcolib.org/>), libraries have facilitated community redevelopment. The Hollywood branch is positioned such that a few floors of apartments are above the library, while shops and a café are incorporated with the library at street level. This makes it a mixed-use property where residential and commercial uses are integrated. In a community currently renovating itself, these elements have positively influenced the area economically.

The Seattle Public Library (<http://www.spl.org/>) designed by Rem Koolhaas, the Salt Lake City Public Library (<http://www.slcppl.org/>) designed by Moshe Safdie, and the Cerritos Millennium Library in Cerritos, California designed by Jim Nardini (<http://www.ci.cerritos.ca.us/library/>) are among the main libraries that incorporate the mixed-use approach. As seen in mega-bookstores like Borders, Barnes & Noble, and Joseph and Beth Booksellers, libraries have become public destinations because of this mixed-use approach, where not only cafes and shops are included, but perhaps museums, art galleries, and even a radio station are integrated with libraries.

Among the more novel uses of a library is that it has become a center of education, public forums, public participation and empowerment, and occasionally entertainment. For example, a festival plaza, where concerts are performed,

as well as places where weddings, receptions and other events take place, have been incorporated in the Salt Lake City Public Library. Another example is the Chicago Public Library's (<http://www.chipublib.org/>) Harold Washington Library Center. The "Winter Garden" has been incorporated within the library, where community events and receptions are hosted.

In collaboration with the metro City/County government, the Indianapolis Marion County Public Library (<http://www.imcpl.org/>) has strategically located its branches. For instance, a large branch library has been located in a mall, while a neighborhood branch library has been replaced with a much larger library, as part of the renovation of an intersection where a new fire station and a police station are accommodated.

Public libraries in the United States have become centers for their communities. People are attracted to interact through the varieties of events and activities that are included in the library. Such activities increase the pride of residents regarding their communities, while fostering a strong sense of belonging. However, the changing functions of libraries stand as a challenge to assessing public libraries nowadays. In this respect, this article presents the development and application of an assessment method that integrates building performance and service area.

Project Design and Methodology Overview

The main objective of this project is to establish a Facilities Master Plan (the Plan) for one of the major library systems in the United States,

the Public Library of Cincinnati and Hamilton County. The present library system is evaluated and recommendations are provided for existing and new branches of the library system. This project utilizes a ground-breaking methodology where building performance evaluation (BPE, Preiser & Vischer, 2005) is employed in combination with the service area and population analysis using Geographic Information Systems (GIS) to evaluate the library system. Recent advances in GIS make it feasible for analysis and presentation of spatial data in a variety of fields (Seder, Weinkauff and Neumann 2000). GIS applications generally enable a user to produce a wide range of end products from simple maps and charts to complex tables and 3-dimensional visualization. GIS analysis supports and improves the effectiveness of the decision process (Badard & Richard, 2001; Dangermond, 1989; Lee, 1990; Worrall, 1990; Singh, 1999; Shamsi, 1996; Grossman & Eberhardt, 1993; Wang, 2005; Gahegan & Lee, 2000).

Building Performance Evaluation (BPE) originated from Post-Occupancy Evaluation (POE) of buildings that have been occupied for some period of time (Preiser, Rabinowitz and White, 1988; Federal Construction Council, 2001; NCARB, 2003). Direct observation, still photography, interviews and survey questionnaires of building users are common data collection methods for rating facility features and qualities. Feedback is typically received based on the levels of performance in the building, which includes health, safety, and security; functionality; efficiency and work processes; and, social, psychological, and cultural. In BPE, the entire building delivery and life cycle is considered. BPE adopts the 'cradle to grave' approach where aspects involved

in the life cycle of a building are investigated. Such aspects range from visioning and early strategic planning, programming, design, and construction to occupancy, and eventually, to the recycling or adaptive reuse of redundant facilities. Over several decades, POEs of individual case studies evolved into more general system-wide assessment BPEs, such as US Postal Service facilities (Farbstein, 2003). BPE of an entire library system is reported in this article.

The main purpose of developing the Plan is to provide a sustainable long-term system of facilities and high-quality services. Such a process is broad because it begins with comparing the system being evaluated with other similar systems in the US and Canada. Subsequently, the individual branches are examined separately and in detail, while being contrasted to other branches within the system. This study surveys library staff members, analyzes library usage, capacity, demographic features, and the spatial distribution of library branches, while benchmarking against professional trends in other national libraries (PLDS Statistical Report 2002 and 2004). To achieve this, the study utilizes the experience of library consultants as well as critically evaluating the state-of-the-art literature on the topic (Himmel & Wilson, 2005).

Staff Surveys and Facility Evaluations

The performance of a library branch is evaluated based on results from library staff surveys and objective facility evaluation measures. The combination of qualitative and quantitative measures of library performance evaluation into a single scoring classification system represents a unique feature in this evaluation method, and puts it under the spotlight.

