

## Research Article

# Research on the Evaluation Algorithm of Social Capital Influence of Enterprise Network Marketing

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In order to improve the problems of low recognition of evaluation results of traditional methods, comprehensive evaluation results, low accuracy, and small number of marketing advertisements, this paper proposes a social capital impact evaluation algorithm for corporate network marketing. It analyzes the influence dimension of social capital from the three dimensions of structure, relationship, and cognition. Starting from different dimensions, by constructing an evaluation index system, calculating evaluation index weights, and designing evaluation algorithms, a complete evaluation index is obtained. Finally, the impact evaluation algorithm is designed using the analytic hierarchy process. The results show that the evaluation results of the algorithm have a high degree of recognition, the evaluation results are comprehensive and accurate, and the amount of marketing advertisements is high, indicating that the algorithm has a high application value.

## 1. Introduction

Corporate social capital is an intangible resource of enterprises, which plays a positive role in promoting the operation and development of enterprises. At present, both microenterprises and large enterprises are facing great market competition pressure. Network marketing has become a new development platform and starting point for enterprises. For modern enterprises, network marketing has changed from special business to conventional business, which is the main idea and means of enterprise management [1]. For enterprises, the market competition is fierce, the pressure is huge, and the living space is limited. Network marketing has become the channel and platform of enterprise marketing and the focus and main means of enterprise development in the future. At present, the research on the influence evaluation of enterprise network marketing on social capital mainly focuses on how to reduce enterprise agency costs, improve the work efficiency of marketing organizations, promote the construction of open network marketing governance model under the condition of network economy, provide enterprises with more employment opportunities, and improve satisfaction [2]. However, most

of these research objects are large enterprises, there is less research on microenterprises, and the reliability of influence evaluation results is not high. Therefore, it is necessary to study a method to accurately evaluate the influence of enterprise network marketing social capital [3].

The study in [4] proposes an improved microblog user influence evaluation algorithm, which comprehensively considers the user's own attributes, determines its own basic influence based on the user's activity, authentication information, and blog quality, and excavates the user's potential influence by introducing the dissemination rate of user blog. Combined with the quality of users' different friends, a microblog user influence evaluation algorithm is constructed based on the improved PageRank algorithm. The experimental results show that the recall rate and F value of the algorithm are high, which shows that it can objectively reflect the actual influence of microblog users and can provide a reference for the research of opinion leader mining, information dissemination, and public opinion guidance in social networks. The study in [5] proposes a microblog user influence calculation method integrating users' own factors and interactive behavior. This method considers the direct influence and indirect influence of

microblog users. In the calculation of users' direct influence, users' initial influence is calculated by analyzing users' own factors, such as the number of microblog users' fans, user activity, and recent microblog quality. Then the user interaction behavior, such as the user's microblog visibility and microblog user interaction coefficient, is analyzed, and the user communication ability is calculated. Finally, the initial influence is combined with the user communication ability, and the user direct influence is calculated based on the improved PageRank algorithm. In the calculation of user indirect influence, by analyzing the connection structure of user network diagram and according to the different connection paths of nonadjacent users, the user indirect influence is divided into three cases, simple path, repeated path, and complex path, so as to calculate the user indirect influence. Experimental results show that the algorithm has high user ranking accuracy. In addition, some scholars have proposed the influence evaluation method of scenic spot microblog platform based on the improved entropy method. This method selects the 5A scenic spot official microblog platform as the research sample and constructs the influence evaluation index system for the information released by the above microblogs from January 1, 2017, to December 31, 2017; based on the media influence formation theory, the improved entropy method is used to weight the index. The results show that the algorithm can analyze the influence of the microblog platform and conclude that the influence level of microblog platform in 5A scenic spots is low as a whole. The study in [6] aims to identify and analyze to what extent digital marketing strategy can improve the organizational agility of MSMEs in Pontianak, Indonesia. It is a management decision-making problem to find influential target users to help enterprises to make online advertisements to maximize the marketing performance. From the perspective of social capital theory, reference [7] studies users' network influences and its growth process in the social capital resources and finds the association relationships between user's influence attributes which include users' domain authorities, text qualities, interaction relationships, and the advertising performance objectives in social network.

Although the above traditional methods realize the evaluation of influence from different angles, there are some problems, such as low recognition of evaluation results, low comprehensiveness and accuracy of evaluation results, and low number of marketing advertisements forwarded. Therefore, this paper puts forward the social capital impact evaluation algorithm of enterprise network marketing, so as to provide ideas and methods for network marketing of small, medium-sized, and microenterprises. The research route of this paper is introduced as follows:

- (1) This paper analyzes the social capital influence dimension of enterprise network marketing, including structure, relationship, and cognition
- (2) Based on the analysis results of the influence dimension of social capital, the evaluation index

system is constructed according to the design principles of evaluation indexes

- (3) Establish judgment matrix and calculate the weight of evaluation index
- (4) The influence evaluation algorithm based on AHP is designed to complete the evaluation of the social capital influence of enterprise network marketing
- (5) The comprehensiveness and accuracy of the evaluation results, the number of forwarded marketing advertisements, and the recognition of the evaluation results are selected as experimental indicators to verify the effectiveness of the algorithm

## 2. Social Capital Influence Dimension of Corporate Network Marketing

The social capital influence of a company's network marketing can be displayed through three dimensions, namely, structural, relationship, and cognitive. They can also be called structural capital, relationship capital, cognitive capital, and the social capital of corporate network marketing. The overall architecture is shown in Figure 1.

