

Empirical Standards for University Libraries in Taiwan

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The library science community has long been discussing the important issue of university library standards. Differences in education systems, economic development and culture make a unified set of standards for all countries impractical. This paper proposes a methodology for establishing standards based on existing libraries. A regression analysis is conducted to find the relationship between each of the three major resources of the library – collections, personnel and buildings – and the university size in terms of the number of students and faculty. The standards are derived from the regression lines. The data of the twenty-four university libraries in Taiwan reveal that the power function has the best explanatory power for

all the three resources. The exponents of the power function are 0.8349, 0.5756, and 0.8703 for collections, personnel and buildings, respectively. All these values are smaller than 1, a sign of decreasing returns. Compared to the standards of the Association of College and Research Libraries, this set of standards is lower in collections and personnel, but similar in buildings. Since the education system, economic development, culture and other factors of a country are taken into account implicitly, empirical standards are more realistic and are achievable by the university libraries. The methodology developed in this study can be applied to establish standards for the university libraries of other countries.

Introduction

University libraries have the primary responsibility for providing sufficient collections, facilities and services to support the university's instructional needs and to facilitate the university's research programs. This has been clearly stated in many university library standards (Hendrickson 1989; Kania 1988; Lynch 1979, 1987). The standards seek to describe a realistic set of conditions, which will provide a good quality to the university library program. However, most of the standards are qualitative. In general, qualitative standards contain many subjective criteria and vague statements having limited practical values in evaluating the level of a library (Baker and Lancaster 1991). The 1987 investigation of the Association of Research Libraries (ARL 1987) revealed that quantitative standards were viewed much more positively by library directors because they

could be used to evaluate their own library's performance and to justify requests for more resources from the university administrators to improve in inadequate areas. In contrast, the qualitative standards point out a direction for making improvement, while quantitative standards provide a specific threshold for a library to satisfy.

Historically, the total amount of resources and services provided by the library has been considered as the indicator of the quality of a research library and has served as the determining factor in accrediting and ranking (ARL 1995, Dougherty 1991). A notable trend is the attempt to develop formulas that address the absolute amount (Baker and Lancaster 1991). For academic libraries, a number of formulas exist, including that (1995) of the Association of College and Research Libraries (ACRL), Clapp and Jordan (1965), Hodowanec (1978), Power and Bell (1978), and Voigt (1975).

The strength of these formulas is that they consider many factors that affect the resources required and the different levels of use by various groups of the library community. Since different countries have different education systems, economic development and cultures, a unified formula may not be suitable for the university libraries of different countries. Many standards committees have noticed this difference and realised that the most realistic and authoritative standards are written after the examination of statistical and research data documenting current library practices (Baker and Lancaster 1991). While critics feel that some standards are set unrealistically high relative to current practice, most of the librarians also consider them as good standards because they can upgrade the libraries by providing substandard institutions with realistic targets toward which they can make improvements (Baker and Lancaster 1991). Based on this idea, this paper examines the current status, especially with regard to the resources of the university libraries in Taiwan. A regression analysis is conducted to derive the empirical standards for the three major resources – collections, personnel, and buildings – for university libraries of different sizes. Another important factor, budget, is not included because its effect is reflected by collections and personnel.

A university library has as its major responsibility the servicing of the students and faculty. Almost all of the existing formulas are based on the number of students or community residents served in addition to other criteria (ACRL 1995, Clapp and Jordan 1965, Hodowanec 1978, Kania 1988, Power and Bell 1978, Voigt 1975). To simplify the formula for easy application, the researchers selected the number of potential patrons of the library as the sole independent variable that determines the required amount of resources. The established standards are compared with the ACRL standards to show the differences between different countries.

In the next section, a unified measure for different types of patrons of the university library is developed. By using the unified measure as the explanatory variable, regression lines for collections, personnel and buildings, respectively, are derived, based on the data collected from the twenty-four university libraries in Taiwan to serve as the standards.

