To Measure and Manage Space

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The Evaluation Problem

In 1994, the director of the Krannert Library of the University of Indianapolis posed a practical research question pointing to a critical factor in terms of future growth of the Krannert Library and the university whose programs the library supports: "Is there adequate seating for students given the recent trend in the increase in student body size?"[1] Indeed, the question corresponds with one of the three norms that form the basis for analyzing library space as set forth by Heather M. Edwards in her book *University Library Building Planning* (Scarecrow, 1990). Two other norms concerning space are library staff (office and processing) and book storage (stacks).[2]

The subject of seating is important. As Edwards has commented, "It is not the building staff itself, but good furniture and layout which are necessary for the success of the library in establishing a satisfactory relationship between user and information."[3]

Description of the Library, University, and Student Body

The holdings of Krannert Memorial Library of the University of Indianapolis were reported as 141,000 volumes in 1994.[4] The library had 121,000 book titles and 1,130 periodical subscriptions that year.[5] There are three special collections which are not considered part of the general collection, (ie. special permission is required for admission and use). They are the Krannert Collection of Rare Books, the Indianapolis Historical Collection, and a special collection of Evangelical United Brethren materials.

The University of Indianapolis is primarily an undergraduate institution, although it does offer thirteen graduate degree programs including Master of Accounting; Master of Arts in Art, English, Psychology, Applied Sociology, History, and Elementary Education; Master of Business Administration (including an Executive Master of Business Administrative program); Master of Science in Biology, Occupational Therapy and Physical Therapy; and Master of Health Science in Physical Therapy.[6] The Krannert School of Physical Therapy of the Graduate Division is nationally recognized.[7]

Enrollment for all students in 1994 totaled 3,583.[8] Full-time students (235 graduate and 1,450 undergraduate) totaled 1,685 for 1994.[9] Residence halls are capable of housing 800 students, slightly less than half of the school's full-time enrollment.[10] A simple calculation based on the registrar's totals would place the percentage of full-time students living on campus at less than 50 percent. The University of Indianapolis is clearly a school with a large commuting student body. Indeed, to include 1,898 part-time students only swells the number of commuters.

A Review of the Literature and the Formation of Standards

Mark Leggett, the manager of the Business, Science and Technology Division of the Indianapolis-Marion County Public Library, stated in a lecture that literature on the interior design of library facilities is scarce and difficult to find.[11] Mr. Leggett's experience developed from his attempt to redesign a reference desk, however, he was referring to interior facilities generally when he remarked: "There's really very little out there to be found."[12] This writer, having made several trips to Bloomington, IN, for the relevant references he was able to find, has to concur that information relating to interior physical facilities is not readily accessible.

Some research was consulted, such as a study conducted by the Buffalo Organization for Social and Technological Innovation (BOSTI), which Heather M. Edwards views as relevant to the concerns of library managers. BOSTI found that of space used, largely by those working in the public sector, the factors directly affecting job satisfaction were: "floor area, temperature/air quality, lighting, noise, ease of communication, comfort,... and privacy."[13] Floor area is a main emphasis of the published standards for evaluating the physical plans of libraries. Other considerations, especially privacy, are also significant.

Importantly, in the BOSTI study an "open plan office with partitioning on three sides of each work station was found to facilitate far better communication than the totally open office plan, as well as providing much needed privacy."[14] The effect of three-sided enclosures suggests that the presence of nearby or bordering stacks as enclosure would provide a desired level of privacy in a library.