### 2.1. Structural Dimensions of Corporate Social Capital.

The structural dimension refers to the structural mode in which people get in touch with each other in interpersonal communication, such as between colleagues and colleagues and between friends and friends. Similarly, in the field of commercial marketing, companies also use this model to establish contact with society and carry out network configuration [8]. Taking e-commerce companies as an example, the social connection mentioned here can be the connection between the company and the consumer or the communication between the consumer and the consumer, including communication time, frequency, and intimacy. For example, through the product and service information provided by the company, Consumer A understands other websites and their consumers' evaluation information on the company to establish their own corporate image. Among them, the network configuration can reflect the relationship structure of all members in interpersonal communication and social connections.

### 2.2. Relationship Dimension of Corporate Social Capital.

The relationship dimension is mainly reflected in the following aspects: the first is how to better create relationships, which is an item that enterprises need to focus on; the second is how to maintain the existing relationship. In addition, it also includes the strength of interpersonal relationships and their impact on individual behavior. Generally speaking, the relationship dimension in the social capital influence system focuses on analyzing the constituent elements from the perspective of dual interpersonal relationship structure, which can help individuals in the organization obtain the required scarce resources to a certain extent [9]. The relationship dimension factors are trust and identity between individuals or organizations. Trust here refers to the

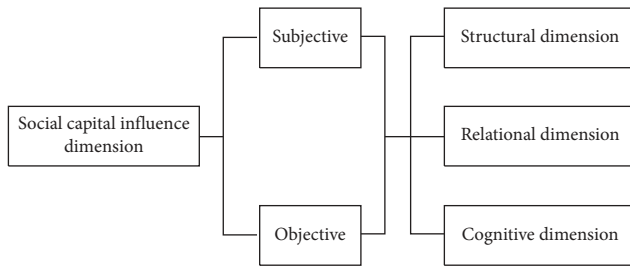


FIGURE 1: The overall structure of social capital of corporate network marketing.

relationship quality transmitted by each individual within the organizational structure, while identity represents an inherent sense of belonging to the organization. Taking an enterprise's microsignal as an example, when individuals in the whole relationship structure really regard themselves as internal members of the organization, they will show a strong desire to pay attention to the enterprise's brand image and new products (such as paying attention to the enterprise's microsignal) and actively share their own information and knowledge with other members.

**2.3. Cognitive Dimension of Corporate Social Capital.** The cognitive dimension can more purposefully reflect the communication status of each individual in interpersonal communication. In other words, the cognitive dimension can intuitively present the communication tools between individuals. With the help of communication tools, individuals have a common language and vision, realize sharing under a unified platform, and provide a strong guarantee for the exchange and sharing of knowledge within the organization. Because the basis of the cognitive dimension comes from language, including jargon, colloquialism, or implied meaning, which belongs to the basis of individual interaction.

### 3. Social Capital Influence Evaluation Algorithm for Corporate Network Marketing

Starting from the social capital influence dimension of enterprise network marketing, this paper designs the social capital influence evaluation algorithm of enterprise network marketing, including the construction of evaluation index system, the calculation of evaluation index weight, and the design of evaluation algorithm. The specific implementation process is analyzed in the following.

#### 3.1. Construction of the Evaluation Index System

**3.1.1. Design Principles of Evaluation Indicators.** In order to correctly construct the evaluation index system of social capital influence of corporate network marketing, it is necessary to realize the importance evaluation of influence factors through case investigation. The basic principles of social capital influence evaluation should include the following.

First, we should use simplified indicators to reflect the evaluation object comprehensively. The evaluation index system cannot be too complicated, and the evaluation method is simple and easy. The evaluation system should avoid the system being too large and complex and avoid selecting single indicators being too one-sided. On the premise of ensuring objectivity, the index system should be simplified as much as possible, and the overall optimization of the evaluation index system can be achieved by removing some indicators with little impact.

Second, the information source channel of the data required for the evaluation index must be reliable and clear, and the importance of each index of the index system must be easy to determine for the evaluator, so it is required that the evaluator can directly use each index of the model for importance evaluation. The purpose of constructing the evaluation index system of social capital influence of enterprise network marketing is to meet the needs of enterprises better and benefit them. Therefore, it is necessary to explain the concept of each index in detail so that enterprises can make more practical choices.

Third, the evaluation methods and data of the social capital influence of enterprise network marketing should be standardized and standardized. In the evaluation process, the accuracy of evaluation should be improved as much as possible, and the error of model establishment and data selection should be as small as possible, which is conducive to the inspection and improvement of the evaluation system.

