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Postprint: Evaluation of Converged Media Communication Capacity Based on Fuzzy Analytic Hierarchy Process

Authors: Zhao Qing, Ni Yepeng

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

Abstract

In recent years, the development of converged media has achieved considerable scale. To evaluate the communication capability of converged media, this paper analyzes the influencing factors of converged media communication capability based on Lasswell' s 5W model and designs an evaluation index system for converged media communication capability. Subsequently, the fuzzy analytic hierarchy process is employed to assess the communication capability of converged media. Finally, Python is utilized for acquiring evaluation index data, modeling the evaluation methodology, and computing and analyzing the evaluation results.

Full Text

Research on Evaluation of Integrated Media Communication Capability Based on Fuzzy Analytic Hierarchy Process

Authors: Zhao Qing, Ni Yepeng
Affiliation: Communication University of China, Beijing 100024

Abstract: In recent years, the construction of integrated media has reached considerable scale. To evaluate the communication capability of integrated media, this paper analyzes the influencing factors of integrated media communication capability based on Lasswell's 5W model and designs an evaluation index system for integrated media communication capability. The fuzzy analytic hierarchy process is then employed to evaluate integrated media communication capability. Finally, Python is utilized for data acquisition of evaluation indicators, modeling of the evaluation method, and computational analysis of evaluation results.

Keywords: integrated media; communication capability; fuzzy analytic hierarchy process; evaluation system; Python

Classification Code: F224.5
Document Code: A
Article ID: 1671-0134(2021)02-026-05
DOI: 10.19483/j.cnki.11-4653/n.2021.02.004
Citation Format: Zhao Qing, Ni Yepeng. Research on Evaluation of Integrated Media Communication Capability Based on Fuzzy Analytic Hierarchy Process [J]. China Media Technology, 2021(02): 26-30.

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1. Research Background

Since the beginning of the 21st century, rapid advancements in information technology, including digitalization, networking, and intelligence, have fundamentally transformed the media industry. For traditional media, this represents both an opportunity and a challenge. Since the 18th National Congress of the Communist Party of China, the Party and the state have recognized this development trend and introduced a series of policies to accelerate media convergence. General Secretary Xi Jinping has emphasized that promoting media integration and building all-media communication has become an urgent task facing us. The goal of media convergence is to strengthen mainstream public opinion, consolidate the common ideological foundation for the unity and struggle of the entire Party and people, and provide powerful spiritual strength and public support for achieving the "Two Centenary Goals" and the Chinese Dream of national rejuvenation [1].

On August 18, 2014, the central government issued the "Guiding Opinions on Promoting the Integrated Development of Traditional and Emerging Media," elevating media convergence to a national strategic level. China' s media industry subsequently embarked on comprehensive reforms across all domains to address the challenges and impacts of new media, marking 2014 as the inaugural year of media convergence in China. Integrated media represents the product of this convergence—a dynamic and evolving concept that, in common understanding, refers to a new media form resulting from the integration of traditional media (broadcast, television, newspapers) with internet-based emerging media. This integration is not merely a simple combination of media platforms but encompasses comprehensive fusion of resources, content, channels, systems, mechanisms, and operations. According to standards released by the State Administration of Radio and Television in 2018, integrated media is defined as the effective combination of broadcast, television, newspapers, and other traditional media with internet-based emerging media, utilizing diversified communication channels and forms to widely disseminate news and information to audiences, thereby achieving resource integration, content compatibility, and mutual promotion.

Communication capability, in this context, refers to the capacity of integrated media platforms to influence audience emotions, attitudes, and actions after disseminating information through communication channels [2]. More specifically, it represents the ability of integrated media platforms to distribute information to audience groups via communication channels, which can be subdivided into three secondary indicators: content productivity, user interaction, and coverage capability. These are further broken down into eight tertiary indicators: daily publication volume, daily original publication volume, daily comment volume, daily readership, daily forwarding volume, daily likes, audience/follower count, and platform coverage count.

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2. Evaluation Index System

Lasswell' s 5W model is the earliest communication model, which describes the information dissemination process through five basic elements: Who, Says What, In Which Channel, To Whom, and With What Effect [3]. In integrated media information dissemination, these correspond respectively to the communicator (integrated media platform), information content, communication channel (method), audience, and communication effect. These five components constitute the information dissemination process and represent the factors influencing integrated media communication capability.

Drawing upon Lasswell' s 5W model, this paper conducts a comprehensive analysis of the factors affecting integrated media communication capability and designs an evaluation index system as shown in .

Content Productivity refers to the ability of integrated media to collect, edit, and distribute information, transforming it into content formats such as text, images, and video for audiences. This includes: (1) Daily Publication Volume—the average number of information releases per day (including original and reposted content) during a given period; and (2) Daily Original Publication Volume—the average number of original information releases per day during a given period.