The methodology

Quantitative standards are generally described by formulas, using prescribed explanatory factors to calculate the minimum resource requirement. For the reasons already stated, this study uses the major patrons of the library as the explanatory factor. The functional form of the formula is determined from the regression analysis based on the empirical data. This *a posteriori* derivation as opposed to the *a priori* regulations is expected to take the qualitative factors such as education system, economic development and culture implicitly into account. Within the context of regression analysis, approximately 50% of the observations lie above the regression line, which implies that 50% of the libraries will pass the threshold of the standards. In other words, this approach will establish standards that are neither too stringent nor too loose. Therefore, this study uses the regression lines to derive the standards for the libraries to follow.

The number of undergraduate-equivalent (UE) students serves as the independent variable in the regression analysis. However, this number has to be calculated because a library has more types of patrons. In the study of Kao and Lin (1999) patrons were classified into seven types: full-time faculty, part-time faculty, teaching assistants, doctoral students, master's students, undergraduate students, and students of extension programs. Each type of patrons has different needs for library services. To determine these differences, Kao and Lin (1999) asked the directors of the twenty-four university libraries to provide the weights for different types of patrons using undergraduate students as the *numeraire* with a weight of 1. The average weights for the seven types are 2.36, 0.98, 0.45, 2.48, 1.93, 1.00, and 0.33, respectively. The number of persons of each type for the twenty-four universities can be found in Kao and Lin (1999). Multiplying the number of persons of each type by their corresponding weight and summing up over all types produces a number representing the number of undergraduate-equivalent (UE) students for each university. Table 1 shows these numbers for the twenty-four universities. The letter *N* denotes National.

The dependent variables considered in the regression analysis are the resources of collections, personnel and buildings. The relationships be-

Table 1. The number of UE students of the twenty-four university libraries in Taiwan.

	University	UE Students
1.	N Chi Nan U	644
2.	N Dong Hua U	976
3.	N Kaohsiung Normal U	4233
4.	N Yang Ming U	4570
5.	N Changhua U of Edu.	5391
6.	N Chung Cheng U	5827
7.	N Taiwan Ocean U	6475
8.	N Sun Yat-Sen U	7656
9.	Providence U	8767
10.	N Tsing Hua U	10125
11.	N Central U	10190
12.	N Chung Hsing U	11779
13.	N Chiao Tung U	12443
14.	Soochow U	12691
15.	Chung Yuan Christian U	13243
16.	Tunghai U	13650
17.	N Taiwan Normal U	16336
18.	Feng Chia U	18135
19.	N Cheng Chi U	18443
20.	N Cheng Kung U	19087
21.	Fu Jen Catholic U	19716
22.	Chinese Culture U	20280
23.	Tamkang U	23169
24.	N Taiwan U	36886

tween the resources and the UE students are to be determined via the regression analysis of the collected data. The regression model with a larger value of the coefficient of determination (R^2) has a stronger explanatory power (Neter et al. 1983). Therefore, the procedure is to try different functional forms, and the one with the highest R^2 is selected as the formula for setting the standards.

The five functional forms frequently used in regression analysis are considered below.

Linear model

$$Y = \alpha + \beta X$$

In this model a fixed amount α is required for libraries of all universities. As the number of UE students increases, a variable amount β is added. Evidently, β must be a positive number. The collections standards of ACRL (1995) and Clapp and Jordan (1965) are of this type.

Quadratic model

$$Y = \alpha + \beta X + \gamma X^2$$

Different from the linear model, a quadratic term γX^2 is added in this model. This term allows for

variable returns to scale (Ferguson and Gould 1980). In other words, as the number of UE students increases, the rate of increase in the resources need not to be a constant. For $\gamma > 0$, the returns to scale are increasing. As the number of UE students increases, more than proportional increase in the resources is expected. On the contrary, for $\gamma < 0$, the returns to scale are decreasing. When $\gamma = 0$, this model degenerates to the linear model, where the returns to scale are constant.

Power model

$$Y = \alpha X^\beta$$

In this model no fixed amount is required. For β being greater than 1, equal to 1, or less than 1, the returns to scale are increasing, constant, or decreasing, respectively. The value of β must be positive, otherwise the total amount Y decreases as X increases.

Exponential model

$$Y = \alpha e^{\beta X}$$

The parameter β in this model must be positive to yield reasonable results. Moreover, since the function is convex, the returns to scale are always increasing.

