

Operational Efficiency of WeChat Official Accounts for Academic Journals in Library, Information and Archival Management: A Three-Stage DEA Analysis Postprint

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Abstract

[Purpose/Significance] By calculating the operational efficiency of WeChat Official Accounts of library, information, and archival management academic journals, this study examines their current development status and provides targeted recommendations, offering guiding significance for the future development of such official accounts in the LIS and archival management field. [Method/Process] Twenty journal official accounts were selected as research samples. The three-stage DEA method was employed to determine input-output indicator data, the DEA-BCC model was used to estimate the operational efficiency values of each official account, and SFA regression was applied to eliminate the influence of environmental factors. [Results/Conclusion] After eliminating the influences of environmental factors and random noise, the average comprehensive efficiency of the official accounts increased compared to the first stage; however, 16 accounts still failed to achieve DEA efficiency. Finally, based on the principles of Data Envelopment Analysis, improvement recommendations for the official accounts were proposed from two perspectives: conserving input resources and ensuring input effectiveness.

Full Text

Research on the Operational Efficiency of WeChat Official Accounts of Library, Information and Archives Management Academic Journals: Based on Three-Stage DEA Analysis

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Abstract: [Purpose/Significance] By calculating the operational efficiency of WeChat official accounts of library, information and archives management academic journals, this study aims to understand their current development status and provide targeted recommendations, which holds certain guiding significance for the future development of such journal official accounts. [Method/Process] Twenty journal official accounts were selected as research samples. Using the three-stage DEA method, input-output indicator data were determined, the operational efficiency values of each official account were estimated through the DEA-BCC model, and the influence of environmental factors was eliminated through SFA regression. [Result/Conclusion] After excluding environmental factors and random noise, the average comprehensive efficiency of the official accounts increased compared to the first stage, but 16 accounts still failed to achieve DEA effectiveness. Finally, based on the principles of data envelopment analysis, improvement suggestions for official accounts are proposed from two perspectives: conserving input resources and ensuring input effectiveness.

Keywords: library, information and archives management; academic journal; WeChat official account; operational efficiency

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Since its launch in August 2012, WeChat has rapidly become an important medium for communication, information transmission, and acquisition. As of Q1 2022, its monthly active users reached 1.2883 billion [?]. Various official accounts on the WeChat platform, leveraging its massive user base, are regarded as important carriers for information dissemination and have gradually become one of the primary sources of information [?]. Today, journal official accounts provide users with article pushes, journal subscription, submission and peer review, and publication query services, which not only facilitate users but also address to some extent the problems of long publication delays and narrow dissemination scope of traditional journals [?].

Library, information and archives management academic journals have distinct disciplinary characteristics that reflect the academic research level and overall industry development status in this field. In view of this, this study examines the officially opened and normally operating WeChat official accounts of library, information and archives management academic journals. After collecting data from each official account over the past six months, three-stage DEA (Data Envelopment Analysis) is used to analyze their operational efficiency. For DEA-ineffective official accounts, this paper will focus on the path of “increasing output while conserving input,” identify problems with non-DEA-effective subscription accounts after analyzing input redundancy and output deficiency, and propose improvement suggestions [?].

In summary, current research lacks studies on library, information and archives management academic journal official accounts. On the other hand, among existing articles that use DEA analysis methods to evaluate official account operational efficiency, most adopt traditional or super-efficiency data envelopment analysis methods without eliminating environmental factors from operational efficiency estimates. In view of this, this paper adopts the three-stage DEA analysis method to overcome the limitations of traditional DEA models. By eliminating environmental influences and random noise, this study provides a more realistic and accurate efficiency evaluation of library, information and archives management academic journal official accounts and offers relevant recommendations for their future development.

Research Methodology

This study employs a three-stage DEA analysis method to evaluate the operational efficiency of library, information and archives management academic journal WeChat official accounts. The three-stage DEA analysis, proposed by H.O. Fried et al. [?], differs from traditional DEA models in that it eliminates environmental factors and random noise, allowing decision-making units to adjust inputs under largely identical environmental conditions, thereby yielding operational efficiency values that better reflect reality. Given that environmental factors and random noise are believed to interfere with the analysis of journal official account operational efficiency, the three-stage DEA method was selected as more scientifically reasonable.