User Interaction refers to interactive behaviors by the audience after receiving disseminated information, typically including daily comment volume, daily readership, daily forwarding volume, and daily likes. These metrics represent the average daily number of comments, reads, forwards, and likes (or "thumbs up") on integrated media content during a specific period.

Coverage Capability refers to the dissemination reach of integrated media, encompassing audience/follower count and platform coverage count. Audience/follower count indicates the number of followers on official accounts across platforms and overall audience size, while platform coverage count represents the number of platforms covered (including WeChat, Weibo, client apps, print media, broadcast, television, etc.).

3. Methodology

3.1 Fuzzy Analytic Hierarchy Process

The fuzzy analytic hierarchy process (FAHP) is a modeling approach that is easily implemented through programming, offering good practicality. It effectively addresses the abstraction of qualitative and quantitative factors in equipment selection problems while avoiding the consistency difficulties of traditional matrices and discrepancies between established matrices and human reasoning. The main steps of FAHP are as follows:

First, analyze the various influencing factors of integrated media communication capability and construct a hierarchical structure model, namely the evaluation index system shown in .1, with the target layer being the integrated media communication capability evaluation index.

3.1.2 Design of Expert Questionnaire To quantitatively describe the relative importance between any two indicators, this study adopts the 0.1-0.9 scaling method [4] shown in to quantify the evaluation index system and designs an expert questionnaire. The specific survey results are statistically presented in , , and .

3.1.3 Construction of Fuzzy Judgment Matrix A fuzzy judgment matrix R represents the relative importance comparison among elements at the current level with respect to a specific element at the upper level. Assuming that an element at the upper level is associated with elements a_1, a_2, ⋯, a at the current level, the fuzzy consistent judgment matrix can be expressed as:

$$R = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1n} \\ r_{21} & r_{22} & \cdots & r_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nn} \end{pmatrix}$$

where r_{ij} represents the membership degree of the fuzzy relationship "⋯is much more important than⋯" when comparing elements a_i and a_j relative to the upper-level element.

Relevant experts conduct pairwise comparisons of elements $a_1, a_2, ..., a_n$ at each level relative to other indicator elements at the same level, providing quantitative values for relative importance. The data corresponding to each indicator are then weighted and averaged to obtain the fuzzy judgment matrices shown below:

- Primary indicator fuzzy judgment matrix for communication capability
- Secondary indicator fuzzy judgment matrix for content productivity

- Secondary indicator fuzzy judgment matrix for user interaction
- Secondary indicator fuzzy judgment matrix for coverage capability

3.2 Weight Calculation

After obtaining the fuzzy judgment matrix, the weight values of each element in the matrix are calculated. If matrix $R = (r_{ij})_{n\times m}$ is an n-order fuzzy matrix, then R is a fuzzy consistent matrix if and only if there exists an n-order non-negative normalized vector $W = (w_1, w_2, ..., w_n)^T$ and a positive number a such that:

$$r_{ij} = a(w_i - w_j) + 0.5$$

From this equation, fixing i yields:

$$r_{ik} = a(w_i - w_k) + 0.5 \quad (k = 1, 2, ..., n)$$

Summing over k gives:

$$\sum_{k=1}^{n} r_{ik} = a\left(nw_i - \sum_{k=1}^{n} w_k\right) + \frac{n}{2}$$

Given the weight vector normalization condition $\sum_{k=1}^{n} w_k = 1$, we obtain:

$$w_i = \frac{1}{n} - \frac{1}{2a} + \frac{1}{na}\sum_{k=1}^{n} r_{ik}$$

In equation (4), the value of a satisfies $a \geq \frac{n-1}{2}$. Here we select $a = \frac{n-1}{2}$. Finally, by incorporating the hierarchical relationships, the weight values between hierarchical levels are transformed into comprehensive weight values relative to the overall target. The weight values of secondary indicators relative to primary indicators are calculated first, followed by the weight values of primary indicators relative to the target layer, and ultimately the comprehensive weight values of secondary indicators relative to the overall target. This yields the subjective weight coefficients w_i for each indicator, as shown in .

3.3 Evaluation Results

3.3.1 Calculation of Combined Weight Coefficients There are two fundamental methods for calculating combined weights: the algebraic sum method and the product method [5][6]. This study adopts the product method to calculate combined weights by combining subjective weight coefficients w_i and objective weight coefficients W_i to obtain combined weight coefficients β_i:

$$\beta_i = w_i \times W_i$$

3.3.2 Calculation of Evaluation Results After obtaining the standardized values $f(X_i)$ and combined weight coefficient values β_i, the evaluation results can be calculated using a weighted function approach. The comprehensive evaluation value for integrated media communication capability is obtained by summing the products of each indicator' s standardized value and its combined weight coefficient:

$$T = \sum_{i=1}^{n} f(X_i) \times \beta_i$$

where T is the comprehensive evaluation value, $f(X_i)$ is the standardized indicator value, and β_i is the combined weight coefficient.