Logarithmic model

$$Y = \alpha + \beta \ln X$$

In this model the returns to scale are always decreasing because the slope of this function is β/X . As X increases, the slope decreases. Similar to the linear model, the parameter β must be positive.

According to the well-known diminishing principle of economics, a university library needs a relatively large amount of collections, personnel, and buildings to serve its patrons. As the university increases in its size, the initial large amount of resources reduces the requirement for additional resources to service the increasing number of patrons. Hence, a decreasing return to scale is expected. Once the regression model is determined, the number of UE students of a university is plugged into the model to calculate the threshold amount of the resources for its library.

Collections

The collections are probably the most valuable asset of a library. A library is unlikely to function effectively if its collections fall below a certain level. There is evidence that the absolute size of the collections is related to the perceived quality of the institution (Blau and Margulies 1974, Jordan 1963, Reichard and Orsagh 1966). The collections include books, serials, microforms, audio-visual materials, and databases, of which the first three categories comprise the major part and are selected in this study to represent the amount of collections. However, it is worthwhile to note that the focus on the size of collections is less relevant now than it has been as the access to electronic resources becomes available and more convenient. Even if books and periodicals are still important, access to electronic resources will increase in importance, and this will influence performance measurement, standards, etc. The second column of Table 2 shows the holdings in volumes of the twenty-four university libraries, where the microforms have been converted to volume-equivalents according to the ACRL formula (ACRL 1995). The regression model of the

strongest explanatory power is the power model in the following form:

$$\text{Volumes} = 197.33(\text{UE-Students})^{0.8349} \quad (1)$$

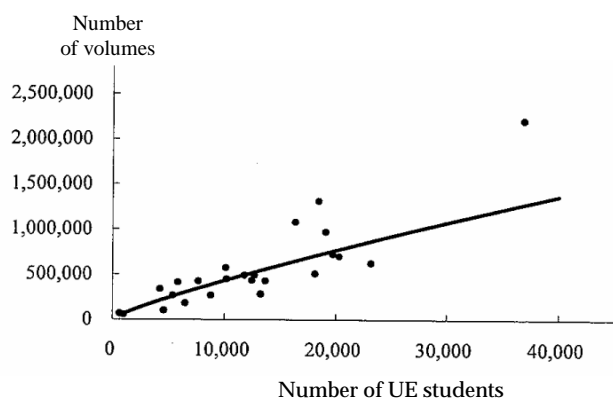
Its R^2 is 0.8008, F -value is 88.45, and p -value is 3.64×10^{-9} , indicating an extremely significant relationship between the volumes and UE students in the statistical sense. This formula is thus adopted as the standard for collections.

The exponent of Equation (1) is less than 1, implying decreasing returns to scale. This is correct intuitively because larger holdings make sharing more effective. Figure 1 is a scatter diagram of the holdings of the twenty-four university libraries. To grasp some idea about the extent of the rate of decrease, the approximate rates for universities of different sizes are calculated. Within the range of 0 and 10,000 UE students, the number of volumes required for each UE student is $43 \approx [197.33(10000)^{0.8349} - 197.33(0)^{0.8349}] / (10000 - 1)$. The number of volumes required for each UE student within the ranges of 10,000 to 20,000, 20,000 to 30,000, and 30,000 to 40,000 UE students are 34, 31, and 29, respectively. The rates decrease as university size increases.

Table 2. The empirical and ACRL standards for collections.