Before conducting three-stage DEA analysis, a traditional DEA model must first be constructed to calculate the efficiency of each decision-making unit and the slack variables of inputs. Since the operational methods of journal official accounts are constantly improving and input scales are continuously increasing, returns to scale often exhibit an increasing trend. Therefore, this study selected the BCC model with variable returns to scale for analysis.

The second stage requires using the slack variables of inputs as explained variables and environmental factors as explanatory variables to establish corresponding SFA (Stochastic Frontier Approach) regression equations. The SFA regression equations can estimate the different impacts of different environmental variables on decision-making units. Subsequently, using the inputs of efficient decision-making units as a reference, the input variables of decision-making units under different environmental and random noise conditions are adjusted to place them under the same environmental factors and random interference. Finally, based on the adjusted input variable values obtained in the second stage and the original output values, the DEA-BCC model is run again to obtain new efficiency values that reflect the true operational efficiency of each decision-making unit after eliminating environmental factors and random noise interference.

2.2.1 Input and Output Indicators Before conducting data envelopment analysis, a scientific evaluation indicator system must be established from both

input and output dimensions, based on the information resources of each journal and the user groups they serve. When Chen Shuangshuang and Hou Shengchao conducted DEA analysis on hospital WeChat official accounts, they included the number of posts, original content rate, and publishing days as input indicators, and treated likes and read counts as output indicators reflecting communication effectiveness [?]. Jiang Youqi and Zhang Bin, when analyzing media subscription account efficiency, included custom menu count as a 细分 indicator in the input system for application platform construction [?]. Zhang Yan and Zhao Wanxin considered fan count an important factor reflecting official account popularity and thus included it as an output indicator [?]. Building on existing research, this study additionally included “average per-article ‘wow’ count” as an output indicator. The “wow” function on WeChat allows users’ friends to see articles they’ ve recently “wowed” within seven days, reflecting user recognition and willingness to share, forming the basis for article forwarding. The specific evaluation indicator system is shown in Table 1 .

2.2.2 Environmental Factor Indicators When conducting three-stage DEA analysis, environmental factor selection must follow two principles: the factor must genuinely affect official account operational efficiency; the factor objectively exists and cannot be controlled by official account operators. When calculating the three-stage DEA model, this study selected four environmental factor indicators for elimination, as shown in Table 2 .

For academic journals, the length of time since founding affects industry awareness to some extent, which in turn influences user attention to their official accounts [?]. Composite impact factor and total citation count reflect the quality of the journal itself. Since the information content disseminated by academic journal official accounts relies on the journal’ s literature resources, these factors significantly impact operational efficiency. Tang Jinyu and Zhu Xuefang included official account operation duration as an input indicator when estimating the efficiency of public cultural cloud WeChat platforms [?]. However, in this study, the data collection period was concentrated within six months, and all surveyed official accounts were in normal operation. At this point, the operation duration differences among official accounts only related to their founding time, which was not controlled by current operators, yet operation duration affected factors influencing operational efficiency such as dissemination scope, brand building, and operational experience. Therefore, official account operation duration met the selection principles for environmental factors and was appropriately included as an environmental factor indicator.

2.3.1 Sample Selection This study referenced the “Overview of Chinese Core Journals,” CSSCI source journals, and extended directory of library, information and archives journals. These journals hold certain influence and representativeness within the discipline. Through WeChat’ s “search” function, journals were searched one by one by name, and 20 officially opened and stably operating library, information and archives management academic journal WeChat official

accounts were identified after screening.

2.3.2 Data Collection The data collection period was from February 1, 2021 to July 31, 2021. Active fan counts were obtained through the Qingbo Big Data platform. Custom menu counts were obtained from the dialog box displayed after following the corresponding official account. Publishing days, post counts, original counts, average per-article read counts, average per-article like counts, and average per-article “wow” counts were obtained by traversing all posts within the time period. Official account operation duration could be obtained from the “About Official Account” section on WeChat; for accounts with missing data on this interface, the time of their first post was used as the reference. Impact factor and total citation count could be obtained through CNKI’s “Journal Navigation” function. Finally, founding year was obtained by visiting journal official websites or Baidu Baike to calculate founding duration. To avoid program robustness issues with zero values, non-zero processing was applied using 0.0001 to replace zero values. Specific data are shown in Table 3 and Table 4 .