Python is employed for data analysis and evaluation modeling. The implementation includes code for storing and managing raw data, standardizing data, and calculating indicator weights using Python. For the evaluation method, the fuzzy analytic hierarchy process is implemented based on the Python language. The combination of these approaches yields combined weights, establishes the methodological model, imports standardized data into the evaluation model, and produces final computational results. presents the evaluation results of integrated media communication capability for 28 provinces from August 2019 to April 2020 (excluding Jiangxi, Xinjiang, Tibet, and Hong Kong, Macao, and Taiwan).

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4. Results Analysis and Conclusions

4.1 Analysis of Evaluation Results

Based on the analysis of evaluation results from 28 provincial radio and television stations, the following findings emerge:

4.1.1 Shanghai, Hunan, Zhejiang, and Jiangsu in the First Tier Analyzing only the top 7 provincial radio and television stations, shows the average scores of the top 7 integrated media communication capabilities. Shanghai and Hunan rank first and second respectively, with evaluation scores mostly above 55, significantly outperforming other provinces. This indicates that Shanghai and Hunan have achieved excellent integrated media development, with Hunan Broadcasting System' s "Mango Model" serving as a successful industry case. The average scores of Hunan, Shanghai, Zhejiang, and Jiangsu all reach 48+, with their monthly rankings showing alternating changes and consistently close performance, placing them in the first tier. Beijing and Shandong' s evaluation results are around 30 points, with alternating rankings indicating similar communication capabilities. Guangdong' s evaluation score of 36.18 lags behind the first tier but outperforms Beijing and Shandong.

4.1.2 Significant Disparities Between Provinces While Shanghai and Hunan achieve scores approaching 60, Inner Mongolia, Qinghai, Ningxia, and Yunnan score below 2, indicating vast disparities in integrated media development across regions. The scores of Hunan, Shanghai, Zhejiang, and Jiangsu are significantly better than other provinces, demonstrating that possessing strong traditional media resources and leveraging these advantages leads to higher integrated media development levels. The regional imbalance is evident when dividing the 28 provincial stations into China' s four major economic zones. As shown in [Figure 1: see original paper], the average evaluation scores are 30.46 for the eastern region, 25.97 for the central region, 17.33 for the northeastern region, and 5.32 for the western region. The top 7 provinces are all from central and eastern regions, while the bottom 7 are all western provinces with scores below 10, closely correlating with economic development levels.

Interestingly, the three northeastern provinces all achieve scores above 15, even outperforming some central and eastern provinces. This unexpected result stems from their strong emphasis on WeChat operation, where their WeChat communication capability ranks in the top 10, though insufficient attention to Weibo and Toutiao creates unbalanced platform development. When dividing the western region into northwest and southwest, the southwest (including Chongqing, Sichuan, Guizhou, Guangxi, and Yunnan) shows an average score of 7.76, significantly better than the northwest (including Shaanxi, Gansu, Ningxia, Qinghai, and Inner Mongolia) at 2.88, again reflecting economic disparities between these sub-regions.

4.1.3 Significant Variation in Some Provinces' Results Most provinces show stable evaluation results with fluctuations not exceeding 10 points, indicating stable integrated media development. However, some provinces exhibit larger variations. Using the coefficient of variation (ratio of standard deviation to mean) to assess stability—where larger coefficients indicate greater data dispersion and instability—shows the five provinces with the highest coefficients: Heilongjiang, Shaanxi, Henan, Guangxi, and Ningxia. This suggests their integrated media construction is ongoing, with unstable communication capabilities, likely due to strategic adjustments or operational changes affecting content production and audience structure.

4.2 Conclusions

This study reveals that the top 5 provinces in integrated media communication capability are Shanghai, Hunan, Zhejiang, Jiangsu, and Guangdong, while the bottom 4 are Inner Mongolia, Qinghai, Ningxia, and Yunnan. These results demonstrate significant disparities and clear polarization in integrated media communication capabilities across provinces. The evaluation outcomes align with research findings from other institutions, showing consistency in identifying well-developed provinces despite minor ranking differences, and correspond closely with results from the "Media Convergence Blue Book: China Media Convergence Development Report (2019)."

Employing the fuzzy analytic hierarchy process to calculate evaluation results for integrated media communication capability, this study accounts for complex relationships between indicators, yielding scientifically rigorous weight calculations and evaluation results consistent with objective conditions. The proposed method provides an effective approach for evaluating integrated media communication capability.

Funding: This research is supported by the National Key R&D Program "Integration and Application of Film and Television Media Convergence Service Technologies" (Project No.: 2018YFB1404000).

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Author Biographies: Zhao Qing (1998-), female, from Zhangjiakou, Hebei, Master' s student, research interests: integrated media technology; Ni Yepeng (1984-), male, from Dalian, Liaoning, Associate Professor, Ph.D. in Engineering, research interests: intelligent media microservices and integrated media evaluation technologies.

(Editor: Zhang Xiaojing)

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

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