Two written survey questionnaires are distributed to and collected from a stratified sample of 178 staff members at 41 branches and 68 staff members at the Main Library. This article only reports the results from the branch library survey. The questionnaire is grouped into building, site, and community. There are 14 questions specifically addressing space categories: entrance/lobby; circulation desk; periodicals area; reference area; adult area; teen area; children's area; computer stations; program room; public restrooms; staff work area; staff break area; collection storage; and, the manager's office. The common elements of the space category questions include adequacy of space, lighting, noise level, temperature, odor, attractiveness, security, accessibility to the disabled, and furnishings. The site questions cover the access, safety, and amenities such as parking, landscaping and personal or property safety of customers and staff. The question assessing the library from the community's perspective include elements regarding to enhancement and support of community activities.

The feedback received is then converted to a four-point score, ranging from poor (0) to fair (1), good (2), and excellent (4), with the fifth column indicating 'not applicable'. The mean scores for each question are averaged into the mean scores for building, site, and community. Finally, the overall staff survey score for each branch library is derived from the average of the three mean scores.

To assuage the compatibility with the staff survey, the facility evaluation by the project team uses the same variables reflected the staff survey questionnaire. This evaluation

also rates items on a four-point scale, while comments are recorded as well. Clearly defined performance criteria are created and evaluation training is conducted so that different teams would produce comparable evaluation results. As illustrated in Figures 1 and 2, the facility evaluation teams have expressed some of the problems/issues through digital photography. A data process similar to the staff survey produces scores for building, site, and community, which are averaged to derive the overall facility evaluation score for each branch library.

Service Area Delineation

For administrative and management purposes, a branch library's service area must be clearly outlined. A library can potentially serve a village, a school district, a county, a city, or a metropolitan area. In this study, Hamilton County is the Library's service area although, for instance, a resident in a neighboring county may be a customer of the Library.

Inside the library service area, a branch library may be visited for viewing its book collection, attending meetings, and partaking in any of its programs. Branch libraries within close vicinity may attract same customers. Yet, the area from which a branch library draws the majority of its patrons may vary depending on its collection, building, site, and community characteristics. Therefore, delineating each branch's service area eases the process of evaluating its facility performance as well as the spatial distribution of branches with regards to the spatial distribution of potential customers. As a result, the project team delineates branch library service areas based on the proportion of library users. To assess branch libraries, these

areas are then divided into two categories. The first category is the primary service area which includes the residents expected to use this branch library, while the second category is the

overlap service area which lacks a dominating branch and may be shared by more than one branch library.



Confusing approach to desk.



Outdated restroom facilities.



Entry with hiding places.



Meeting room lacks privacy.

Figure 1: Facility visit photos showing a historic branch library (Source: Authors).



Circulation desk area can be congested.



Staff area lacks daylight.



Lighting at stacks is dim.

Figure 2: Facility visit photos showing a recently-built branch library (Source: Authors).

Circulation records, buffer distance, travel time and distance are all important aspects one should note when defining a service area. The criterion used is the number of circulation by census block group. It is believed that

circulation records reflect customer distribution most evidently and reliably even though there are other activities that people may travel to libraries for. These activities are reflected in other variables to be discussed later. In the context of

the preceding aspects, this analysis is based on circulation records from March to April in both 2003 and 2004 provided by the Library.

The computation of the active library users in a census block group using the same branch follows the GIS geocoding process whereby the home address of the customers is traced. The geographic data of census block group boundaries and streets are from the Cincinnati Area Geographic Information System (CAGIS), a consortium of local government agencies and utility companies. Each branch library then has an effective service area, which is further divided into primary and secondary service areas. On one hand, the primary area is defined as the census block groups where more than 65% of expected customers use the branch library. This gives room for other branch libraries to have a maximum of one-third of active customers from the census block group. On the other hand, the overlap area is defined as the census block groups where branch users do not exceed 65% percent and do not go below 17%.

Quantitative Data Variables

The Library operation, building and physical condition of the site, operation costs, capacity, and demographic characteristics of a service area is mirrored in the quantitative data that has been gathered. The evaluation of each branch library involves the analysis of over 50 variables.

The following data are obtained from the 2000 US census data: population percentage by five age groups (children - 13 and younger; teens - 14 to 18; adult #1 - 19 to 34; adult #2 - 35 to 65; and adult #3 - 65 and older); education levels

of the population with ages of 25 years and older (less than high school; high school; some college; Bachelor; and above); population percentage living below the poverty line; and population percentage owning vehicles and the number of vehicles owned, if any.

The digital spatial data acquired from CAGIS include: census block groups; streets; property parcels; and building footprints. Those data are used to derive physical dimensions such as building and site size.

A considerable amount of information regarding service and management is provided by each library's staff members. The records obtained from the staff constitute circulation records, number of staff, and the library's working hours. More information, like the circulation per capita, can be inferred from the aforementioned data. It is determined by dividing the circulation of a branch by the population residing in its effective service area.

The quantitative variables are categorized into six indicators: the service area; the usage; the building; the site; the staffing output; and the capacity. The first indicator, the service area, as mentioned earlier, is determined based on the size of effective service area and population within the effective service area. Second, the usage indicator is made up of four variables: circulation, visit counts, number of programs, and working hours. Third, the building indicator points out the buildings age how sufficient the building and parking spaces are. Fourth, the site indicator exemplifies the physical features and qualities of the library's location. Fifth, the staffing output indicator is made up of two variables: staff cost per circulation, and

circulation per full time staff equivalent (FTE). The final indicator is the Capacity of the building and to what extent it could house programs and activities un-related to the common circulation. The Capacity indicator is made up of six variables: seats per 10,000 population; meeting room capacity; program attendance in 2004; number of rooms for programs and activities; internet station shortage; and items owned per capita.