Results and Analysis

3.1 First-Stage Model Analysis According to the methods described above, DEAP2.1 was used for first-stage data analysis to calculate the operational efficiency of library, information and archives management academic journal WeChat official accounts, with results summarized in Table 5 . Due to different objective operating environments for each official account, the results cannot reflect the true operational efficiency and require separation of environmental factors and random errors.

3.2 Second-Stage Model Analysis According to the methods described above, the second stage requires constructing an SFA regression model. Using the slack variables of various inputs as explained variables and the four environmental variables such as founding duration as explanatory variables, SFA regression analysis was conducted using Frontier 4.1.

Analysis of the SFA regression model estimation results shows that when constructing SFA regression models with the slack variables of post count, original count, and publishing days for library, information and archives management academic journal WeChat official accounts as explained variables, the one-sided likelihood ratio (LR) tests for all three models passed at the 1% significance level, and most t-test values in the tables passed testing. The selected environmental variables had significant impacts on these three input slack variables, reasonably rejecting the null hypothesis of no inefficiency terms. However, for the slack variable of custom menu count, the model’ s one-sided LR test result was 0.452, failing the significance level test, indicating that the selected environmental variables did not significantly affect this input slack variable.

Table 6 shows the second-stage SFA regression model estimation results.

Specific analysis of the three models that passed consistency testing reveals that the γ values are all 1, indicating that the main reason for slack in input variables is management inefficiency rather than random noise. The coefficients of environmental variables in the table are both positive and negative. When the environmental variable coefficient is positive, an increase in the environmental variable leads to increased input redundancy, thereby reducing the operational efficiency of library, information and archives management academic journal official accounts. When the coefficient is negative, an increase in the environmental variable leads to decreased input redundancy, thereby improving overall operational efficiency. Specific analysis is as follows:

- (1) The founding duration of library, information and archives management academic journals has a positive impact on the slack variables of post count and other three inputs, significant at the 1% level. This indicates that official accounts of longer-established journals have greater redundancy in content production and time investment, with relatively unreasonable allocation of input resources.
- (2) The impact factor of library, information and archives management academic journals has a negative impact on post count and publishing days, significant at the 1% level. The reason may be that journals with higher composite impact factors have greater authority and recognition in the industry, and users have greater demand for information push services from such journal official accounts, which is conducive to improving the utilization rate of input items. The impact factor has a positive impact on original count slack variable, significant at the 10% level, possibly because users place more value on high-quality articles published in the journal and have greater demand for posts that republish or report such articles, neglecting the original posts invested by the official account itself.
- (3) The operation duration of library, information and archives management academic journal official accounts has a negative impact on the slack variable of post count, significant at the 1% level. The reason is that as operation duration increases, operators can gain more operational experience, thereby understanding user needs and reducing investment in ineffective posts. The operation duration's impact on original count and publishing days slack variables is mixed but not significant. The reason may be that original count and publishing days depend on journal characteristics and account traditions or operational habits, which are less affected by operation time.
- (4) The total citation count of library, information and archives management academic journals has a positive impact on the slack variables of post count and publishing days, passing significance tests at the 1% and 10% levels respectively. Journals with more citations indicate that their published articles are more recognized, and official account operators hope to provide users with more literature resources. At this time, the input redundancy of post count and time items increases, causing waste of in-

vested resources. The impact of total citation count on original count slack variable is negative, playing a positive role in official account operational efficiency, but not passing the significance test.

3.3 Third-Stage Model Analysis By substituting the new input variables obtained in the second stage and the original output data into the DEA-BCC model, new operational efficiency estimates for library, information and archives management academic journal WeChat official accounts and changes compared with pre-adjustment efficiency values can be obtained, with specific results shown in Table 7 .

Table 7 shows that after eliminating the interference of environmental factors and random noise, the average comprehensive efficiency value of each journal official account is 0.572, an increase of 0.05 compared with the first stage; the average pure technical efficiency is 0.822, an increase of 0.055 compared with the first stage; and the average scale efficiency value is 0.671, a decrease of 0.057 compared with the first stage.

