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Postprint: An Empirical Study on Influencing Factors of APP Promotion Based on Interpretive Structural Modeling

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Date: 2023-10-08T00:00:00+00:00

Abstract

[Purpose/Significance] This study proposes a novel method for solving based on the Interpretive Structural Model (ISM) from the perspectives of users and designers, and investigates the factors influencing the promotion of mobile terminal application APPs. [Process/Method] In the research process, statistical analysis of the data is first conducted using SPSS software to obtain correlation coefficients of various factors to determine their correlations; then, based on regression analysis, the dependency relationships among various factors are obtained; finally, through the interpretive structural model, a detailed analysis of various factors is performed to obtain their hierarchical relationships. The combination of SPSS and ISM can effectively compensate for the shortcomings of ISM, namely, eliminating the need for subjective judgment of the relationships among various factors. [Results/Conclusion] The research results reveal the hierarchical relationships of factors influencing the promotion of several commonly used APPs, providing a basis for more effective development, usage, and promotion of APPs in the future.

Full Text

The Influential Factors in APP Promotion: An Empirical Study Based on Interpretive Structural Modeling

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Abstract

[**Purpose/Significance**] This study proposes a novel method for solving interpretive structural models from the dual perspectives of users and designers, and investigates the factors influencing mobile terminal application (APP) promotion. [**Process/Method**] The research process involves three main stages: first, using SPSS software to conduct statistical analysis of the data to obtain correlation coefficients among various factors and determine their interrelationships; second, employing regression analysis to establish dependency relationships between factors; and finally, applying interpretive structural modeling (ISM) to conduct a detailed analysis of each factor to determine their hierarchical relationships. The integration of SPSS and ISM effectively compensates for the limitation of ISM requiring subjective judgment of relationships among factors. [**Result/Conclusion**] The results reveal the hierarchical relationships among influencing factors for several commonly used APPs, providing a foundation for more effective APP development, utilization, and promotion in the future.

Keywords: Interpretive Structural Modeling; APP Promotion; SPSS; Correlation Analysis; Regression Analysis

1. Introduction

According to the 36th "Statistical Report on Internet Development in China" released by the China Internet Network Information Center (CNNIC), by June 2015, China's internet user population had reached 668 million, with mobile internet users accounting for 594 million—an increase of 36.79 million since December 2014 [1]. This surge in mobile users has led to explosive growth in various mobile terminal applications (APPs). While these numerous APPs facilitate daily life, they also raise critical questions: how to evaluate and select APPs, how to improve them, and how designers can create APPs that users will more readily accept [2-7]. A review of existing literature reveals that most current APP evaluation studies construct indicator systems to assess individual APPs from either the user or developer perspective alone, lacking comprehensive research on the factors influencing APP promotion.

This study examines APP promotion factors from both user and designer perspectives, leveraging SPSS software's statistical analysis capabilities and interpretive structural modeling (ISM). The findings not only uncover hierarchical relationships among various factors but also enable APP designers to influence intermediate and surface-level factors through changes to root factors during the design and promotion process, thereby enhancing user acceptance and adoption of their APPs.

2.1 Variable Factors

Through expert consultation and brainstorming sessions, this study identified 15 variable factors that encompass nearly all aspects influencing APP promotion:

APP function updates, APP user positioning, APP functionality, APP content presentation, APP security and stability, APP account universality, APP page design, APP application platform, APP memory size, APP operational difficulty, APP usage cost, APP promotion or acquisition channels, APP usage benefits, APP user volume, and APP download volume. Detailed descriptions of each factor are provided in Table 1 .

Table 1. Variable Factor Descriptions

Variable Factor	Description
APP Function Updates	Content and functions updated in later versions of the APP
APP User Positioning	Analysis and investigation of target users during initial development
APP Functionality	Functions that the APP can perform
APP Content Presentation	Content displayed on APP pages
APP Security and Stability	Required security and stability levels for the APP
APP Account Universality	Whether the APP allows login through other accounts (e.g., QQ, WeChat, Weibo)
APP Page Design	User interface design based on preliminary analysis
APP Application Platform	Platforms supported, including Android, iOS, and tablets
APP Memory Size	Memory occupied and required during usage
APP Operational Difficulty	User-perceived ease of operation
APP Usage Cost	Charges during usage and data consumption costs
APP Promotion or Acquisition Channels	Developer promotion channels and user acquisition methods
APP Usage Benefits	Initial installation benefits and ongoing usage benefits
APP User Volume	Actual number of users
APP Download Volume	Total downloads across all platforms

3. APP Promotion Influencing Factor Analysis

The data used in this study were collected through a questionnaire survey. Based on the 15 identified indicators, respondents evaluated the importance of

each indicator from both developer and user perspectives. The measurement scale ranged from 0 to 9, with higher values indicating greater importance. The questionnaire was distributed online, allowing internet users to complete it freely and authentically. The survey covered 21 provinces and autonomous regions nationwide, targeting mobile terminal users aged 15-40. A total of 312 questionnaires were collected, and after removing invalid responses, 206 valid questionnaires remained.

