

Evaluating e-book vendors in the era of smart libraries

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ARTICLE INFO

Keywords:

E-book platform
Vendor evaluation
Smart library
AHP analysis
OLS analysis

ABSTRACT

In recent years, people's reading habits have undergone a digital transformation, and library funds are insufficient to meet this growing digital demand. A good way of optimizing resource allocation is the regular evaluation of suppliers to select resources. E-book resources were used as the starting point to examine the method of supplier evaluation within the concept of "smart library" using an analytic hierarchical process to integrate and weight perspectives from e-vendors, academics, and professional librarians. Findings demonstrate that both traditional and "smart" factors impact the final evaluation of e-book suppliers. In addition, the influence of smart service factors on the efficacy of library innovation can be evaluated by the linear regression method. Two systematic methods in the assessment of e-book suppliers were outlined and the concept of "smart factors" based on traditional indicators for application in constructing digital book resources was introduced.

1. Introduction

The concept of "smart library" originated from that of "smart city". Its application overlaps with several other scenarios such as smart logistics, smart homes, and smart buildings. All of these concepts involve the use of information and communication technologies to improve people's quality of life, thus contributing to sustainable development (Capdevila & Zarlenga, 2015). However, the smart library is fundamentally different compared to other application scenarios. It relies on collections and users.

To be more precise, the "smartness" of a library refers to the use of new-generation technology to enhance the sense of interaction with users, to help them quickly locate books, with minimal use of human resources. After several years of development, the innovation of smart libraries has come to focus mainly on paper books (i.e., physical collection).

However, with the growing popularity of portable electronic devices such as smartphones and tablets, and the outbreak of the COVID-19 pandemic, people's reading habits have undergone a digital transformation, from traditional paper books to electronic books (i.e., virtual collections). Accordingly, if a smart library does not reflect and respond quickly to changes in the community, the word "smartness" will become specious in this context.

Currently, "smart" e-book services of a university library largely depend on the e-book platform supplier and its technical level. Because

the proportion of virtual collections is increasing, this study evaluates e-book platform suppliers from the perspective of a smart library to help its managers select suppliers by balancing both "smart" and "non-smart" factors. The results of this study would enable them to reasonably judge the effectiveness of the smart services of e-book suppliers.

2. Problem statement

2.1. Importance of evaluating e-book vendors

"Even the longest-held vendor/library relationships should not be taken for granted. Vendor evaluation should not only occur at the time a contract is being renegotiated or if a vendor is performing poorly; instead, it should be a regular process" Saponaro and Evans (2019).

In the past decade, with the deepening popularity of smartphones, tablets, and other portable electronic devices, the reading habits of library users have quietly changed, from a reliance on traditional paper books to an increasing tendency to use e-books. These changes have profoundly influenced and changed the direction and strategy of library funds (Cottrell & Bell, 2014).

However, the total funding for libraries cannot keep up with the increase in demand for digital resources, and even faces cuts. Moreover, the current pattern of multi-e-book platforms has not been broken, and it is difficult to form a unified "national e-book acquisition alliance of libraries". In this context, it is necessary to conduct regular evaluations

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and management of e-book suppliers, which helps to select better resources and maximize the efficiency of funding use.

Nonetheless, the rise and development of the smart library concept is a positive signal for libraries, one that promotes the use of next-generation technology to improve the experience of patron-library interaction and thus increase the influence and position of libraries in the minds of the general public. Thus, if e-book providers can be evaluated from a smart perspective, this is a new and important research topic for contemporary libraries considering the trend of increasing the proportion of virtual collections.

2.2. Lacking comprehensive methodology for evaluating e-book vendors

As described below, a comprehensive evaluation method is not available in the existing literature on e-book vendor evaluation. All existing literature is either *ex parte* or subjective in terms of evaluation indexes, lacking a quantitative method to consider strategically the impact of each index on the ranking of suppliers, lacking the consideration of weighting among indexes, and unable to identify smart factors on supplier evaluation results, not to mention evaluate the role of the impact of smart services on library efficiency.

Fortunately, the authors found in the literature on the evaluation of paper book suppliers that most of them use hierarchical analysis to form comprehensive indicators to evaluate suppliers. However, it is important to note that the evaluation metrics of paper book suppliers (e.g., arrival rate, arrival cycle, cataloging and processing services) (Shi & Zhao, 2006; Shi, 2010; Sun, 2007; Wang et al., 2013; Wen & Qiang, 2007; Zhu, 2012) have long been inapplicable to e-book supplier evaluations because e-book procurement is characterized by “what you see is what you get” and “what you get is ready to use”. These characteristics, coupled with the unique copyright requirements of e-books, have determined that we cannot copy the evaluation indexes of paper book suppliers.

Further, the literature evaluates only availability rather than the efficiency of e-book vendors' services. Therefore, a method is needed that addresses the interdependence between services provided by e-book vendors and the efficiency impact on libraries.