Composite Scoring and Branch Ranking

To measure branch library performance, the qualitative and quantitative variables are then compiled into a matrix with a standardized five-point scoring system. The criteria for scoring are based on a combination of variable distribution, library consultants' experience, and national benchmarking. For instance, "library visits per hour open" are scored such that 0 implies that there is no visits, 1 implies that between 1 and 11 people visited the library, 2 implies that between 12 and 14 people visited the library, 3 implies that 15 to 18 people visited the library, while 4 implies 19 to 24 visitors.

Moreover, the relative importance of each indicator in the branch performance evaluation is allocated a weight as judged collectively by the project team. For example, the project team sees that the staff survey indicator is 3 times less important as the capacity indicator. Figure 3 illustrates this weighting.

High performers are indicated by branches with a composite score of more than 2.5. Any branch whose total score is less than 2.5 is viewed as one that needs improvement in any of its indicators, in order to excel, when contrasted to widely accepted standards.

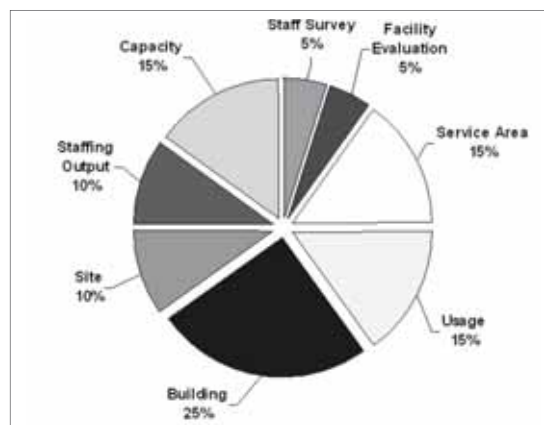


Figure 3: Weighting of performance indicators.

System Performance Evaluation/National Benchmarking

The library system under investigation consists of the main library and 41 branch libraries and is considered one of the largest in the United States and Canada. If Hawaii's statewide library system is not considered, the studied library and its branches would be ranked ninth with regards to their number of facilities, and ranked eighth with regards to their annual circulation. Over time, the Library's system evolved from the desire of municipalities and neighborhoods within the county to have their own library.

Quantitative data (salaries, output measure, library finances and other annual data) is obtained through the Public Library Data Service (PLDS). The majority of U.S. and Canadian libraries participates as volunteer members of the PLDS.

Statistical information provided by the PLDS is usually described through the population that the library serves. Service population is divided into two categories: ones serving over one million residents; and the other, which includes the Library, serving between 500,000 and 999,999 people. A comparison between the Library and other participating libraries in the U.S. and Canada is then carried out to assess the differences and similarities in each library's performance. Such comparison relies on data from the 2004 PLDS Statistical Report (FY 2003 data) and from the 2002 PLDS Statistical Report (FY 2001 data).

Subsequently, the project team finds that the Library serves the thirtieth largest population among the sixty three U.S. and Canadian libraries that serve over 500,000 people with a main library and at least one branch library. The Library has branches above the average number of branches. On average, the Library serves 20,375 people per branch, more than just one library system - the Buffalo and Erie library system which serves an average of 18,633 people per branch, with a total of fifty one branches. In contrast, the Columbus Metropolitan Library serves 40,384 people per branch, with a total of twenty branches, which makes it one of the most efficient systems in the country, along with Marion County Library in Indianapolis.

The Library performs well on measures relating to circulation per capita (both overall and circulation to children). However, given the large number of branches, the Library does not fare well on the total number of branch visits, or on the number of reference transactions completed in the branches. The Library is

below the average in reference transactions completed in the branches. This is, at least in part, due to the fact that many of the branches are too small to have anything more than very basic reference collections.

Most of the branch libraries serve an area inside the average 2.7 miles distance between branch libraries. Overall, 44 percent of the library service area and 39 percent of the population lay inside a branch library's primary service area. Some branches clearly compete with other nearby branches, since there is a 55 percent overlap area of library service area and 59 percent overlap area of the population being served.

According to branch distribution, it is evident that large branch libraries are situated in suburban areas, whereas small branch libraries are located in the more inner urban regions. Figure 4 illustrates how branch libraries are registered by their building size and by staff FTE (Full Time Equivalent).

From the preceding comparison with other urban library systems, it can be concluded that while the Library has twice as many branch facilities, taking its population into consideration. Having separate branch facilities within each neighborhood is an unsustainable goal from a medium/long-term perspective. This may significantly constraint the services provided by the individual branch library. Staff resources are limited and a large number of users' resources must be bought in order to have an adequate collection for all branches.