University	Current holdings	Empirical standard	Empirical ratio	ACR Standard	ACRL ratio (grade)
1. N Chi Nan U	67081	43685	1.54	148684	0.45 (F)
2. N Dong Hua U	52942	61814	0.86	166548	0.32 (F)
3. N Kaohsiung Normal U	336518	210417	1.60	279095	1.21 (A)
4. N Yang Ming U	100202	224314	0.45	480888	0.21 (F)
5. N Changhua U of Edu.	267420	257492	1.04	333568	0.80 (B)
6. N Chung Cheng U	412812	274766	1.50	617226	0.67 (C)
7. N Taiwan Ocean U	181620	300052	0.61	444098	0.41 (F)
8. N Sun Yat-Sen U	425428	345101	1.23	749802	0.57 (D)
9. Providence U	268229	386438	0.69	303106	0.88 (B)
10. N Tsing Hua U	573577	435810	1.32	856747	0.67 (C)
11. N Central U	448506	438145	1.02	824217	0.54 (D)
12. N Chung Hsing U	491276	494495	0.99	1133229	0.43 (F)
13. N Chiao Tung U	435724	517662	0.84	811265	0.54 (D)
14. Soochow U	494392	526262	0.94	493150	1.00 (A)
15. Chung Yuan Christian U	284042	545305	0.52	576556	0.49 (F)
16. Tunghai U	430802	559262	0.77	613694	0.70 (C)
17. N Taiwan Normal U	1081457	649753	1.66	951003	1.14 (A)
18. Feng Chia U	509559	708973	0.72	552158	0.92 (A)
19. N Cheng Chi U	1316176	719012	1.83	1014867	1.30 (A)
20. N Cheng Kung U	972128	739914	1.31	1266750	0.77 (B)
21. Fu Jen Catholic U	724440	760217	0.95	754370	0.96 (A)
22. Chinese Culture U	704833	778331	0.91	812406	0.87 (B)
23. Tamkang U	627813	869870	0.72	857830	0.73 (C)
24. N Taiwan U	2213379	1282525	1.73	2624397	0.84 (B)

Figure 1: The scatter plot and fitted regression line for collections.



Plugging the number of UE students into Equation (1) derives the minimum requirement for the collection of a university library. The third column of Table 2 shows the minimum amount of volumes, i.e., the empirical standard for collections, required for the twenty-four university libraries. There are eleven university libraries that have their holdings higher than the standard and thirteen libraries lower than the standard. In terms of percentage, National Cheng Chi University exceeds the standard by the largest extent, followed by National Taiwan University and National Taiwan Normal University. For libraries with insufficient collections, National Yang Ming University is the worst, with only 45% of the required amount. The next is Chung Yuan Christian University and the third is National Taiwan Ocean University. The fourth column of Table 2 shows the ratio of the holdings to the empirical standard.

The ACRL (1995) has a standard for collections for college libraries described by the following equation:

$$\text{Volumes} = 85000 + 100 \times (\text{Faculty}) + 15 \times (\text{Students}) + 350 \times (\text{Undergraduate-fields}) + 6000 \times (\text{Master's-fields}) + 6000 \times (\text{Specialist-fields}) + 25000 \times (\text{Doctoral-fields})$$

When a master's field has a higher degree being offered, the coefficient 6000 is replaced by 3000.

In Taiwan the basic unit of the university is the department. The concept of field is vague. Therefore, in applying this equation to calculate the required amount of volumes for the twenty-four

university libraries, the number of fields is replaced by the number of departments. Since the number of departments is obviously smaller than the number of fields, replacing the number of fields by departments will underestimate the required amount of collections. Column five of Table 2 lists the ACRL standard for the twenty-four university libraries calculated from the above equation. The last column is the ratio of the holdings to this standard.

Even though the ACRL standard for collections is underestimated in this study, there are only four university libraries – National Kaohsiung Normal University, Soochow University, National Taiwan Normal University, and National Cheng Chi University – which have reached the threshold. Interestingly, Soochow University satisfies the ACRL standard but fails to reach the empirical standard of this study. Under the ACRL standard, National Yang Ming University is still the worst, which only has 21% of the required amount of collections. The second worst is National Dong Hua University.

The ACRL standard has a principle for determining the grade of a university library in terms of library resources. Libraries that can provide 90% to 100% of the standard can be graded A, from 75% to 89% are graded B, from 60% to 74% are graded C, from 50% to 59% are graded D, and below 50% are graded F. Using this principle, six university libraries in Taiwan are graded A, five graded B, four graded C, three graded D, and six graded F. The ratios in columns four and six of Table 2 show that the empirical standard of this study is lower than the ACRL standard. As a matter of fact, the total of the entries in Column three is approximately 69% of the total of the entries in Column five, indicating that the empirical standard of this study is lower than the ACRL standard by 31%.