3. Literature review

3.1. Origin of smart library: A fast positioning of physical collections

The concept of “smart library” was put forward and applied by Aittola et al. of the Oulu University Library in Finland as early as 2003. At that time, “smart” referred to the use of wireless LAN technology in a library to provide users with an electronic map for searching for books, quickly locating the correct bookshelf, and finding the best path to it (Aittola et al., 2003). With the emergence of new technologies, in 2010, Yan (2010) defined this location-aware library facility as a service and management with the use of information technologies such as Internet of Things and cloud computing, to improve the “clarity, flexibility and response speed” of interaction between users and libraries.

After more than 10 years of development, the innovation and application of smart libraries in China have come to center on paper books. Its applications are an automatic book access system at the Suzhou Second Library, an intelligent book inventory robot at the Wuhan University and Nanjing University Libraries, and automatic book sorting and transmission system at the Shenzhen Bao An Library. Users and librarians can avail themselves of these innovations to quickly locate paper books, with minimal use of human resources, as compared to the traditional barcode, magnetic stripe, and other technologies.

3.2. Extension of smart library: Responding to electronic collection needs

Although the origin and application of the smart library were focused on physical book collections, in recent years, the technology has quietly

altered the internal and external environments of libraries. With the popularization of portable electronic products such as smartphones and tablets, the reading habits of library-goers have undergone a digital transformation. Moreover, the coronavirus disease 2019 (Covid-19) pandemic forced users to access collections “online” from locations other than libraries. In addition, a library has limited space for housing growing physical collections. Therefore, in 2017, China's Ministry of Education issued a document on the formal incorporation of e-books into universities' collections for performance evaluation. Later, in 2020, it issued detailed rules, stipulating that electronic books cannot constitute more than 40% of the total book resources. Therefore, smart libraries should focus not only on physical collections but also expand to incorporate virtual collections to avoid being marginalized and, ultimately, reducing the financial support they receive.

Contrary to practical applications, most academic discussions do not specify the type of book collection when defining smart libraries (Chu & Duan, 2018). For example, Cao et al. (2018) argued that a smart library should be user-centered and adapt to their needs. The “smartness” of libraries should enable them to “automatically” know users' needs and provide the required resources and services. Likewise, Duan et al. (2021) summarized the connotation and characteristics of a smart library as “high perception,” “ubiquitous interconnection,” “efficient collaboration,” “precise service,” “user-friendliness,” and “innovative development.” These definitions extend to practical applications of smart libraries for electronic collections.

3.3. Evaluating indexes of e-book suppliers' services

The evaluation indexes found in the existing literature on “Chinese E-Book Platforms” were classified according to collection resources, reading experience, resource disclosure, procurement mode, background statistics, copyright arrangement, and pricing mode (S. Duan, 2018; X. Duan, 2019; Liu et al., 2021; H. Zhang, 2021; Y. Zhang et al., 2022). Details in the evaluation index used in the existing literature can be found in Appendix 1.

As implied from Appendix 1, the literature is *ex parte* in which only a few indexes rather than all are considered a unified, standard method of evaluating e-book suppliers is not specified and systematic evaluation indexes are not supplied. Moreover, the literature does not consider differences in the importance of categories of indicators. While some works mention the concept of “smartness” in services (Zhang et al., 2022), in-depth analyses are lacking. The literature evaluates only availability rather than the efficiency of e-book vendors' service.

3.4. Analytic hierarchy process

Analytic hierarchy process (hereinafter referred to as AHP), which was established by Saaty in the early 1970s, is a mathematical method that helps in decision-making by decomposing the relevant elements into levels such as objectives, criteria, and alternatives, on top of which qualitative and quantitative analysis is performed (Saaty, 1987).

The advantage of this method is that it is systematic and integrates the influence of each factor on the results. The weight setting of each indicator in the AHP method finally affects the results directly or indirectly. Moreover, the influence of each indicator on the results is quantified, which is clear and explicit relative to the method used in the existing literature. In addition, this method is simple and practical, which can turn the multi-objective, multi-criteria, and difficult-to-quantify problem into a multi-level single-objective problem.

On the evaluation of library suppliers, AHP can precisely achieve the target level, i.e., a comprehensive rating of suppliers from high to low, by comparing the various indicators at the criterion level. The AHP can also transform multiple objectives (i.e., distinguishing between “smart factors” and “non-smart factors”, and evaluating suppliers) and multiple criteria into a multi-level (indicator) and single-objective (scoring suppliers) problem.

Besides AHP, there are numerous methods for comprehensive supplier evaluation, for example, VIKOR (ViseKriterijumska Optimizacija I Kompromisno Resenje) which stands for multi-criteria optimization and compromise solution, or TOPSIS (technique for order preference by similarity to ideal solution), etc. These methods may have different approaches. In addition to the “systematic” and “easy to use” method described above, the AHP method was chosen for another very important reason, “continuity”. As stated in section 2.2, the AHP model has been used in the previous literature for the evaluation of paper book suppliers. This methodological “continuity” can be compared with previous literature.