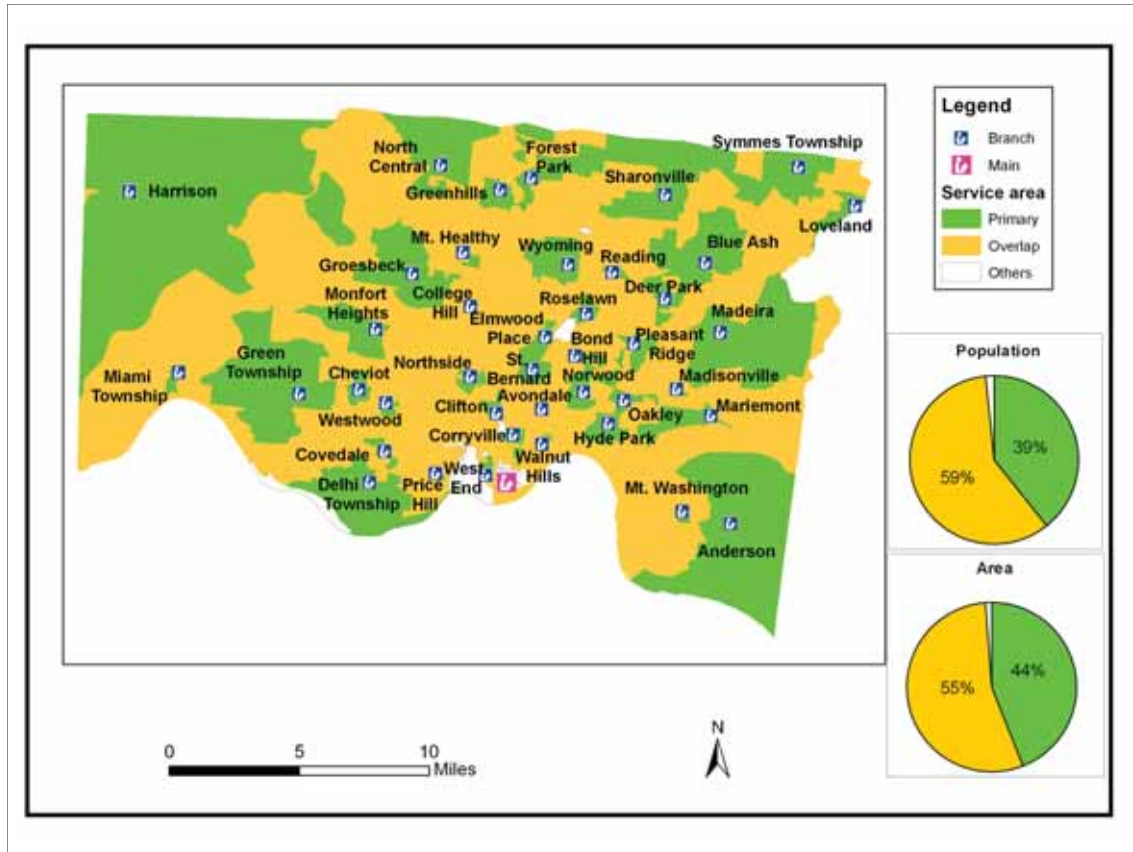


Figure 4: The library service area patterns.

Overall Scores for Branch Libraries

Branches are ranked according to the total scores compiled. Suggestions for the Plan are derived from the individual indicators' scores. The following discussion analytically looks at the overall scores and the eight performance

indicators, as described in the three tiers in table 1. The overall branch performance ranges from 1.29 (worst performer) to 3.24 (best performer). A few of the indicators are inconsistent. For instance, the lowest service area score is 0, while the highest is 4. It can be clearly inferred from the data gathered that the top fourteen

branches consistently perform better than the bottom ten, with differences between the two occasionally being strikingly significant. The

eight indicators show that the higher performing libraries' service areas are the geographically larger ones.

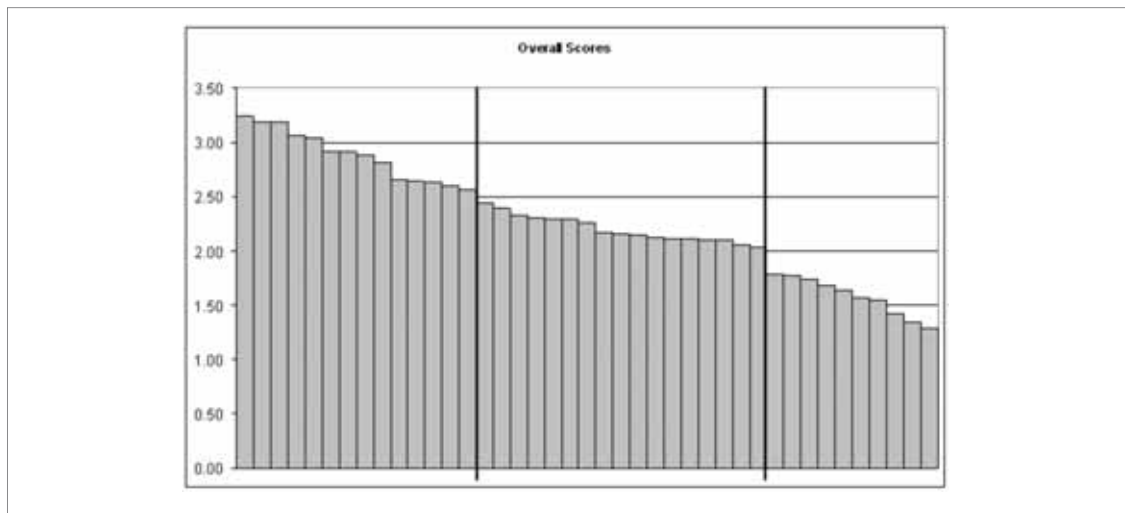


Figure 5: Composite library scores.