Actual occupancy of seats in a library was calculated in an interesting way by Lynda H. Schneekloth and Ellen Bruce Keable. In addition to counting seats occupied by people in the Newman Library of Virginia Polytechnic Institute and State University, the two researchers also counted the number

of seats occupied by debris. The term "debris" was defined as "material (such as books, magazines, and backpacks) occupying a chair or table which effectively filled that space... For every 100 seats occupied by users, 80.3 seats were occupied by debris."[15] The debris factor diminished as the library became crowded, "suggesting that spreading out is a luxury that disappears during heavily used times."[16]

Interestingly, Schneekloth and Keable found that "the Newman Library is perceived full when seating has reached the 50 percent capacity of people occupancy with debris occupying other seating areas."[17] Obviously, perception is an inexact guide, yet perception is a truth to the observer and could force some people to turn around and leave. Schneekloth and Keable suggested that management make an effort to keep tables and chairs free of debris during peak study times.[18]

In summary, layout and area, particularly the idea of space enclosures, were found important by the Buffalo Organization for Social and Technological Innovation. Perception of activity and interaction patterns, especially a sensitivity to others' territories demonstrated by an expanding and retreating debris line (or "spread out" factor), emerge from the research of Schneekloth and Keable. One is reminded of how people reposition themselves in an elevator, creating a measured distance among themselves. In other words, area is as much a matter of perception as it is a matter of physical measurement. Indeed, perception can prove to be an overriding factor in measurement.

From the 1950's on, many people have tried to arrive at desirable physical measures for libraries. A brief chronology given by Edwards lists eight people who had published guidelines up to 1970: Smith (1954), Russell and Doi (1957), Metcalf (1965), Bareither and Schellinger (1968), Ellsworth (1968), and Havard-Williams (1970).[19] In 1967, an attempt initiated by the Association of College and Research Libraries and supported by the Association of Research Libraries presented a mandate to a committee chaired by Downs to complete a list of criteria "that would result in excellent library service and facilities."[20] The committee "selected and analyzed fifty leading university libraries, and any library could then be measured against a library or group of libraries to which it aspired. The standards given consisted primarily of concrete, quantitative data."[21] A follow-up committee decided, in the midst of a sustained disagreement over the use of quantitative or qualitative standards, that the Downs committee approach would yield invalid results and recommended "the use of common techniques rather than quantitative standards."[22]

A separate effort to provide university library guidelines was made by the Planning and Management Division of the Western Interstate Commission for Higher Education (WICHE) in Colorado. The library standards were part of a larger effort aimed at covering an entire range of higher education activities. The standards for university libraries are specific, providing quantitative measures of physical space within a library.[23]

This writer has had the WICHE standards and the published standards of K.D. Metcalf. In researching this study, however, he has reserved the right to apply whatever standard seems to pertain to the situation at the University of Indianapolis, regardless of author.

The Methodology and Reported Results

In the relatively new area of space management, potentially assignable areas are being measured. In his standards, Metcalf gives the fewest categories in recommending desirable seating choices. His list omits individual rooms (the province of faculty at the University of Indianapolis and, hence, safely excluded from consideration) and group rooms. A comparison seating (types of stations) in the Krannert Memorial Library to those in Metcalf's standards is given below:

Type of Station	Metcalf's Recommendation	In the Krannert Library
Lounge chairs	Not more than 15%	23.84%
Individual desks and carrels	Up to 85%	38.67%
Group seating	Not more than 20%	35.53%

(For the source of totals, see Tables 1 through 4 at the end of the text.)

The Krannert Memorial Library is overly filled with sofas and lounge chairs by 8.84 percent, seriously short of individual seating and carrel space by 46.33 percent, and in excess of Metcalf's group seating recommendation by 15.53 percent.

Another measure often applied to university libraries is the recommended number of reader stations in relation to the FTE (full-time equivalent) user enrollment being served by the institution. The most appropriate percentage of stations to users is 20 percent, according to Godfrey Thomp-

son, for colleges "where less than 50 percent of the FTE enrollment resides on campus"[24], which is the situation at the University of Indianapolis. Twenty percent means one seat for every five students. When lounge chairs and sofas are included as reading stations, Krannert Memorial Library exceeds Thompson's recommendation by 4.39 percent. The library's 403 seats divided by 1,685, (the FTE enrollment of the school) yield 23.9 percent. This resulting percentage is actually closer to the more frequently published recommendation of 25 percent, specified by Metcalf, WICHE, Havard-Williams, and Ellsworth.[25]

Having established the general adequacy of seating at the time, this writer will project his calculations to answer the library director's original question: "Is there adequate seating for students given the recent trend of increase in student body size?" Using Godfrey Thompson's recommendation of one seat for every five students and averaging the annual increases in FTE enrollments for the past five years (62.75 more students per year over a five-year period according to the registrar),[26] the capacity of Krannert Memorial Library will reach Thompson's recommended percentage of 20 percent in the year 1999 when the library would enter the year 2000 feeling the beginning of a pinch.