4. Methodology

4.1. Research steps

The research method was divided into the following steps. The first step was to establish a baseline index for evaluating the traditional (“non-smartness”) and “smartness” of e-book suppliers' services. Indicators were extracted from previous literature and integrated into a framework. This framework was then presented to e-book suppliers who were asked to provide assessments on their services. The data from e-book suppliers were then analyzed to generate an updated index to use in obtaining assessments from experts through a Delphi process to weight the index values. Once the expert data was analyzed and

weighted, a comprehensive index was produced. Finally, linear regression analysis was used to provide measures of innovative development.

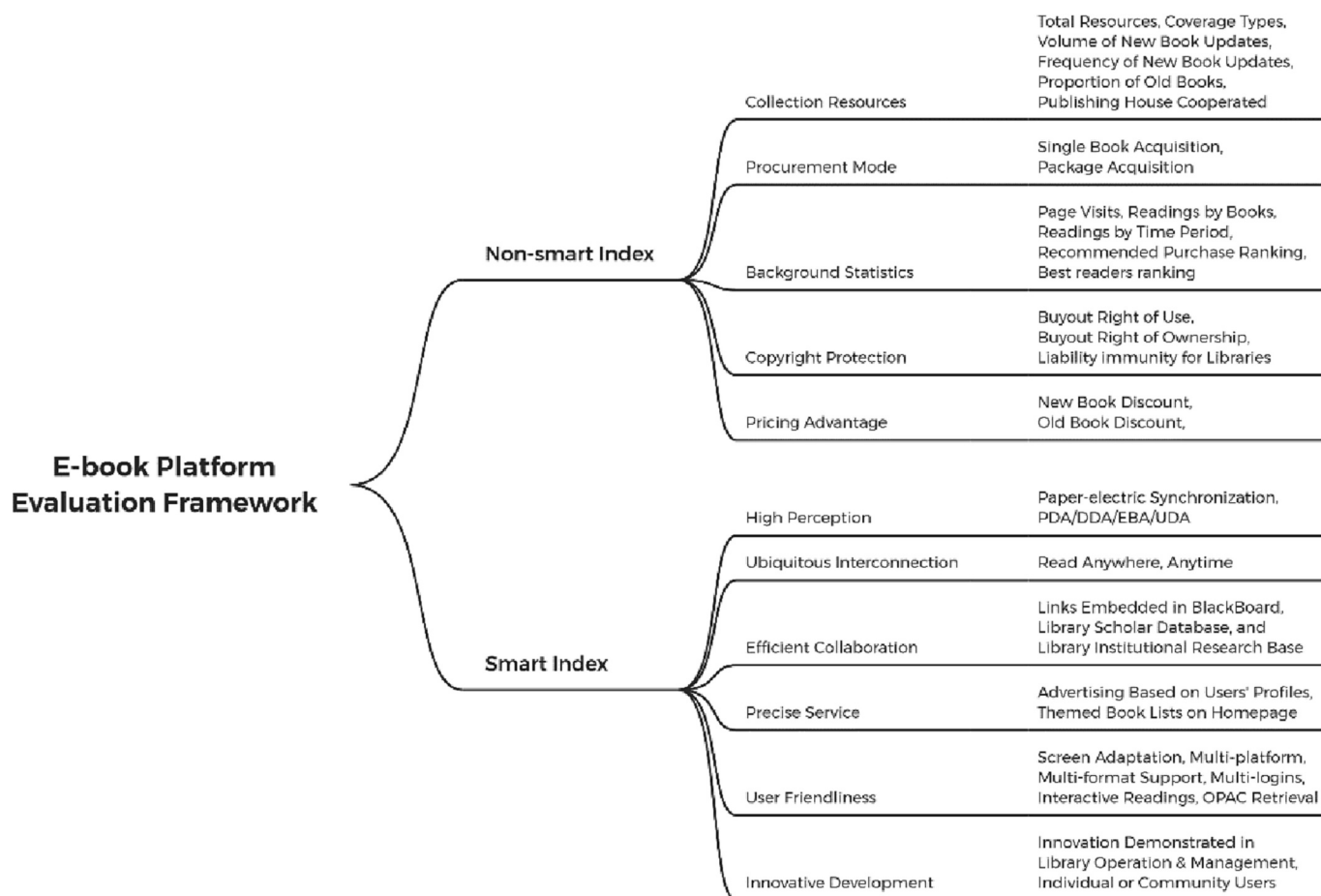
4.2. Establishing a baseline index for evaluating e-book suppliers' services

4.2.1. Classification of evaluation indexes

While at the target level, the rating of the e-book suppliers is specified, two layers of evaluation indexes at the criterion level to distinguish “smart factors” and “non-smart factors” were classified. According to Duan et al. (2021) definition of a smart library, the indexes summarized above can be classified as the following figure. See Fig. 1.

When categorizing non-smart indexes, previous studies for information on resource collection, procurement mode, background statistics, copyright stability, pricing mode, and other first-level indicators were examined. As for smart indexes, their main evaluative criteria were classified according to five aspects: high perception, ubiquitous interconnection, efficient collaboration, precise service, user-friendliness, and innovative development.