White (1986) examined the libraries of the nineteen California State Universities using the 1986 version of the ACRL standards (the same as the 1995 version). Seventeen libraries (about 89%) satisfied the requirements. For the libraries of Taiwanese universities, only 17% (four out of twenty-four) of the libraries satisfy the requirements. This result indicates that while the ACRL standard for collections is suitable for the libraries of American universities, it is too stringent for the libraries of Taiwanese universities.

Personnel

A university library must have a sufficient number of skilled personnel to maintain a proper operation and provide good service. In the study of Kao et al. (1998), the personnel of the university libraries in Taiwan were classified into tenure-track staff, non-tenure-track staff, unclassified staff, and student assistants. Except for the student assistants, all the other three types are full-time staff in charge of the operation, including the services to the patrons of the library. The second column of Table 3 lists the total numbers of these people for the twenty-four university libraries. Figure 2 is the associated scatter diagram.

Of the five regression models, the quadratic model of the following form has the strongest explanatory power for the relationship between the number of staffs and the number of UE students:

$$\text{Staff}=14.553+0.0005(\text{UE-Students})+6 \times 10^{-8}(\text{UE-Students})^2$$

Its R^2 is 0.7233, F -value is 27.44, and p -value is 1.39×10^{-6} , which is significant. However, the coefficient of the quadratic term is positive which is an indication of increasing returns to scale. This is contradictory to the diminishing principle of

economics. An in-depth examination reveals that the upward trend of the regression line is caused by the extraordinarily high value of National Taiwan University (no. 24 in Figure 2). This university is the oldest university in Taiwan. For some historical reasons, this university has a larger number of staff than other universities. Its library has adopted a decentralised organisation. Every college and some departments have their own branch libraries, resulting in the problem of duplicated services and functions, and an excessive number of staff. If this university is excluded in fitting the regression line, the most suitable model becomes the power function in the following form:

$$\text{Staff}=0.2304(\text{UE-Students})^{0.5218}$$

This model has a reasonable exponent smaller than 1 and a sign of decreasing returns to scale. Therefore, the power function is adopted to fit the twenty-four observations. The results are:

$$\text{Staff}=0.1456(\text{UE-Students})^{0.5756} \quad (2)$$

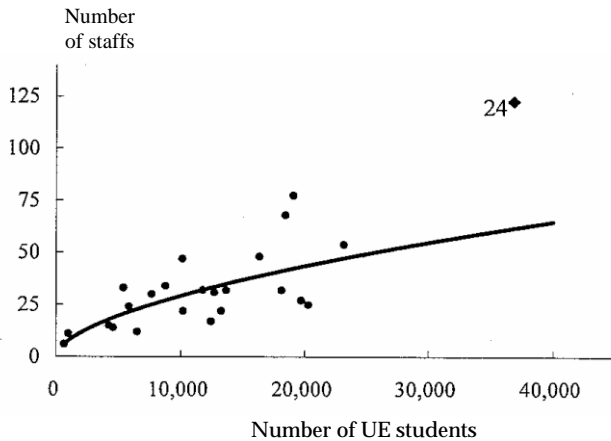
with $R^2=0.6452$, F -value=40.00, and p -value= 2.3×10^{-6} . This regression line is depicted in Figure 2.

When Equation (2) is adopted as the standard for personnel, the number of staff required for

Table 3. The empirical and ACRL standards for personnel.