Specific analysis is as follows:

- (1) From the perspective of returns to scale, 14 official accounts are in a state of increasing returns to scale, accounting for 70%; 5 official accounts have constant returns to scale, accounting for 25%; and 1 official account has decreasing returns to scale, accounting for 5%.
- (2) From the perspective of DEA effectiveness, journal official accounts can be divided into three categories: DEA-effective journal official accounts, DEA-weakly effective journal official accounts, and DEA-ineffective journal official accounts. The official accounts of *Journal of Intelligence*, *Library Tribune*, *Library Journal*, and *Library and Information Service* have comprehensive efficiency equal to 1, making them DEA-effective journal official accounts, accounting for 20% of the research subjects. The official accounts of *Data Analysis and Knowledge Discovery*, *Journal of Library Science in China*, *New Century Library*, *Archives and Construction*, *Zhejiang Archives*, *China Archives*, and *Library Work and Study* have pure technical efficiency equal to 1 and scale efficiency less than 1, making them DEA-weakly effective journal official accounts. The main reason is insufficient scale efficiency, and they can appropriately increase inputs such as post count and original count to optimize resource allocation schemes. The official accounts of *Information Science*, *Information Studies: Theory & Application*, *Modern Information*, *Journal of Intelligence*, *Journal of Information Resources Management*, *Digital Library Forum*, *Library Development*, *Library and Information Knowledge*, and *Archives Management* have both pure technical efficiency and scale efficiency less than 1, making them DEA-ineffective journal official accounts with considerable room for improvement in input allocation and technical and management levels.

- (3) Analyzing the changes in comprehensive efficiency values of each journal official account shown in Figure 1 [Figure 1: see original paper] reveals that 7 WeChat official accounts experienced increased comprehensive efficiency, accounting for 35%, with the largest increase being the *Zhejiang Archives* journal official account at 76.4%, which operates in the most unfavorable environment. Nine WeChat official accounts experienced decreased comprehensive efficiency, accounting for 45%, with the largest decrease being the *Journal of Library Science in China* official account at 59.2%. This official account was in a DEA-effective state in the first-stage DEA analysis because its environmental factors including founding duration and composite impact factor were very high, boosting its comprehensive efficiency. For example, its founding duration ranked 3rd among the surveyed journals, and its composite impact factor ranked 1st. However, after eliminating these environmental factors in the third-stage DEA, its comprehensive efficiency declined rapidly. Upon reviewing its official account, it was found that since its registration in May 2020, it has only updated 11 posts, with content primarily focused on notifications in relatively singular form. Therefore, the three-stage DEA analysis truly reflects the operational status of this official account.
- (4) From a disciplinary perspective, journals were divided into library/information science and archival science categories because library science and information science journals have widespread cross-publication phenomena, making further subdivision inappropriate. Calculation results show that library/information science journal official accounts have smaller changes in operational efficiency values, with most decreasing compared to the first stage; while archival science journal official accounts have larger changes in operational efficiency values, all increasing compared to the first stage. This indicates that the operating environment for library/information science journal official accounts is superior to that of archival science journals. The reason is that archival science research has a narrower disciplinary scope and fewer scholars engaged in archival research, placing such official accounts in a relatively passive and unfavorable situation. The first-stage data underestimated the real efficiency of such journal official accounts in practice. On the other hand, due to the overlapping effects of library science and information science in research fields and content, there is widespread cross-publication between the two. Taking *Library and Information Service* as an example, there are many amphibious publications in library and information science that publish papers in both fields, making the user base for such journals broader and the corresponding operating environment for official accounts relatively more favorable.

Conclusions and Recommendations

In today's era of promoting all-media construction and digital reading, WeChat official accounts, as information transmission platforms with a huge user base, represent an important front for library, information and archives management academic journals to achieve media convergence. Through three-stage DEA analysis, this study finds that: Environmental factors such as founding duration, impact factor, official account operation duration, and total citation count have significant impacts on the slack variables of three inputs: post count, original count, and publishing days. When calculating the operational efficiency of library, information and archives management academic journal official accounts, environmental factors need to be eliminated to ensure data authenticity and accuracy. Environmental factors have greater impact on archival science journal official accounts, with obvious negative effects. Archival science journal WeChat official accounts need to invest greater effort to cope with relatively unfavorable objective environments. Combined with actual calculation results, the current overall operational efficiency of library, information and archives management academic journal official accounts is not high, with considerable room for improvement in technical and management levels.