First, vendors with “high perception” smart services should support: PDA/DDA (Patron Driven Acquisitions (PDA), Demand Driven Acquisitions (DDA)) users, driven by demand acquisition; evidence-based purchasing (EBA) based on reading behavior analysis such as the number of pages read above a certain threshold, to achieve procurement standards; use-driven procurement (UDA,) based on browsing data analysis such as reaching the procurement standard when the frequency



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Fig. 1. E-book platform evaluation framework.

of browsing exceeds a certain threshold; and synchronous purchasing of paper and electronic books to meet users' diverse needs.

Second, vendors with "ubiquitous connectivity" smart services should ensure access to e-books wherever an Internet connection is available.

Third, vendors with "efficient collaboration" smart services should promote the university's teaching platform (e.g., BlackBoard) to embed electronic teaching references and e-book links in the institutional research and scholar databases.

Fourth, vendors with "precision service" smart services should provide personalized and precise book advertising according to users' portraits (e.g., reading preference, subject classification, etc.), and support themed book lists on the homepage to promote accurate reading.

Fifth, vendors with "user-friendly" smart services should provide screen adaptation, that is, ensure access to electronic books on fixed or mobile terminals (PCs, tablets, mobile phones, readers). They must also support reading requirements on various portals/platforms (such as web pages, small programs, and apps); different e-book text formats (EPUB/PDF/CEBX/TXT/JPG, etc.) for variously sized screens and software reading; various login methods such as VPN, CARSI, WeChat or QQ; interactive reading and full-text search; and the OPAC interface retrieval platform.

4.2.2. Data collection from e-book suppliers

Questionnaires were sent out to 10 major e-book vendors mentioned in the literature; all but one provided feedback. The participant vendors were COL, Apabi, Keledge, Bookan, Chaoxing, Zhangyue, JD Reading, Tiantian, and CX star.

The questionnaire subjects were selected because they are mentioned in the existing literature reviewed by the researchers and reflect the main Chinese e-book vendors chosen by libraries in recent years (see Appendix 2). While other suppliers such as (Tencent Literature, Douban Reading, MIGU Reading, iReader Technology, etc.) may be more popular among users, they are geared towards a mass audience and not library users.

Traditional (non-smart) evaluation indexes of e-book suppliers were investigated according to five aspects: resource collection, procurement mode, background statistics, copyright protection, and pricing advantage. The e-book suppliers' smart indexes were also examined based on five aspects, all of which involved modern technology to enhance the interaction between a library's e-book service and users: high perception, ubiquitous interconnection, efficient collaboration, precise service, and user-friendliness.

4.3. Determining the weights of indexes with experts: Analytic hierarchy process

A questionnaire was designed using the Delphi method to solicit the opinions of eight experts. The experts consisted of two research librarians, one associate research librarian, and five librarians. The experts' positions included one director, one vice director, four department heads, and two acquisition librarians.

The experts were asked about the importance of each indicator with a scale of (1 point for not important, 2 points for slightly important, 3 points for relatively important, 4 points for important, and 5 points for very important).

Next, with the help of the SPSSAU statistical software, the weight of each index of the smart and non-smart factors, and the weight of combined smart and non-smart factors were calculated. Finally, the consistency test results of data from these three tables were conducted.

4.4. Measuring innovative development: Linear regression analysis

The purpose of the regression model was to provide a methodological complement to the AHP evaluation explained in the previous section. While the AHP method provides an indicator-based evaluation of

vendor data, the regression model evaluation is based on library users, i.e., it evaluates whether the behavior of librarians or users (dependent variable Y) has changed/innovated as a result of the vendor's services (explanatory variable X). In short, the AHP evaluates the "availability" of various resources/services, while the regression model evaluates whether intelligent resources and services bring innovative utility (whether the dependent variable Y is influenced by the explanatory variable X) (Cohen et al., 2015).

It is worth noting that "innovative development," one of the smart library factors mentioned earlier, is not included in the analytic hierarchy process outlined above. Duan et al. (2021) used "innovative development" to refer to innovative library operation and management. In this sense, innovation and development are measures of effectiveness, which are influenced by four other smart factors, high perception, ubiquitous interconnection, efficient collaboration, and user-friendliness, as well as knowledge innovation and creation by individual or community users. Therefore, the method of linear regression analysis (LRA) would be best to evaluate the effectiveness of innovative smart services.

In short, LRA is a statistical analysis method to measure the quantitative relationship of interdependence between two or more variables. This approach models the relationship between one or more independent variables (explanatory and control variables), and dependent variables (explained variables). The LRA model used in this study measured the influence of suppliers' smart services (explanatory variable) on the innovation of management and operation modes, and user behavior (explained variable), on the condition that non-smart (control variable) factors, other than suppliers, remain unchanged. Specific ideas are reflected in the following mathematical formula:

$$Y_{ik} = \alpha + \beta X_{it} + \gamma C_{ik} \quad (1)$$

Variable Y is the explained variable that measures the effectiveness of innovative smart libraries, specifically of management and users' behaviors. Variable X is the explanatory variable, and it measures the supplier's smart service, including high perception, ubiquitous interconnection, efficient collaboration, and user-friendliness. Variable C, as the control variable, measures the factors that trigger the innovation effect (except the "smart" construction of a library), such as the literacy of the librarians (which may trigger innovation in management) and users (which may trigger innovative behavior in users). β is the regression coefficient and measures the effect of influence. It is also the main object of evaluation and analysis in the linear regression analysis and measures the influence of smart factor X on innovation effect Y (innovative management and operation, user behavior), under the condition that the non-smart factor, variable C, remains unchanged. The degree of influence is expressed by the beta coefficient (a positive value indicates a positive influence, a negative value indicates a negative influence, with the significance of the influence considered, with 0 indicating no influence), under the condition that the non-smart factor, variable C, remains unchanged. γ is also the regression coefficient, which measures the influence of control variable C (librarian literacy, user literacy) on the innovation effect. α is also a regression coefficient, but not the main object of research, which measures the value of explained variable Y, when explanatory variable X and control variable C are equal to zero; i represents the cross-sectional, individual data of various suppliers, while k represents the cross-sectional, individual data of different libraries. t represents time series data across diverse units of time, such as the year. More details can be found in Appendix 3.

5. Findings

5.1. Baseline index

Table 1 describes the index values of the e-book platform's non-smart and smart factors, respectively.

The index values of the resource collection denote each platform's e-

Table 1
Index values of e-book platforms.

	Non-smart factors				Smart factors					
	Resource Collection	Procurement mode	Background Statistics	Copyright Protection	Pricing Advantage	High Perception	Ubiquitous Interconnection	Efficient Collaboration	Precise Service	User Friendliness
COL	33	20	30	30	40	0	100	20	50	67
Apabi	24	50	60	60	40	80	100	30	80	71
Kedage	24	30	50	40	20	110	100	30	30	67
Bookan	23	20	40	40	35	0	100	20	80	70
Chaoxing	39	20	20	30	30	0	100	0	50	66
Zhangyue	26	20	30	40	20	0	100	30	80	74
JD Reading	46	20	50	40	20	0	100	0	30	69
TianTian	16	20	40	40	25	30	100	0	80	60
CXstar	47	50	50	30	40	80	100	30	80	68

book stock and resource advantage, the proportion of new e-books in the last three years, the average annual increase of e-books, the frequency of e-book updates, and the total number of cooperative publishers/units, which were normalized by multiplying by 10. The index values of procurement mode are single book acquisition mode, assigned by 30; and package acquisition, assigned by 20. The index values of copyright protection are buyout right of use, assigned by 10; buyout right of ownership, assigned by 20; and liability exemption, assigned by 30. Pricing advantage means the weighted average of old and new book price advantages (with 0.5 as the weight for each). The old book price discount values are large discount (40 points), small discount (30 points), the same price of paper and electric books (20 points), and beyond the paper price (0 points). The new book price discount values encompass large discounts (40 points); small discounts (30 points); the same price of paper and electric books (20 points); and beyond the paper price (10 points). The background statistics function values incorporate page visits (10 points); reading times by books (10 points); reading times by period (10 points); recommended purchase ranking (10 points); best reader ranking (10 points); and other statistics if there is one (10 points).

The index values of high perception are paper-electric synchro (50 points); PDA/DDA (30 points); and EBA/UDA (30 points). The index values of the highly efficient collaborative are links embedded in the online teaching platform (10 points); library scholar database (10 points); and library institutional knowledge base (10 points). The index values of ubiquitous interconnection are reading anytime and anywhere (100 points); reading otherwise (0 points). The index values of precision service are accurate advertising according to users' profiles (50 points); and themed book lists on the home page (30 points). The index values of user-friendliness are screen adaptive (10 points); multi-platform (10 points); multi-format support (10 points); multiple login modes (10 points); interactive reading, including retrieval (10 points); and OPAC interface retrieval (50 points).

From the above tables, the statistical values of the secondary indexes of each supplier in the ten aspects of resource collections, procurement mode, precise service, and user-friendliness can be derived, from which the ranking of each supplier can be judged. However, to determine which supplier has the highest rating, the weight of each secondary index and the weight of the two primary indexes, i.e., non-smart factors and smart factors must be found.

In order to make the values of different indexes comparable, the statistical values of the above indexes are normalized by the following formula.

$$x' = \frac{x - \min(x)}{\max(x) - \min(x)} \tag{2}$$

The normalized indexes are presented in [Table 2](#):

5.2. Weights of indexes

The opinions of eight experts according to their titles and positions are shown in Appendix 4. The weights of indexes of the non-smart factors and smart factors are displayed in Appendix 5.

The weights of indexes of the non-smart factors are close to each other but vary from high to low. Among them, the weight value of copyright protection is the highest, followed by that of resource collection, procurement mode, background statistics, and pricing advantage.

Also, the weights of the smart factors' indexes are close but different. Among them, the weight values of high perception and ubiquitous interconnection are the highest, followed by those of user-friendliness, efficient collaboration, and precise service. These findings reflect the experts' support for easy accessibility of e-books anywhere and anytime, and suppliers' high expectations of providing on-demand, evidence-based procurement, and paper-to-electricity synchronization services.