University	Current staff	Empirical standard	Empirical ratio	ACRL standard	ACRL ratio (grade)
1. N Chi Nan U	6	6	1.00	37	0.16 (F)
2. N Dong Hua U	11	8	1.44	11	1.00 (A)
3. N Kaohsiung Normal U	15	18	0.84	49	0.31 (F)
4. N Yang Ming U	14	19	0.75	43	0.33 (F)
5. N Changhua U of Edu.	33	20	1.61	60	0.55 (D)
6. N Chung Cheng U	24	21	1.12	83	0.29 (F)
7. N Taiwan Ocean U	12	23	0.53	49	0.24 (F)
8. N Sun Yat-Sen U	30	25	1.20	80	0.38 (F)
9. Providence U	34	27	1.26	83	0.41 (F)
10. N Tsing Hua U	47	29	1.60	103	0.46 (F)
11. N Central U	22	30	0.74	86	0.26 (F)
12. N Chung Hsing U	32	32	1.00	91	0.35 (F)
13. N Chiao Tung U	17	33	0.51	94	0.18 (F)
14. Soochow U	31	34	0.93	97	0.32 (F)
15. Chung Yuan Christian U	22	34	0.64	89	0.25 (F)
16. Tunghai U	32	35	0.92	97	0.33 (F)
17. N Taiwan Normal U	48	39	1.24	163	0.29 (F)
18. Feng Chia U	32	41	0.78	117	0.27 (F)
19. N Cheng Chi U	68	42	1.64	157	0.43 (F)
20. N Cheng Kung U	78	42	1.83	154	0.51 (D)
21. Fu Jen Catholic U	27	43	0.63	137	0.20 (F)
22. Chinese Culture U	25	44	0.57	134	0.19 (F)
23. Tamkang U	54	47	1.14	137	0.39 (F)
24. N Taiwan U	123	62	1.99	214	0.57 (D)

Figure 2: The scatter plot an fitted regression line for staff.



each 1000 UE students is approximately 2.9, 1.5, 1.1, and 1.0 for the number of UE students in the ranges of 0 to 10000, 10000 to 20000, 20000 to 30000, and 30000 to 40000, respectively. Using the rate of 1.5 as an example, it is calculated as: $15 = [0.1456(20000)^{0.5756} - 0.1456(10000)^{0.5756}] / (20000 - 10000)$. The average rates show a decreasing trend. The third column of Table 3 shows the empirical standard for staff for the twenty-four university libraries calculated from Equation (2), and the fourth column shows the ratio of the current staff to the empirical standard. There are thirteen libraries that have passed the threshold of the empirical standard, of which National Taiwan University has the highest ratio, followed by National Cheng Kung University and National Cheng Chi University. Their ratios are 1.99, 1.83, and 1.64, respectively. The three worst libraries are National Chiao Tung University, National Taiwan Ocean University, and Chinese Culture University, with the ratios of 0.51, 0.53, and 0.57, respectively.

The ACRL (1995) also has a standard for staff based on the number of students and the amount of collections. For students in the range of 0 to 10000 full-time equivalent (FTE) students, every 500 FTE students need one librarian. Thereafter, every 1000 FTE students require one librarian. For collections, every 100,000 volumes need one librarian and every 5,000 volumes added and/or withdrawn per year need another librarian. In addition to librarians, the ACRL standard requires 65% of the staff to be skilled support personnel. Thus, to get the total number of staff for each college library, one needs to divide the number of required librarians by 0.35. Column five of

Table 3 lists the ACRL standard for staff for the twenty-four university libraries, and column six shows the ratio of the current staff to the ACRL standard. Only National Dong Hua University has reached the ACRL standard. Three libraries, namely, National Chunghua University of Education, National Cheng Kung University, and National Taiwan University, have grade *D*. All of the remaining twenty libraries have less than 50% of the requirement. Specifically, the total of the entries in column three is only 32% of the total of the entries in column five.

The empirical standard for personnel of Taiwanese universities is much lower than the ACRL standard of American universities. The major reason is that in Taiwan the Ministry of Education has a rule of providing, in general, four positions for the academic staff and one position for the general staff for every fifty students in public universities. Private universities follow this rule more or less. Thus, the ratio of the general staff to the academic staff is approximately one to four. For a university of 10,000 students, there are approximately 800 academic staff and 200 general staff. Of these general staffs, only a portion will be allocated to the library. Most universities hire non-tenure-track staff and unclassified staff to support the tenure-track staff. However, the number is still limited.

The study of White (1986) for the nineteen California State University libraries showed that only one library met the requirements for an *A* grade. Three libraries had a *B* grade, nine libraries had a *C* grade, five libraries had a *D* grade, and one library had an *F* grade. The performance is not satisfactory, with approximately 80% of the libraries having a *C* grade or lower. This indicates that the ACRL standard for staff is stringent not only for libraries of Taiwanese universities, but also for libraries of American universities.