This writer admits that he has a real problem counting sofas and lounge chairs as anything other than reading stations (as opposed to workstations or carrels). Only one study activity can be carried out on sofas -- specifically, reading. In the Krannert Memorial Library, often a footstool or end table is found next to a lounge chair; however, it is difficult to write on these as it puts the body in an unnatural position. In other words, a person can read in comfort in a lounge chair; but he could not take notes or write with ease for a prolonged period of time without a flat surface in front of him (i.e. a table or carrel space). In sum, this writer would apply the term "reader stations" to all seating, including lounge chairs and sofas. He would, however, reserve the terms "work stations" and "study stations" for chairs at tables and carrels, where writing activity could be carried out for sustained periods of time. This distinction will explain the format of the tables found in the appendixes, which separate lounge chairs and sofas from all other categories.

If the reader accepts the writer's more rigid definition, then seating capacity stands at 18.1 percent (derived from 305 work or study stations divided by 1,685, the present enrollment), almost two percent short of Thompson's recommendation. Clearly, the library is below recommended capacity now.

Estimating desired reader space is another common measure in a university library. Sonja Johnson, director of the Bureau of Facilities Planning at Indiana University-Bloomington, gives a simple, straightforward formula for measuring needed reader space: "Count the total number of actual reader stations [which would include lounge chairs and sofas] in the library and multiply by twenty-five square feet. Include stations at the card or on-line catalog, index tables, etc., as reader stations for this purpose."[27] There are no stations in any real sense at the card and on-line catalogs of the Krannert Memorial Library.

Measuring as Johnson suggested (403 seats at Krannert multiplied by 25) yields 10,075 square feet of seating, or 23.6 percent of the library's total floor space of 42,682 square feet for the first, second, and third floors. Measuring across the widths of the second and third floors shows seating to be one fourth of the width (or 25 percent) on each floor. Krannert Memorial Library more than meets the recommendation of 20 percent. The next measure to be described in this text adds support to the statement just made. Square feet per station is a supporting measure commonly taken of interior space and the furniture within it. Godfrey Thompson gives the clearest statement among all the authors mentioned: "Each study station shall be assumed to require twenty-five to thirty-five square feet of floor space, depending on its function."[28] It is the qualification "depending on its function" which complicates the application. This writer chose to use Metcalf's recommendations, which suggests less space is needed than Thompson's.[29]

A spot-check of selected locations was made at Krannert. On the first floor, two round tables seating four students each shared 150 square feet, counting the surrounding space to the stacks. This surrounding space is in excess of doubling the ASF (assigned square footage) for both tables.

Type of Station	Requirement in ASF (Assigned Sq. Ft.)		
	Minimum	*Adequate*	*Generous*
Lounge chairs	20	25	30
Tables for four	22.5	25	27.5
Individual carrels	20	22.5	25

(The table of categories is not fully reproduced.)

Two long tables in the law section, each seating four occupants, shared 119 square feet, counting the distance to the stacks, again in excess of doubling the ASF for both tables. Of the two study areas on the first floor just described, two study areas on the second floor, and four study areas on the third floor (the quiet floor, a critical section), every station and study area exceeded, in terms of the total square feet surrounding the stations, the recommended space for the types of stations selected.