The weights of combined smart and non-smart factors show that experts rated non-smart traditional factors as slightly more important

Table 2
Normalized index values.

	Non-smart factors				Smart factors					
	Resource Collection	Procurement mode	Background Statistics	Copyright Protection	Pricing Advantage	High Perception	Ubiquitous Interconnection	Efficient Collaboration	Precise Service	User Friendliness
COL	0.55	0.00	0.25	0.00	1.00	0.00	1.00	0.67	0.40	0.50
Apabi	0.24	1.00	1.00	1.00	1.00	0.73	1.00	1.00	1.00	0.79
Keledge	0.26	0.33	0.75	0.33	0.00	1.00	1.00	1.00	0.00	0.50
Bookan	0.21	0.00	0.50	0.33	0.75	0.00	1.00	0.67	1.00	0.71
Chaoxing	0.74	0.00	0.00	0.00	0.50	0.00	1.00	0.00	0.40	0.43
Zhangyue	0.31	0.00	0.25	0.33	0.00	0.00	1.00	1.00	1.00	1.00
JD Reading	0.95	0.00	0.75	0.33	0.00	0.00	1.00	0.00	0.00	0.64
Tiantian	0.00	0.00	0.50	0.33	0.25	0.27	1.00	0.00	1.00	0.00
CXstar	1.00	1.00	0.75	0.00	1.00	0.73	1.00	1.00	1.00	0.57

than smart ones. The consistency test results of data from these three tables are satisfactory in the AHP analysis.

5.3. Comprehensive index

The values in Table 2 were multiplied by the weights of each index of the smart and non-smart factors mentioned above, to obtain the comprehensive index. The comprehensive indexes were multiplied by their corresponding weight to get the total index, as presented in Table 3.

5.4. Effectiveness of innovative suppliers' smart services

Using the linear regression analysis model presented above, evaluators can analyze and evaluate the effectiveness of innovative smart services provided by e-book suppliers, including (but not limited to) the following situations:

- 1) whether, and to what extent (measured by regression coefficient β), the increase of personalized e-book auto-advertising services (the “highly perceived” factor), the explanatory variable X , improves the efficiency of library management (e.g., by reducing the number of traditional acquisition and marketing librarians versus increasing the number of study support and research support librarians), the explained variable Y , under the condition that the control factor C remains unchanged;
- 2) whether, and to what extent (measured by regression coefficient β), the access to library e-book platforms anytime and anywhere (i.e., “ubiquitous interconnection”), the explanatory variable X , improves users' information literacy (such as the increase in the proportion of winners who read more e-books than paper books, in information literacy competitions), the explained variable Y , under the condition that the control factor C remains unchanged;
- 3) whether, and to what extent (measured by regression coefficient β), embedding e-book links in the scholar library (the “highly collaborative” intelligent factor), the explanatory variable X , enhances the effectiveness of library services (such as increased e-book browsing/download rate, compared to without embedding links), the explained variable Y , under the condition that the control factor C remains unchanged; and.
- 4) whether, and to what extent (measured by regression coefficient β), supporting the synchronous acquisition of paper and electricity (i.e., “user-friendliness”), the explanatory variable X , updates the traditional Integrated Library System (ILS; wherein procurement of paper books and e-books are separate) to the third generation library system or Library Service Platform (LSP; wherein procurement of paper and e-books are integrated), the explained variable Y , under the condition that the control factor C remains unchanged.

Table 3
Comprehensive and total indexes of e-book suppliers.

E-book Vendors	Non-smart Comprehensive Index	Smart Comprehensive Index	Total Index
COL	0.35	0.51	0.43
Apabi	0.83	0.90	0.86
Keledge	0.34	0.71	0.52
Bookan	0.35	0.67	0.51
Chaoxing	0.25	0.37	0.31
Zhangyue	0.19	0.79	0.49
JD Reading	0.43	0.34	0.38
Tiantian	0.21	0.46	0.33
CXstar	0.73	0.85	0.79

6. Discussion

6.1. Baseline index

Table 3 reflects the performance of e-book providers in the following aspects.

Resource inclusion: CXstar, JD Reading, and Chaoxing rank the top three, indicating that these three e-book platform suppliers have more e-books in stock compared with other vendors, the advantages of each platform's resources are more in line with the needs of universities, a high proportion of new books in the past three years, more new e-books on average per year, more frequent e-book updates, and more number of cooperative publishers/units.

Procurement models: CXstar and Apabi scored higher because they allow for both single-book acquisition mode and package acquisition, while other vendors only allow for one of these two procurement models.

Background statistics: Apabi scores the highest because it contains the most comprehensive statistics, including statistics on visits, number of books read by category, number of books read by period, ranking of recommended purchases, and ranking of reading masters.

Copyright protection: Apabi scored the highest because it offers three types of protection, buyout of usage rights, buyout of ownership rights, and library immunity in case of disputes.

Pricing advantage: COL, Apabi, and CXstar scored higher because these three e-book platforms have a greater discount advantage in both new and old book prices.