Buildings

Seating capacity and space for collections and staff is another important factor for satisfactory library service. The current sizes of the twenty-four university libraries in square meters are shown in the second column of Table 4. Figure 3 is the scatter diagram showing the relationship between the library size and the university size. On this diagram, National Chung Cheng Univer-

sity (no. 6) is far away from other observations and looks like an outlier. This is because when this university was established, the financial situation of Taiwan was at its highest peak and the request of this university for constructing a large library was fully supported. Since this is a special case, it is excluded in fitting the regression line, to avoid a misleading result.

The regression model with the best explanatory power is still the power function of the following form:

$$\text{Building} = 3.1429(\text{UE-Students})^{0.8703} \quad (3)$$

with $R^2 = 0.6929$, $F\text{-value} = 47.39$, and $p\text{-value} = 8.38 \times 10^{-7}$, which is significant. This regression line is also drawn in Figure 3.

Similar to the case of collections and personnel, the exponent is less than 1, a sign of decreasing returns to scale. Based on this equation, the minimum sizes required for the twenty-four university libraries are calculated and are shown in the third column of Table 4. When the number of UE students is below 10,000, the area required for each UE student is roughly 0.95 square meters, which is calculated as: $[3.1429(10000)^{0.8703} - 3.1429(0)^{0.8703}] / (10000 - 0)$. For ranges of 10000 to 20000, 20000 to 30000, and 30000 to 40000 UE students, the re-

quired areas are 0.79, 0.74, and 0.70 square meters, respectively. Column four of Table 4 is the ratio of the current size to the empirical standard. The extremely high ratio of 5.74 confirms that National Chung Cheng University is an outlier. There are fourteen libraries that have reached the level required by the empirical standard. Most universities perform rather well in this criterion, providing more than 75% of the space required by the standard. There are only three libraries – Chinese Culture University, National Dong Hua University, and National Chiao Tung University – which perform unsatisfactorily with the ratios of 0.19, 0.32, and 0.52, respectively. It should be noted that National Chiao Tung University has just completed a new library with approximately thirty thousand square meters, clearly satisfying the standard.

The ACRL (1995) also has a formula for the size of the college library buildings. This formula is composed of three parts: space for users, space for books, and space for staff. Specifically, the area is calculated as:

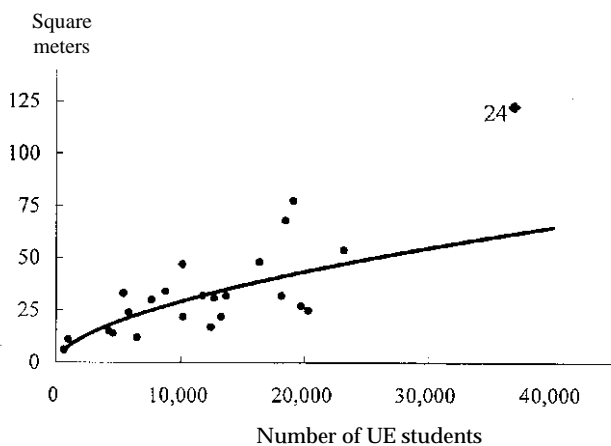
$$\text{Area} = [5(\text{FTE-Students}) + a(\text{Volumes})] \times 1.125$$

where a is equal to 0.1, 0.09, 0.08, or 0.07 for the number of volumes in the range of 0 to 150000,

Table 4. The empirical and ACRL standards for buildings.