Table 1: Summary of branch libraries									
Factor	Staff Survey	Facility Evaluation	Service Area	Usage	Building	Site	Staffing Output	Capacity	Overall
Highest Score	3.46	3.67	4.00	4.00	3.50	3.75	4.00	3.67	3.24
Lowest Score	1.86	1.36	0.00	0.75	0.75	1.00	1.00	0.67	1.29
Average Score	2.73	2.86	2.05	2.37	1.98	2.69	2.41	2.20	2.30
Median Score	2.74	2.92	2.00	2.25	2.00	2.75	2.50	2.30	2.30
Top 14 Average	2.79	2.98	3.25	3.46	2.16	3.18	3.07	2.81	2.88
Middle 17 Average	2.82	2.86	2.03	2.09	1.88	2.72	2.50	2.05	2.20
Bottom 10 Average	2.47	2.67	0.40	1.33	1.88	1.95	1.35	1.77	1.58

The fourteen highest performers lie in the sixty seven percent suburban part of the county. The remaining seventeen moderate performers cover more urban areas and twenty eight percent of the county. Those moderate performers are characterized by having a limited service area, and a small building and site size. They are also younger than the other suburban libraries. To demonstrate the limitation of the service area, the collected data delineate that the bottom ten performers serve just 5 percent of the county. Fifty percent of county residents are served by the fourteen top branch libraries, whereas only thirteen percent of total residents are supported by the bottom ten branches.

Individual Indicator Scores for Branch Libraries

Staff Survey Synopsis

The staff survey indicator constitutes three variables: building, site, and community. The 'building' variable is analyzed according to its overall design quality which includes convenience for the disabled, signage, security, maintainability, pleasant appearance, amount of space, connection between spaces/layout, flexibility to changing uses, quality of building materials, and environmental quality. The 'site' variable is analyzed according to how the building can possibly be traveled to and accessed. The site may be accessed in the following ways: on foot; bicycle; vehicle; the disabled; public transport; and, from businesses, community centers and schools in close vicinity. Finally, the 'community' variable constitutes how the community views the branch's location, usage convenience, compatibility with surroundings, quality of collection,

availability and quality of internet access, hosting community activities, community development, and unconventional uses and resources of the library.

As illustrated in Table 2, staff evaluations in the form of a survey is based on the responses' fixed frequencies and relative collective percentages from the responding libraries, such that the frequency of comments is divided by fortyone, since all the branch libraries have responded. Some staff members reported a number of serious problems, some of which are the occasional lack of a sufficient number of computer terminals, poor maintenance, inadequate staff work spaces, as well the occasional incompatibility with the Americans with Disabilities Act-ADA (Preiser, 2001; Salmen, 2001).

Facility Evaluation

Like the categories used in the staff survey, facility evaluation also includes three categories: building, site, and community. The 'building' category focuses on its design as a whole, including the entrance/lobby and other spaces in the building. More specifically, ample room, comfortable lighting, acoustics and temperature are also used in the evaluation. Program rooms, among others, are spaces assessed and found to have an average score of 2.8 on the five-point scale explained earlier. Another space that is assessed similar to the assessment in the staff survey is the branch manager's office. Twenty two out of the forty one branches do not have separate offices for branch managers.

The second category is the 'site' which constitutes the assessment of the accessibility, safety, and amenities as a whole, while also

scrutinizing more specific criteria (i.e. all types of user groups). The third and final category is the 'community' whereby the general community's perspective is taken into consideration. Criteria under this category include convenience of usage, high quality of collection, dependable internet access, community outreach programs, advocating non-library programs and activities, as well as fulfilling community needs.

Table 2: Staff survey comments: Cumulative

Building		
Spaces inadequate (size):		
Program Room	8	19.5%
Reading Areas	14	34.1%
Support Spaces	21	51.2%
Spaces missing:		
Program Room	13	31.7%
Reading Areas	3	7.3%
Support Spaces	13	31.7%
Adjacencies/ space arrangements	11	26.8%
Maintenance issues	17	41.5%
Security issues	13	31.7%
Noise issues	4	9.8%
Air quality	7	17.1%
Lighting	13	31.7%
Thermal Comfort Issues	13	31.7%
Furniture	22	53.7%
Computers inadequate (Staff and Public)	30	73.2%
Signage/ Way finding	11	26.8%

Positive Comments	4	9.8%
Site		
Accessibility (Vehicular, Pedestrian, bicycle)	9	22.0%
Entry from site to building	6	14.6%
Visibility and signage	8	19.5%
Parking	13	31.7%
Security issues	12	29.3%
ADA issues		
Building	18	43.9%
Site	8	19.5%

Service Area

The service area indicator reveals the number of customers as well as how much space the library's services and facilities occupy. Two variables constitute the service area indicator: the total population of the effective service area, and the size of the effective service area. Higher scores are given to the branch libraries that have a larger population to serve and a larger service area. It is important to note the discrepancies in the population density in each service area. As observed, low performing branch libraries serve areas with high population densities; moderately performing branch libraries serve areas near inner urban regions with a fairly high population density; and, the highest performing branch libraries border areas with the lowest population density. Differences in population features are explored in the following section.