3.1 Correlation Analysis

Correlation analysis examines whether relationships exist between two or more variables and measures the strength of these relationships [8], with the correlation coefficient being a key indicator [9]. This study first conducted correlation analysis on the preprocessed data using SPSS software to obtain correlation coefficients between all variable factors. The complete correlation matrix is presented in Table 2 .

Correlation coefficients greater than 0.500 were selected as the threshold for determining significant relationships between variables. The filtered results are shown in Table 3 . While alternative thresholds (e.g., 0.600) could be used, experimental results indicated that 0.500 provided the most realistic representation of actual conditions.

3.2 Regression Analysis

Regression analysis examines dependency relationships and their strength between two or more variables, identifying which variable is independent and which is dependent [10-11]. Based on the correlation coefficients obtained above, regression analysis was performed on all variable factors, and regression coefficients [12] were used to determine dependency relationships. The regression coefficients are presented in Table 4 .

Regression coefficients greater than 0.500 were selected as the basis for constructing the adjacency matrix, with the filtered results shown in Table 5 . Although alternative thresholds (e.g., 0.700) could be considered, experimental results demonstrated that 0.500 yielded the most realistic outcomes. Table 5 served as the initial adjacency matrix for the interpretive structural model, with regression coefficients exceeding 0.500 represented as 1 in the matrix.

4. APP Promotion Influencing Factor System Structure

4.1 APP Promotion Influencing Factor System Structure

The Interpretive Structural Model (ISM) was proposed by Professor J.N. Warfield in 1973 to analyze structural problems in socio-economic systems [13]. Its core principle involves processing system elements through various techniques combined with directed graphs, matrices, and computer technology to present a hierarchical structure that is understandable to non-experts. The

main steps include: regional partitioning, level partitioning, skeleton matrix extraction, and multi-level hierarchical directed graph drawing. Its working principle is illustrated in Figure 1 [Figure 1: see original paper] [14].

The adjacency matrix was derived from the regression coefficient table, as shown in Table 6 . The matrix after M1=$(A+I)^1$ calculation is presented in Table 7 ; after M2=$(A+I)^2$ in Table 8 ; after M3=$(A+I)^3$ in Table 9 ; and after M4=$(A+I)^4$ in Table 10 . Since M3=M4, the reachability matrix of the adjacency matrix is M=M3=M4.

Through regional partitioning, the reachable set R(Si), antecedent set A(Si), common set C(Si), and starting set B(S) were obtained, as shown in Table 11 . Because B(S)={S3, S9, S11} and R(S3) R(S9) R(S11)={S1, S2, S4, S5, S6, S7, S8, S10, S12, S13, S15} {S9, S10, S12} {S1, S2, S4, S6, S8, S10, S11, S12, S13, S14}≠ , all factors belong to the same region, indicating that the region is indivisible.

Level partitioning of this region yielded the results shown in Table 12 . The skeleton matrix, obtained after removing strong connections, skip-level binary relationships, and self-binary relationships, is presented in Table 13 . Based on the skeleton matrix, the multi-level hierarchical directed graph was drawn, as shown in Figure 2 [Figure 2: see original paper]. The final APP promotion influencing factor system structure, with variable factors (Si) replaced by actual variables, is illustrated in Figure 3 [Figure 3: see original paper].

4.2 Conclusion Analysis

Analysis of the final results demonstrates that they align well with reality, confirming the feasibility of this ISM solution approach. The hierarchical structure reveals several key findings:

(1) The APP promotion influencing factor system structure comprises seven levels: the first level represents the surface layer, levels two through six constitute intermediate layers, and the seventh level represents the root layer. Notably, the factor “APP user volume” appears at the second (intermediate) level rather than the surface layer where it might be expected in practice.

(2) The structure from level three to level seven divides into two main components: one including “APP function updates, APP functionality, APP security and stability, APP content presentation, APP page design, APP account universality, APP operational difficulty, APP application platform, and APP memory size”; and the other comprising “APP user positioning, APP functionality, APP usage cost, APP promotion or acquisition channels, and APP usage benefits.”

(3) Although the total download volume cannot fully and accurately determine an APP’s success, it represents the most direct manifestation of success. While “APP user volume” most authentically reflects current

popularity, statistical cost considerations prevent its use in practice for judging APP success. This indicates that measuring actual user numbers is nearly impossible, leading developers to rely on download volume as the primary success metric.

(4) The analysis reveals that "APP function updates" constitutes a root-level factor, demonstrating that post-launch function updates are crucial for influencing other intermediate factors and ultimately affecting user volume. Additionally, targeted usage benefits and promotion channels based on "APP user positioning" can directly impact user numbers, explaining the common phenomenon of offering benefits for APP installation.

5. Implications and Recommendations

Based on the analysis of the APP promotion influencing factor system structure, this study offers recommendations for APP developers, users, and platforms.