In summary, to further improve the operational efficiency of library, information and archives management journal official accounts, active and reasonable adjustments should be made for DEA-ineffective official accounts. To improve operational efficiency, it is necessary to start from both input and output dimensions, increasing output while reducing input as much as possible. However, in reality, increased output often cannot be achieved without input supply, and blindly reducing input will inevitably affect output results. Therefore, the essence of improving official account operational efficiency lies in: reducing unnecessary input consumption and saving input resources while maintaining existing output; ensuring that increased input can be more efficiently transformed into increased output, guaranteeing the effectiveness of resource input and avoiding blind ineffective input, thereby placing input and output in an efficient and stable equilibrium. Accordingly, combined with actual official account operations, the following recommendations are proposed to improve the efficiency of library, information and archives management academic journal official accounts, with the recommendation framework shown in Figure 2 [Figure 2: see original paper].

4.2.1 Conserving Input Resources

- (1) Clarify target user groups. Posts are the main form of input for library, information and archives management academic journal WeChat official accounts. Therefore, the core of conserving input resources lies in reducing ineffective post input. Before content production, official accounts should first identify their target user groups and appropriately produce posts according to user demand characteristics and volume.
- (2) Enrich post formats and beautify content layout. Choosing appropriate

post formats and beautifying post layout reflects improved input quality and can stimulate user interest in reading posts, thereby increasing official account attention. High-quality input that has been finely processed can often be transformed into output more efficiently. Directly listing large blocks of text or presenting published articles in image form is less intuitive and creates greater reading pressure for readers than content presented through video, audio, and mind maps. When arranging post content, official accounts should adhere to principles of standardization and aesthetics. Official accounts should unify post font size, typeface, line spacing and other elements, divide posts into different columns and edit series titles to make post presentation more standardized. In terms of background color, decoration, and illustration selection within posts, they should create a comfortable and relaxed reading atmosphere as much as possible.

- (3) Official account communication and linkage. A WeChat official account matrix refers to horizontal combinations within professional fields [?], transmitting information content in a broader space. Rich and diverse dissemination and promotion channels can enable official accounts to serve more users, allowing post content to improve communication influence on a wider platform and increase the efficiency of transforming input into output.

Library, information and archives management academic journal official accounts, relying on their literature resources, can actively cooperate with official accounts of libraries, archives and other institutions, providing academic support and combining cutting-edge academic achievements with practical work. Simultaneously, journal official accounts should actively integrate into the “WeChat +” trend, enabling functions such as journal subscription, open courses, and academic conferences to be realized through forms like “WeChat + e-commerce,” “WeChat + courses,” and “WeChat + live streaming,” expanding the application and service space of official accounts as much as possible [?].

4.2.2 Ensuring Input Effectiveness

- (1) Provide targeted services. Determining user groups can help official account operators clarify platform positioning and determine later-stage topic planning and post content arrangement [?]. WeChat user groups include not only researchers in library, information and archives disciplines but also many non-professional users. Providing targeted post services for different user groups can improve the matching degree between input and demand, thereby ensuring that input can be smoothly transformed into a considerable amount of output.

In terms of daily pushes, they should be reasonably divided into professional posts and popular science posts. Professional posts can utilize rich journal literature resources to push scientific and technological achievements, frontier

developments, and excellent articles published or accepted in the current issue in the academic research field. Popular science posts should be positioned to serve the general public, using more accessible and interesting language and presentation forms to convey popular science knowledge and hot topics related to their lives to users.

Official accounts should promptly pay attention to data information such as read counts and like counts of published posts during operation, understand user reading preferences, summarize characteristics of high-quality posts, and form typical paradigms. For posts with poor data, experiences should also be summarized, and production of similar types and content can be appropriately reduced. In short, official account operators should avoid the waste of input resources that blindly pile up post quantity while neglecting feedback effects.

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Author Contributions

Ma Yunzhe: Proposed the topic, developed the interview outline, wrote the initial draft.

Cui Xu: Developed the paper framework, reviewed and revised the paper, and finalized the manuscript.

Note: Figure translations are in progress. See original paper for figures.

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