Library Usage

Library usage constitutes four variables that evaluate the efficiency of the services in each branch library. The four variables are: annual circulation per piece owned; circulation per working hour; library visits per working hour; and number of programs in 2004.

The fourteen lowest performing branches have an average circulation per working hour of fifty one, as illustrated in Figure 6. The moderate branches have an average of ninety six circulations per working hour, while the fourteen highest performing library branches have an average of one hundred sixty five circulations per working hour. When compared to other library systems, the Library is generally a high performer with regards to circulation issues, including the 'turnover rate' which is the term often used for the average annual circulation per piece owned. The number of programs provided also makes the Library a high performer. Moreover, the number of visits to the branch libraries lowers the Library's overall performance score.

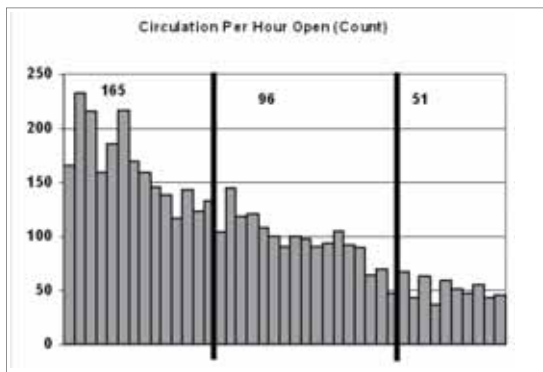


Figure 6: Circulation per hour open.

Building

Unlike the 'building' variable used in the staff survey and facility evaluation, where the assessment is based on the qualitative views of staff and experts on the building as a physical entity, this 'building' indicator uses quantitative data acquired from library records. The 'building' indicator constitutes four variables: circulation per square foot; building age since last renovation; facility size per capita; and cost of maintenance per square foot.

The forty one branch libraries exhibit inequities in the diversity of facilities, as shown by the analysis. The ratio of the entire building size measured in square feet to the population density in the effective service area is used to derive the facility size per capita. The lowest value found was 0.15 square feet, which implies that the branch library's facility is too small to occupy all the potential customers. The largest value found was 1.48 square feet per capita. Regardless of additions or renovations, the forty one branch libraries' age was found to range from nearly new to ninety nine years.

The circulation per square foot lies between twenty five and forty. The collected data reveals that circulation per square foot hints that the facilities in the Library are efficiently used. Occasionally, a rate larger than forty circulations per square foot indicates that the branch library's building is working beyond capacity, and has the potential of being overcrowded.

The majority of values of maintenance cost per square foot are tolerable. The Library must be aware of the building with a maintenance cost per square foot of \$4.00. Any higher costs are

usually caused by problems that rarely occur. It is important for the Library to closely keep track of all costs, including those rare high costs, to fairly judge whether or not the maintenance costs need to be lowered. Notably, the analysis reveals that the Library is capable of carefully tracking and controlling maintenance costs by keeping record of all data.

Site

The 'site' indicator mirrors the overall features of the property as a whole. This category constitutes four variables: distance to closest bus stop; availability of parking space for the disabled; availability of off-street parking space; and potential for expansion.

According to Waters and Wilson (2005), office parking space should be about one parking space per 250 square feet of facility size. To find the off-street parking space deficit, the available parking spaces are subtracted from the recommended number of parking spaces. The ratio of off-street parking space deficit number to the recommended parking space number is used to find the proportion of parking space deficit. As shown in Figure 7, the moderately ranked library branches have ratios between 20% and 80%. The parking deficit for the remaining low ranked library branches, excluding one branch, is a ratio exceeding 50%, including five branches with no available parking spaces at all. Thus, one can infer that the shortage or lack of parking space does not motivate customers to travel to and use the library.

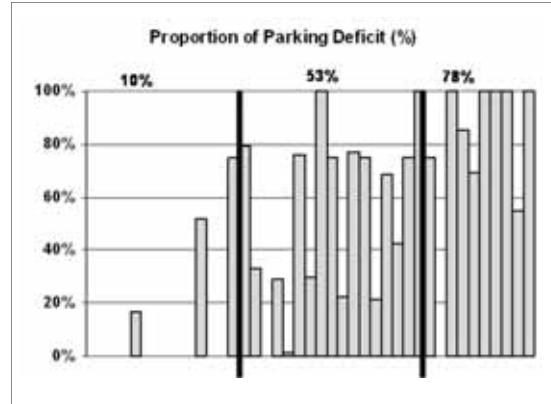


Figure 7: Proportion of parking deficit.

Staffing Output

Like the retail world, this evaluation process uses an approach aimed at assessing the effects of staff employment on the library system as a whole. Variables such as the general staffing costs, number of staff members assigned, and the usage with regards to circulation is analyzed in contrast to the two main variables that constitute the 'staffing output' indicator, which is measured by calculating staff cost per circulation, and circulation per FTE (Full-Time Equivalent) staff member.

As indicated by the staff cost per circulation, the highest ranked library branches when compared to lower ranked ones have lower unit costs. Increasing cost-effectiveness can be predicted if the higher cost branches are further developed.