Recommended carrel dimensions are difficult to find, although it is possible to create a recommendation by adjusting the dimensions recommended for audio visual carrels. The recommendations given by Edwards are forty-eight inches wide and forty-two inches deep.[30] The recommendation for depth can be reduced by one half, allowing for the space occupied by any object sharing space with the patron -- an adjustment that proved extremely accurate in establishing widths for index tables. (See explanation given in Table 1.) With that adjustment, this standard becomes forty-eight inches wide and twenty-one inches deep. None of the carrels in the Krannert Memorial Library meets the recommendation for width. Deep carrels are fourteen inches short of the recommendation; shallow carrels are ten inches short. For depth (the adjusted measure), deep carrels exceed the recommendation by three inches; shallow carrels only one rather insignificant inch short of the recommendation. In passing, it should be mentioned that nine tables out of all tables in the library (those described as short medium, long narrow, and long in the closing tables) fail to meet the recommended width of four feet for tables with chairs on both sides.[31] No other variations from recommended norms are reported.

This writer wanted to make an original contribution to the research literature. He wondered why so little is written about the size of the work space in front of the student on a table. Only when dimensions for carrel space is given, is this very immediate work space specified in the recommended measures. The amount of satisfactory immediate work space on tables has to be guessed, at best.

Determining the average work space necessary per occupant was the original purpose behind the construction of the tables found at the end of this article. The table provides space per occupant for all types of tables and carrels. The total of all "space per occupant" calculations for tables and carrels (lounge chairs and sofas excluded) in the Krannert Memorial Library is 1,541,512 square feet. When that figure is divided by the total number of possible occupants for all tables and carrels (305), the division yields an

average of about five square feet per student, which is accommodating enough since the depth of the space is rarely at issue.

Interpretation of the Results

The Krannert Memorial Library is short of carrels by 46.33 percent, although there might be a slight compensation because of the excess of 15.53 percent in group seating.

By counting lounge chairs and sofas as "reading stations," along with the other categories of furniture that provide accompanying seating, the Krannert Memorial Library exceeds the recommended allotment of space for study stations per total number of FTE enrollment given by Thompson. Recalculated using "work stations" or "study stations" alone (by this writer's distinction), the library has an 18.57 percent allotment of space to "work stations." To answer the library director's critical question, the seating accommodations will be adequate to the year 1999. When measuring the *use* of space, (redefining the use of space and the problem), the library is in a cramped condition already.

In terms of reader space, the amount of space given to student seating conforms to the recommendations for reader-station space using Sonja Johnson's formula. In terms of study areas spot-checked by this writer, each study area exceeded the recommended assigned square feet required for the selected study stations, and this writer admits he tended to select what might prove to be cramped areas. They were not.

The carrels have less width than recommended standards; and the author will interject that he would have felt comfortable with a wider carrel, as subjective as that comment is.

In connection with calculating space per occupant by type of station in square feet, it is hoped this writer's contribution is meaningful. This is the space the occupant feels. It is the occupant's private area, of which expansion is welcomed and contraction is felt as an infringement on rights. It is comforting to know that each student has almost exactly five square feet of work surface to himself.

In summary, the Krannert Memorial Library's space is comfortably close to most published standards. In fact, it exceeds many such standards.

Advantages and Disadvantages of the Methods Employed

The advantage of the methods used in this evaluation is that they are quantitative, and the methods are backed by experts. The disadvantage is that many psychological factors alter the application and the practical meanings of the results. People do not use space as it is mathematically allotted. Earlier we mentioned Schneekloth and Keable's "debris" factor. The writer witnessed one student whose debris occupied a full round table -- all four seats. Further spreading out was impossible. Schneekloth and Keable were being realistic in counting seats occupied by debris. Heather M. Edwards has pointed out:

> It should be borne in mind that so-called four-, six-, and eight-seat tables rarely accommodate the stated number of readers and are thus uneconomical in terms of space usage. Despite having the requisite work surface area, visual disturbance is generally too great, and readers will seek a more private location.[32]

Along with the "visual disturbance", one is reminded of the very human trait of people repositioning themselves within an elevator to achieve even distances among themselves. Human beings spread out as much as their belongings will allow. Remember that Schneekloth and Keable found that a library is perceived as filled when it reaches fifty-percent capacity. People are inclined to claim more space than they can personally occupy.