University	Current area	Empirical standard	Empirical ratio	ACRL standard	ACRL ratio (grade)
1. N Chi Nan U	1267	857	1.45	1044	1.21 (A)
2. N Dong Hua U	400	1256	0.32	1093	0.37 (F)
3. N Kaohsiung Normal U	6053	4504	1.34	5712	1.06 (A)
4. N Yang Ming U	4212	4815	0.87	3530	1.19 (A)
5. N Changhua U of Edu.	10711	5559	1.93	5764	1.86 (A)
6. N Chung Cheng U	34128	5948	5.74	7267	4.70 (A)
7. N Taiwan Ocean U	6962	6520	1.07	5616	1.24 (A)
8. N Sun Yat-Sen U	17854	7544	2.37	8420	2.12 (A)
9. Providence U	7852	8488	0.93	7848	1.00 (A)
10. N Tsing Hua U	10648	9621	1.11	11138	0.96 (A)
11. N Central U	15000	9675	1.55	10147	1.48 (A)
12. N Chung Hsing U	18237	10975	1.66	11344	1.61 (A)
13. N Chiao Tung U	5941	11512	0.52	11412	0.52 (D)
14. Soochow U	8828	11711	0.75	11974	0.74 (C)
15. Chung Yuan Christian U	11294	12153	0.93	10656	1.06 (A)
16. Tunghai U	13435	12478	1.08	12001	1.12 (A)
17. N Taiwan Normal U	17800	14589	1.22	18489	0.96 (A)
18. Feng Chia U	13765	15978	0.86	15499	0.89 (B)
19. N Cheng Chi U	24279	16214	1.50	21660	1.12 (A)
20. N Cheng Kung U	16500	16705	0.99	19183	0.86 (B)
21. Fu Jen Catholic U	17096	17183	0.99	17927	0.95 (A)
22. Chinese Culture U	3394	17611	0.19	18080	0.19 (F)
23. Tamkang U	24291	19775	1.23	19435	1.25 (A)
24. N Taiwan U	30113	29639	1.02	38474	0.78 (B)

Figure 3: The scatter plot and fitted regression line for buildings.



150000 to 300000, 300000 to 600000, or over 600000, respectively. The mark-up 0.125 ($=1.125-1$) is to account for the space required for personnel. The units are in square feet. Column five of Table 4 shows the area calculated from this equation and column six is the ratio of the current area to this standard. There are seventeen libraries which are graded A, three graded B, one graded C, one graded D, and two graded F. The ratios in Columns four and six are quite similar, indicating that these two standards produce similar threshold values for area for every library. This is also manifested from the ratio of the total of the entries in column three to the total of the entries in column five, which is 0.9238, a number quite close to 1.

Conclusion

Establishing standards for university libraries is a very difficult task because many factors are involved. However, as more factors are considered, the standard thus derived will be too sophisticated to be applied in practice. Baker and Lancaster (1991) indicated that the most useful standards were based on research about current practices at the existing institutions. This paper collects the data of the twenty-four university libraries in Taiwan and uses the number of undergraduate-equivalent (UE) students as the independent variable to fit three regression lines to determine the standards for collections, personnel and buildings. The three regression models that explain the data the best are all of the power function form

with the exponents less than 1. The implication is that the rates for increasing the three resources decrease as the number of UE students increases, which coincides with the concept of the ACRL standards (1995).

Compared with the ACRL standards, the empirical standards of the collections of Taiwanese university libraries are rather low. This is also true for personnel. On average, the total collections of the twenty-four libraries required by the empirical standard are 68.66 percent of that of the ACRL standard. For personnel, the percentage is only 31.88%. The two standards for buildings are quite similar, with a percentage of 92.38%. However, it is worthwhile to note that the ACRL standards for personnel and buildings depend upon the number of students as well as collections. The empirical standard for collections is approximately 31% lower than the ACRL standard. Moreover, the ACRL standard for collections for the Taiwanese universities is underestimated because the number of departments replaced the number of fields in the ACRL formula, and the former is usually larger than the latter. If the ACRL standard for collections, rather than the current holdings, are substituted into the ACRL formula for calculating the standard for staff, the amount of staff required will be higher. In other words, the ratio of the empirical standard to the ACRL standard for staff will be smaller than 31.88%. By the same token, the ratio of the empirical standard to the ACRL standard for buildings will be smaller than 92.38%.

The empirical standards are derived from the data of the existing libraries. It represents the general status of the university libraries in Taiwan. The factors such as education system, economic development, culture, etc., have been accounted for implicitly. Therefore, it is more realistic and is achievable. If the ACRL standards were adopted for the university libraries in Taiwan, no libraries would satisfy the requirements. As the economic situation or other factors change, it is possible that the empirical standards will shift upward. Hence, after a period of time, it would be necessary to review the standards and make appropriate modifications.

As a final remark, although this study concentrates on the standards for the university libraries in Taiwan, the methodology is readily applicable to the university libraries of other countries.

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