As illustrated in Figure 8, cost per transaction in the high ranking branch libraries varies greatly in comparison to the low ranking branch libraries.

For instance, the fourteen highest performing branch libraries have a \$0.90 average branch staff cost per circulation, while the ten lowest performing branch libraries have a \$1.41 average branch staff cost per circulation and a \$1.50 average branch staff cost per transaction. Staff cost per transaction in the four lowest performing branch libraries is nearly twice the cost per transaction in the four highest performing branch libraries.

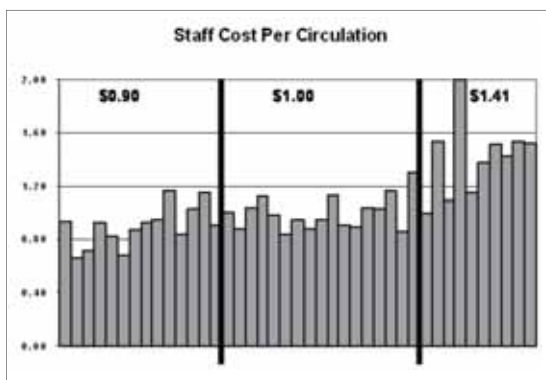


Figure 8: Staff cost per circulation.

Capacity

The 'capacity' indicator shows the extent to which a branch library can carry out the conventional library activities, like library material collections and seats available, as well as emerging functions. The 'capacity' indicator constitutes six variables: holdings owned per capita; seats per 10,000 potential customers; ratio of computer/internet terminals shortage; program attendance in 2004; meeting room capacity; and the number of program rooms.

Only five branch libraries have a shortage

of computer/internet terminals, while all the remaining branch libraries perform highly in this regard. Most low performing branch libraries lack a meeting room, whereas most of the high performing branch libraries have a large and sufficient capacity.

Recommendations

The project team proposes a Facility Plan that is important for fulfilling the library's sustainable goals by establishing a system that could supply high quality services and facilities that are economically sustainable on a long-term basis.

An examination of more than forty recent instances (Wilson, 2005) in which small, inefficient branches or several small branches are replaced by considerably larger facilities serving a larger population base, showed increases in usage (measured by circulation) of between 40% and 107%. This information has been used to project the levels of use that might be experienced by the Library if the below four strategies to achieve greater cost-effectiveness and improved service are implemented. This will result in fewer, but larger branch libraries. However, implementation will also result in usage by a larger percentage of the population and in higher total circulation per capita. An overall increase in circulation in the Library's branches is projected to be approximately 30%. The four strategies to be applied to specific branches include:

1. No major changes.
2. Upgrade and/or expand existing facilities.
3. Replace existing facilities.
4. Consolidate branches with overlapping service areas

This recommendation aims to serve more of the population in the Library's entire service area, particularly populations near urban areas, while aiming to increase the Library's efficiency. Occasionally, some branch libraries used a combination of the four proposed strategies. For instance, two significantly efficient branch libraries that serve three previously overlapping service areas can come into being if a library is completely reconstructed and a new facility is built to replace two other inadequate branches.

The ratio of one branch library per 27,267 residents, which resulted from the recommended changes, is still higher than that of top libraries in the nation. With the adoption of the Plan, more people would use the libraries, and the extent to which the use of libraries would rise. The following data compares the population served by branch libraries of the Multnomah County Library and Columbus County Library:

Columbus Metropolitan Library (<<http://www.cml.lib.oh.us/>>

1 branch library for every 40,384 in population

Multnomah County Library (Portland, OR)

1 branch library for every 41,891 in population.

If the Plan is completely executed, the overall Library circulation is expected to increase by approximately 3.5 million, or about 30%, based on the experience of other libraries that have consolidated smaller branches into larger branches.

In sum, residents in Hamilton County will greatly

benefit from the Plan. Branch libraries will be capable of providing better collections for users, as well as longer hours of operation. Library expansions with larger and renovated meeting facilities will result in an increase in community meetings and events. The improved computer technology terminals will also greatly benefit new library users.

Conclusions

The Library's Board of Directors is now more capable of leading the development of the Library's system and facilities, with the Plan as the channel through which unbiased decisions can be made. The services will then be more balanced.

Overall, the approach of research and analysis in this project is a promising method of evaluating library performance through the integration of quantitative and qualitative techniques. Summary scores for specific branches and an entire library system are obtained by analyzing different types of primary and secondary data. Recommendations and future action strategies in the Facilities Master Plan are based on these scores.

The integration of performance evaluation and analysis with planning and decision-making is very important from the viewpoints of politicians, policy makers, as well as the general public. This article aims at reaching a compromise with regards to the future of a public library system through joint efforts among major stakeholders. The analytic capabilities of the performance evaluation of the library will improve through the emerging use of GIS and BPE. GIS can assess a building's performance by analyzing

the service area characteristics whereas BPE can assess a building's performance by utilizing systematic 'consumer feedback' and expert observation.

Social interaction within a service area is promoted through the library system recommendations. The assessment of the Library's overall performance suggests the need for adjustment of branch libraries. The assessment of the branch libraries provides the specific recommendations for such adjustments. The results illustrate the importance of comprehending spatial distribution of branch libraries, their interaction, and their conditions. Finally, one can conclude that the results help reach a compromise between stakeholders and the creation of recommendations and practical measures.