It is understandable why the follow-up committee to Downs' committee rejected quantitative standards. One really has to ask whether the measures calculated in this article are applicable to the reality of how people use space.

Recommendations

This writer would recommend that the Krannert Memorial Library eliminate all tables of less than four feet in width. Even the round tables that are four feet in diameter place individuals too close together due to the "pull in" effect. He also recommends the elimination of what he would call "swirl" carrels (four carrels joined together in a pattern).

While these occasional carrel arrangements have ample space surrounding them by published standards, people are really sitting too close together for any real privacy.

The writer would recommend that all furniture removed be replaced by new carrels of the recommended forty-eight inch width to bring the library's number of carrels closer to Metcalf's recommendation of eighty-five percent.

Tables

Table 1

Types of Reader and Study Stations Designated by Shape and Size, Found in the Krannert Library of the University of Indianapolis

Round Tables

Dimensions: 4' (feet) in diameter
Area for one table: 12.57 square feet (result of 4 [radius of 2, or 2 times itself] times pi, as 3.14159)
Seating: 4 chairs to a table
Space per occupant: 3.14 (result of 12.57 divided by 4, the number of chairs)

NOTE: WHAT FOLLOWS DECIMAL POINTS ABOVE AND BELOW REPRESENTS TENTHS OF SQUARE FEET, NOT SQUARE INCHES.

Square Tables

Dimensions: 4' x 4'
Area for one table: 16 square feet
Seating: 4 chairs, one to each side
Space per occupant: 4 square feet (result of 16 square feet divided by 4)

Short Medium Tables

Dimensions: 3' x 5'
Area for one table: 15 square feet
Seating: 4 chairs, 2 to each long side
Space per occupant: 3.75 (result of 15 square feet divided by 4)

Medium Tables

Dimensions: 4' x 6'
Area for one table: 24 square feet
Seating: 4 chairs, 2 to each long side
Space per occupant: 6 square feet (result of 24 square feet divided by 4)

Long Narrow Tables

Dimensions: 2'-6" x 8' (or 2.5' x 8')
Area for one table: 20 square feet

Seating: 6 chairs, 3 to each long side
Space per occupant: 3.3333333 square feet (after decimal point, tenths of inches; could be considered 3 square feet and 4 square inches)

Long Tables
Dimensions: 3' x 8'
Area for one table: 24 square feet
Seating: 4 chairs, 2 to each long side; except on third floor, where there are 6 to a table, 3 to each long side
Space per occupant: on all floors, but the third floor: 6 square feet; on third floor: 4 square feet

Odd Index Table (only one on all three floors)
Dimensions: 3' x 4'
Area for table: 12 square feet
Seating: 2 chairs, 1 to each short side
Space per occupant: 6 square feet

One Oddly Dimensioned Table (only one on all three floors)
Dimensions: 3'-6" x 7'-6", converted to tenths of feet as 3.5' x 7.5'
Area for table: 26.25 square feet, or 26 square feet and 3 square inches
Seating: 2 chairs, both to one long side
Area per occupant: total area reduced to one half because one half of the table holds microfilm readers; consequently, area for persons: 6.56 (result of 13.125, one half the area of the table, divided by 2)

Carrels, Shallow
Dimensions: 1'-10" (deep) x 3'-2" (wide); converted to tenths of a foot as 1.83333 and 3.16333
Area for enclosure: 5.7994 (what follows decimal point being tenths of a square foot; could be considered 5 square feet and 9.6 square inches, approximately)
Seating: one person to a carrel

Carrels, Deep
Dimensions: 2' (deep) x 2'-10" (wide), converted to tenths of a foot as 2.83333 for latter number
Area for enclosure: 5.6666 (in tenths of square feet after decimal; could be rendered as 5 square feet and 8 square inches)

Seating: one person to a carrel

Computer Tables

Dimensions: 4' x 6'