(1) For APP developers: Do not judge promotion success solely by download volume; instead, prioritize actual user numbers. To reduce statistical costs, developers can first estimate based on download volume, then combine this with sample surveys to assess promotion success, achieving both realistic results and cost savings. For users: Do not decide on APP usage based only on download rankings, as high download volumes do not guarantee high user numbers. Users should consider APP functionality in their decisions.

(2) Since the influencing factor system has two main components, developers should initially focus on "APP user positioning" and "APP function updates" during design, as these root factors can influence all other factors through intermediate elements, ultimately determining success via "APP download volume."

(3) In the system structure, "APP application platform, memory size, operational difficulty, usage cost, promotion/acquisition channels, and usage benefits" directly influence "APP user volume." This suggests that developers should emphasize these six factors during early promotion stages to achieve rapid adoption, while in later stages, they should adjust root elements to influence higher-level factors for maximum success.

(4) For users, understanding this system structure provides a basis for evaluating APP quality before adoption, rather than relying on single factors like download volume or benefits while ignoring functionality importance. During usage, users should pay attention to "APP function updates" as a key indicator of long-term value.

6. Research Outlook

This study proposes a novel approach to solving interpretive structural models by combining SPSS statistical analysis with ISM to examine APP promotion factors from both user and designer perspectives. The results clarify relationships and hierarchical structures among factors, providing guidance for developers to influence intermediate and surface factors through root factor adjustments, thereby enhancing user acceptance. For users, this framework offers criteria for evaluating APPs. However, several limitations warrant future research:

(1) More sophisticated algorithms for correlation and regression analysis could be developed, such as specialized algorithms tailored for APP evaluation contexts.

(2) Factors could be further subdivided—for example, separating "APP promotion or acquisition channels" into distinct "APP promotion channels" and "APP acquisition channels."

(3) Future studies could assign weights to factors to better understand their relative importance.

(4) More precise data could be obtained from relevant enterprises during initial data collection.

References

[1] China Internet Network Information Center. CNNIC Releases the 36th Statistical Report on Internet Development in China [EB/OL]. [2015-07-23]. http://www.cnnic.net.cn/hlwfzyj/hlwxzbg/hlwtjbg/201507/t20150722_{52624}.htm.

[2] Guo Jing, Zhang Zhiqiang. The Development Process and Evaluation of APP Electronic Publications by Chinese Publishing Houses [J]. Science-Technology & Publication, 2014(2): 66-69.

[3] Hao Jia, Su Hui, Zhao Binbin. Application and Effect Evaluation of Mobile APP in Digital Outpatient Nursing Work [J]. China Digital Medicine, 2015(9): 57-60.

[4] Shen Zuoyuan. Research on Smart APP Design Evaluation for Travel Agencies Based on AHP [J]. Special Zone Economy, 2015(3): 80-83.

[5] Hu Chang'ai, Xing Meiyuan, Yang Chunwei, et al. Functional Evaluation of Medical Consultation APPs in China [J]. Chinese Journal of Medical Library and Information Science, 2014(2): 7-10.

[6] Zhang Sumin, Yan Xiaoyan, Xie Li. Analysis of Mobile APP Applications and User Evaluations by Foreign Database Publishers [J]. Library Journal, 2012, 31(6): 56-61.

[7] Wang Zhijin, Li Mingzhen. The Construction Method and Process of Website Evaluation Index System [J]. Library and Information, 2006(3): 45-52.

[8] Qian Yu. Canonical Correlation Analysis of Corporate Social Responsibility and Corporate Performance: Based on Stakeholder Perspective [J]. Enterprise Economy, 2013(3): 79-82.

[9] Zhang Shiqiang, Lü Jieneng, Jiang Zheng, et al. Discussion on Correlation Coefficients [J]. Mathematics in Practice and Theory, 2009, 39(19): 102-107.

[10] Luo Fengming, Qiu Jinbiao, Li Minghua, et al. How to Use Statistical Software SPSS for Regression Analysis [J]. Computer Knowledge and Technology, 2008(2): 293-294, 297.

[11] Xu Sheng, Yu Biyang, Ma Xingchuan. Construction of a Regression Analysis Model for Future Professionals' Stereotypes of Librarians [J]. Library and Information, 2013, 150(2): 112-116.

[12] Shen Shuxia, Liu Luqin. Relative Efficiency Between Bayes Estimation and Least Squares Estimation of Regression Coefficients [J]. Journal of Wuhan University (Natural Science Edition), 2003, 49(1): 6-10.

[13] Wang Wanqiu, Zhang Yong'an. Analysis of Influencing Factors on Synergistic Effects of Enterprise Technology M&A Based on ISM [J]. Science of Science and Management of S.& T., 2009, 30(4): 104-109.

[14] Hu Zhenhua, Cai Xin. Analysis of Influencing Factors on Utilization Rate of Paper Resources in University Libraries Based on ISM [J]. Library and Information Service, 2010, 54(7): 46-50.

Author Contributions:
Huang Wei: Conceived the main ideas and wrote the paper;
Li Zongke: Collected materials and participated in writing;
Li Yuefeng: Conducted data analysis and participated in writing.

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

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