Acknowledgments

The excellent contributions by Himmel and Wilson, Library Consultants, are gratefully acknowledged. For their outstanding collaboration in this project, we thank The Public Library of Cincinnati and Hamilton County: Kim Fender, Executive Director; Raymond Hills, Facilities and Security Director; Library staff, Branch managers, as well as facilities staff. Thanks are owed to research assistants Eric Anspach, Gordon Bennett, Megan Conover, Sean Harry, Scott Hines, Hexiang Huang, Duygu Karadeniz, Chandrima Pal and Heather Sturgill. An earlier version of this article "Assessing library performance with GIS and building evaluation methods" was published in the journal *New Library World*, Vol 107, No. 1224/1225, 2006, PP. 193-217. We thank Ashraf Salama for his editorial work in condensing the manuscript for purposes of *IJAR*.

References

- Adler, J. (1997). Where the Books Are, *Newsweek*, July 14, pp.72-73.
- Badard, T. And Richard, D. (2001). Using Xml For The Exchange Of Updating Information Between Geographical Information Systems, *Computers, Environment And Urban Systems*, Vol. 25, No.1, pp.17-31.
- Dangermond, J. (1989). Trends in GIS and Comments, *Computers, Environment and Urban Systems*, Vol. 12, No.3, pp.137-159.
- Farbstein, J. (2003). Diagnostic Post-Occupancy Evaluation: USPS Retail Space Design, In: National Council of Architectural Registration Boards (2003, Wolfgang F.E. Preiser, author), *Improving Building Performance*, NCARB, Washington, DC., USA.
- Federal Construction Council, (2001). Learning from our Buildings: A State-of-the-Practice Summary of Post-Occupancy Evaluation, National Academy Press, Washington, DC., USA.
- Gahegan, M., and Lee, I. (2000). Data Structures and Algorithms to Support Interactive Spatial Analysis Using Dynamic Voronoi Diagrams, *Computers, Environment and Urban Systems*, Vol. 24, No.6, pp. 509-537.
- Grossmann, W. D., and Eberhardt, S. (1993). Geographical Information Systems and Dynamic Modelling, In M. M. Fischer and P. Nijkamp (Eds.) *Geographic Information Systems, Spatial Modelling, and Policy*, Springer-Verlag, Berlin, Germany.
- Himmel, E. and Wilson, W. (2005). Library Consultants. 417 E. High Street, Milton, WI 53563. Consultants (wilson@libraryconsultants.com), Personal Communication.
- Lee, Y C. (1990). *Geographic Information Systems For Urban Applications: Problems and Solutions*, Environment And Planning B: Planning and Design, Vol. 17, No.4, pp. 463-473.
- National Council of Architectural Registration Boards

(2003, Wolfgang F.E. Preiser, author). Improving Building Performance, NCARB, Washington, DC., USA.

Nethaway, R. (2005). Get More Use From Libraries, The Cincinnati Enquirer, April 3.

Perlman, E. (2004). Library Living.Governing, November, 51-54.

Public Library Data Service (PLDS) Statistical Report (2002 & 2004). Chicago, IL: Public Library Association (<<http://www.ala.org/platemplate.cfm?Section=aboutpla>>

Preiser, W.F.E., and Vischer, J.C. (Eds.)(2005). Assessing Building Performance, Elsevier, Oxford, United Kingdom.

Preiser, W.F.E. (2001). Toward Universal Design Evaluation, In: Preiser, W.F.E. and Ostroff, E.(Eds.)Universal Design Handbook, McGraw-Hill, New York, USA.

Preiser, W.F.E., Rabinowitz, H.Z., and White, E.T. (1988). Post-Occupancy Evaluation, Van Nostrand Reinhold, New York, USA.

Salmen, J.P. (2001). U.S. Accessibility Codes and Standards: Challenges for Universal Design, In: Preiser, W.F.E. and Ostroff, E. (Eds.) Universal Design Handbook, McGraw-Hill, . New York, USA.

Seder, I., Weinkauff, R., and Neumann, T. (2000). Knowledge-based Databases and Intelligent Decision Support for Environmental Management in Urban Systems, Computers, Environment and Urban Systems, 24: pp. 233-250.

Shamsi, U.M. (1996). Storm-Water Management Implementation Through Modeling and GIS. Journal of Water Resources and Management, Vol 122, No.2, pp.114-127.

Shill, H.B. and Tonner, S. (2003). Does the Building Really Matter? Facility Improvements and Library Usage, ACRL Eleventh National Conference, April 10-13, Charlotte, N.C., USA.

Singh, R. R. (1999). Sketching the City: A GIS-Based Approach. Environment and Planning B: Planning And Design, 26, pp. 455-468.


Wang, X. (2005). Integrating GIS, Simulation Models, and Visualization in Traffic Impact Analysis, Computers, Environment, and Urban Systems, 29(4), pp. 4871-496.

Waters, R.L. and Wilson, W. (2005). Based on a formula developed by Providence Associates, Cottonwood, AZ and Himmel & Wilson, Library Consultants. Personal Communication.

Worrall, L. (Ed). (1990). Geographic Information Systems: Developments and Applications, Belhaven Press, London, United Kingdom.

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