Area for one table: 24 square feet

Seating: 2 chairs per table, both to one long side

Area per occupant: total area of table reduced by three-fourths because computers are set in center of table, occupying one half of the width of the table, plus an additional one fourth of space lost behind the computers, leaving only one fourth of surface in front of computers to students; space per student: 3 square feet (result of 1/4 of area, 6 square feet, being divided by 2 students)

Index Tables

Dimensions: 4' x 7'-6", converted to 4' x 7.5'

Area for one table: 30 square feet

Seating: 6 chairs, 3 to each long side

Area per occupant: total of area of table reduced by one half because book cases holding the indexes occupy one half the total width, running directly down the center of the table width-wise; space per student: 2.5 square feet, or 2 square feet and 6 square inches (result of 15', half of total area, being divided by 6 occupants)

Table 2

Reader and Study Stations, First Floor

Type of Station	No.	No. of Potential Occupants		Space Per Occupant		Total Space for Occupants
Round Table	5	20	x	3.14	=	62.8 sq. ft. (10ths of ft. after decimal)
Long Narrow Table	1	as used, with one side flush to wall and 1/2 of surface filled with microfilm readers, only 2 occupants		5		given conditions to the left: 10

Continued, next page

Table 2, Continued

Odd Index Table	1	2	6	12
Oddly dimensioned Table	1	2	6.56	13.12
Computer Tables	4	8	3	24
Index Tables	3	18	2.5	45
Totals:	15	52		166.92

Lounge chairs and sofas (seating not used with tables or writing surface; hence, "reading" stations, not "work" or "study" stations by the author's distinction): 19 potential occupants.
(sofas seating 2 persons counted as an equivalent of 2 lounge chairs)
(sofas seating 3 persons counted as an equivalent of 3 lounge chairs)

Table 3

Reader and Study Stations, Second Floor

Type of Station	No.	No. of Potential Occupants		Space Per Occupant in Square Ft.		Total Space for Occupants for Type
Round Tables	2	8	x	3.14	=	25.12
Square Tables	2	8		4		32
Short Medium Table	1	4		3.75		15
Medium Tables	8	32		6		192
Long Narrow Table	1	6		3'-4", or 3.3333'		20
Carrels, Shallow	57	57		5.7994		330.57
Totals:	71	115				614.69

Lounge chairs and sofas ("reading" stations only): 46 potential occupants
(sofas seating 2 persons counted as an equivalent of 2 lounge chairs)
(sofas seating 3 persons counted as an equivalent of 3 lounge chairs)

Table 4

Reader and Study Stations, Third Floor

Type of Station	No.	No. of Potential Occupants		Space per Occupant in Square Ft.		Total Space for Occupants Per Type
Round Tables	4	16	x	3.14	=	50.24
Short Med. Tables	2	4		7.5		30
Medium Tables	6	24		6		144
Long Tables (See special conditions for this type on the third floor in Table 1, "Types of Reader or Study Stations")	4	24		4		96
Carrels, Deep	70	70		5.6666		396.662
Total:	86	138				716.902

Lounge chairs and sofas ("reading" stations only): 33 potential occupants
(sofas seating 2 persons counted as an equivalent of 2 lounge chairs)
(sofas seating 3 persons counted as an equivalent of 3 lounge chairs)

Endnotes

1. Young.
2. Edwards, 9.
3. Ibid., 6.
4. *American Library Directory, 47th ed.*, 606
5. Ibid, 606
6. *1993-95 Academic Catalog*, 61
7. *Peterson's Guide to Four-Year Colleges, 1995*, 1033.
8. Gibbs
9. Ibid, 10
10. *1993-1995 Academic Catalog*, 12
11. Leggett
12. Ibid
13. Edwards, 125
14. Ibid

15. Scheekloth and Keable, 18
16. Ibid
17. Ibid
18. Ibid
19. Edwards, 14
20. Ibid, 15
21. Ibid
22. Ibid
23. Ibid
24. Thompson, 210
25. Edwards, 17
26. Gibbs
27. Johnson, 45
28. Thompson, 210
29. Edwards, 17
30. Ibid, 113
31. Ibid, 124
32. Ibid

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