Height perception: Keledge provides the most comprehensive services, including paper-electric synchro, PDA/DDA, and EBA/UDA.

Ubiquitous interconnection: the index values imply that all providers support access to e-books from any location where the Internet exists.

Efficient collaboration: Apabi, Keledge, and CXstar scored high, indicating that they can provide all relevant services to users, i.e., embedding links in online teaching platforms, embedding links in library scholar databases, and embedding links in library institutional knowledge base.

Accurate service: Apabi, Bookan, Zhangyue, Tiantian, and CXstar scored high because they can provide advertising according to users' profiles and set up themed book lists on the home page.

User-friendliness: Zhangyue, Apabi, and Bookan scored higher because these providers can support multiple reading devices, various platforms including web, applets and APPs, multiple reading formats, multiple login methods, various interactive reading such as comment or marking and OPAC search.

6.2. Weights of indexes

The baseline index only reflects the performance of each supplier in a certain aspect, and the comparison between suppliers only shows the ranking under a single index. In order to rank suppliers from highest to lowest by considering their overall performance under all indexes, evaluators need to assign weights to the different indices to differentiate their importance.

The findings show that the traditional non-smart factors are slightly more important than the smart factors according to the assessment of experts with different titles and positions. This is mainly because the experts believe that the traditional factors of copyright protection for e-books are very important and are related to whether the library is involved in legal risks. Moreover, the experts believe that although there are qualitative differences between e-books and paper books in terms of reading carriers and methods, the same importance should be attached to resource collection.

Nevertheless, experts consider the importance of smart factors to be very high. Among them, experts attach particular importance to high perception and ubiquitous interconnection. This is because, on the one hand, experts value ubiquitous interconnection as the basic technical

guarantee for access to e-book reading services. On the other hand, the importance of high perception (supporting paper/electronic synchronization, PDA/DDA, and EBA/UDA) reflects the experts' consensus on the revolutionary shift of smart libraries from "resource-centered" to "user-centered".

6.3. Comprehensive index

As can be surmised from Table 3, irrespective of whether it is the traditional index of non-smart or smart factors, or the total index with a combined weight of both, Apabi and CXstar top the lists. These platforms are superior to other vendors for both traditional non-smart factors and current smart factors.

Surprisingly, Chaoxing, an established e-book supplier, is at the bottom of the list. The reason is explained in Figs. 2 and 3, which list three platforms with the highest, median, and lowest values of the total index for comparison. Although Chaoxing's resource collection has advantages for certain indexes and its index value for user-friendliness is not much inferior, it ranks at the bottom for other non-smart and smart indexes. Therefore, the results imply that both traditional and smart factors impact the final evaluation of e-book suppliers.

Based on these score rankings, managers can decide on several issues such as selecting the best suppliers in a context where e-resource prices are increasing each year, in comparison to library funds.

6.4. Effectiveness of innovative suppliers' smart services

Since many indices, such as the service of personalized auto-advertising from the vendor is still under development, data on the utility that can be demonstrated by such service is not available. The empirical demonstration using those data using linear regression models may be developed to help assess the utility of the vendor's services in the foreseeable future.

7. Conclusion

The methods developed in this study provide a more standardized and unified framework for libraries to evaluate e-book services than has previously been available. The framework integrates past research and current expert opinion on both traditional and smart library dimensions. It addresses both the availability and efficiency of e-book vendors' services. The method enables libraries to be more confident and efficient in their evaluation and selection of services for their patrons.

Assessors can use these two methods in scoring and ranking multiple library suppliers' traditional and smart services and for a deeper understanding of each supplier's specific performance, according to diverse indexes. The AHP method would then help managers decide on issues such as subscription and cancellation of supplier services. The linear regression method would also aid in evaluating the practical effect of constructing "smart" libraries on innovative management and user behavior.

Funding statement

The article is funded by China National Library and Information Committee of Finance and Economics Universities.

Author statement

The article "Evaluating E-book Vendors in the Era of Smart Libraries" is funded by China National Library and Information Committee of Finance and Economics Universities and CEInet Data Co., Ltd.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.lisr.2023.101254>.

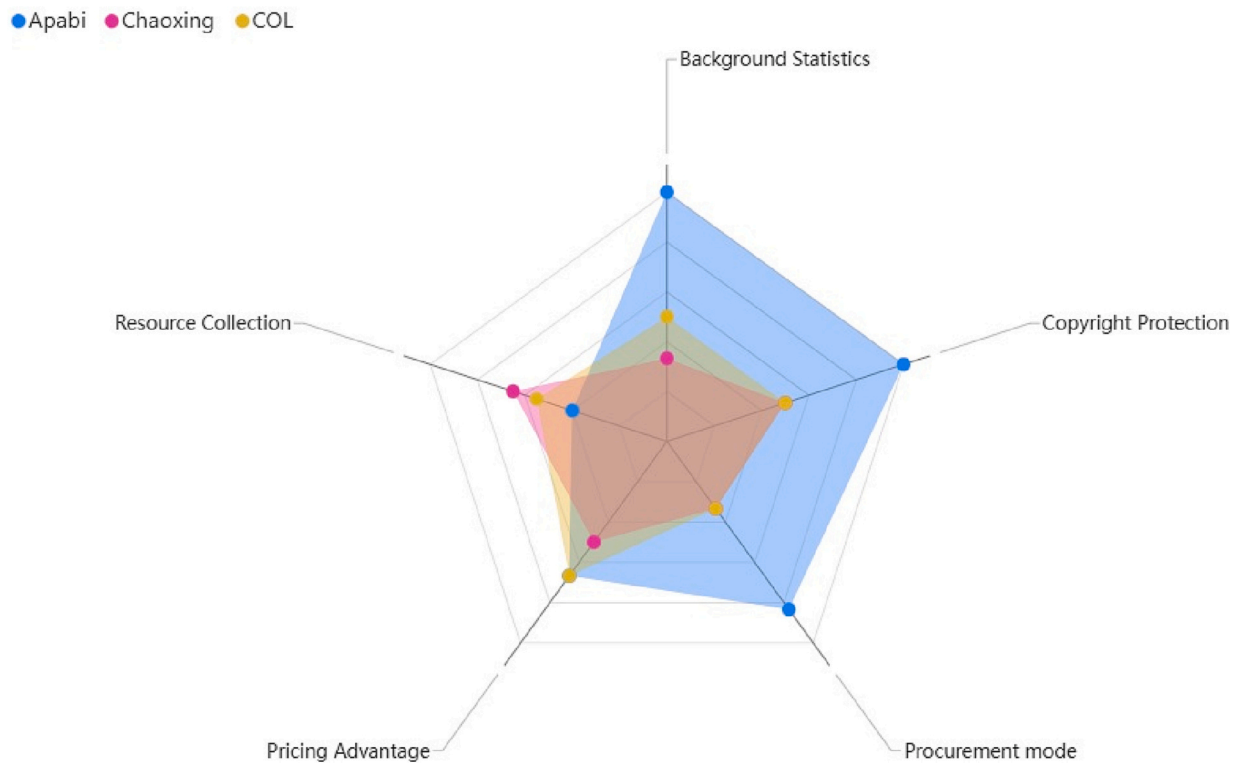


Fig. 2. Non-smart index radar chart.

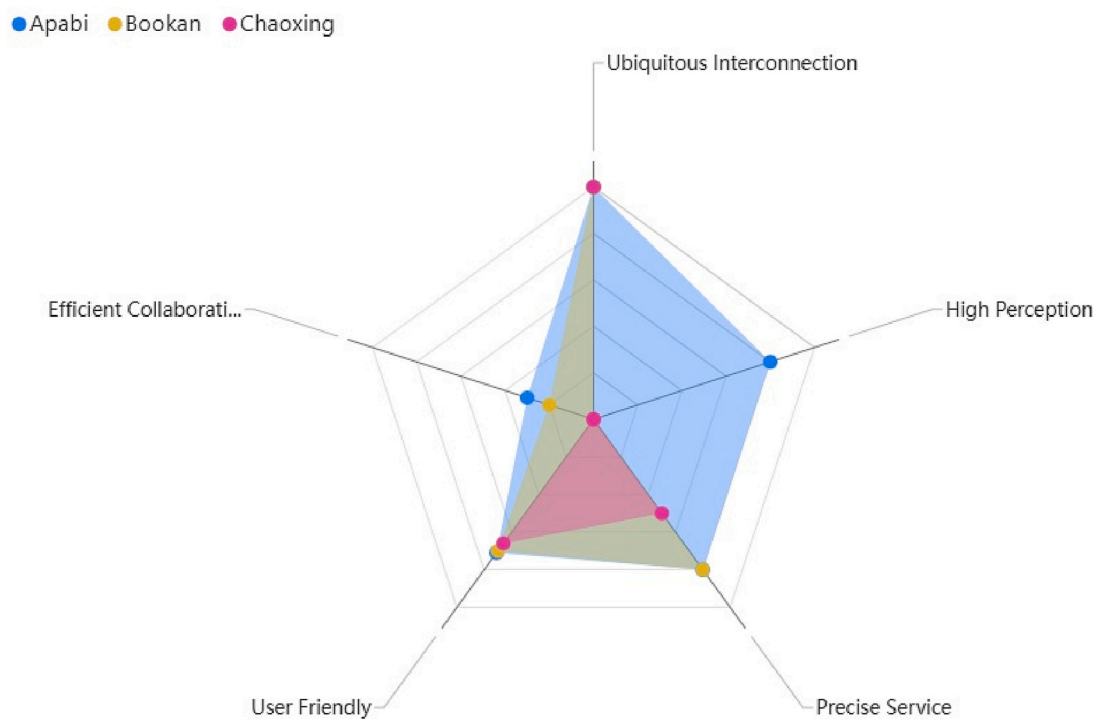


Fig. 3. Smart index radar chart.

[org/10.1016/j.lisr.2023.101254](https://doi.org/10.1016/j.lisr.2023.101254).

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