**3.1.2. Evaluation Subject.** The evaluator is generally called the subject of evaluation, sometimes a person, and sometimes a group. The evaluation subject is at the core of the evaluation process. The evaluation subject needs to formulate evaluation objectives, establish an evaluation index system, and screen some unreasonable indicators. The subjects of this paper are experts in the fields of sociology and information management and Internet users who frequently use platforms such as Weibo and WeChat.

**3.1.3. Establishment of the Evaluation Index System.** This paper designs an evaluation index system for the social capital influence of corporate network marketing [10]. This index system consists of five first-level indicators: network marketing scale, network marketing direction, network marketing effect, network marketing content, and network marketing time. It consists of two secondary indicators. Among them, the direction of online marketing refers to the service attributes of a specific group, which is the basic condition for influencing. The selection and content of other indicators are shown in Table 1.

#### 3.2. Establishment of Evaluation Index Weights

**3.2.1. Construction of the Judgment Matrix.** Using the questionnaire survey method, experts in the fields of sociology and information management and Internet users who often use platforms such as Weibo and WeChat are invited

TABLE 1: The evaluation index system of social capital influence of enterprise network marketing.

	First-level indicator $A$	Secondary index $B$	Indicator description
The evaluation index system of social capital influence of enterprise network marketing	Network marketing scale $A_1$	Number of online marketing ads $B_1$	The scale of online marketing advertising
		Number of users following $B_2$	Number of users who pay attention to online marketing copywriting and advertising
		User clicks $B_3$	Number of times users clicked on marketing content
	Internet marketing direction $A_2$	Can quantify the number of ads monitored $B_4$	High-quality online marketing ads
		Subject sensitivity $B_5$	User's interest in marketing topics
		Target users $B_6$	User group characteristics, age, and so on
		Audience analysis $B_7$	It is smaller than the general user range, indicating users who are closely related to the marketing content
	Internet marketing effect $A_3$	Transaction contribution rate $B_8$	The proportion of the transaction volume formed by online marketing in the total transaction volume
		Forwarding rate $B_9$	Probability of users reposting marketing content
		Marketing advertising awareness $B_{10}$	Increase in corporate visibility
	Internet marketing content $A_4$	Marketing advertising efforts $B_{11}$	The intensity of marketing and publicity investment
		Content usefulness $B_{12}$	Whether the content of online marketing meets the actual needs of users
	Internet marketing time $A_5$	Content novelty $B_{13}$	Whether the content of online marketing can attract users' attention
		User browsing time $B_{14}$	The amount of time the user continues to browse a certain marketing content
		Durability $B_{15}$	Persistence of online marketing programs or advertisements at the time level

to compare various indicators and score them to distinguish the degree of importance. A total of 20 experts in the field of sociology and information management and Internet users who frequently use platforms such as Weibo and WeChat were invited in this study to score the social capital influence evaluation indicators of corporate Internet marketing [11] shown in Table 1. Calculate the scores, and then carry out a weighted average [12] to construct the judgment matrix of each layer of the social capital influence evaluation index system of corporate network marketing. Taking network marketing scale  $A_1$  as an example, the judgment matrix of  $B_1$ – $B_4$  evaluation index is given, as shown in Table 2.

As shown in Table 2, if the evaluation index is equally important, then  $K=1$ ; if the former is slightly more important than the latter, then  $K=2$ ; if the former is obviously more important than the latter, then  $K=3$ ; if the latter is more important than the former, then  $K=1/2$ .

**3.2.2. Judgment Matrix Weight Calculation.** First, calculate the product of each row element in the judgment matrix. The calculation formula is

$$\partial(k) = \sum_{i,j=1}^n |a_{ij}^{(t)+} - a_{ij}^{(t)-}|, \quad (1)$$

where  $a_{ij}^{(t)+}$  represents the preference of the judgment matrix;  $a_{ij}^{(t)-}$  represents the ranking vector;  $i$  represents the row

TABLE 2: Judgment matrix.

$K$	$B_1$	$B_2$	$B_3$	$B_4$
$B_1$	1	1/2	2	1
$B_2$	2	1/2	1/3	2
$B_3$	1	2	3	1/2
$B_4$	1/2	1	2	1

in the judgment matrix; and  $j$  represents the column in the judgment matrix.

Then calculate the  $n$  root of  $\partial(k)$ :

$$\overline{\partial(k)} = \sqrt[n]{\partial(k)}. \quad (2)$$

Finally, the vector is normalized to obtain the weight vector. The calculation formula is

$$\partial(k)_{ij} = \frac{\overline{\partial(k)}}{\sum_{i,j=1}^n \overline{\partial(k)}} \quad (3)$$

**3.2.3. Establishment of Evaluation Index Weights.** The data in the matrix are subjective judgments of various experts. It is difficult for experts to make accurate judgments on the value of each element, and there will be deviations in calculations. Therefore, in order to maintain the consistency of the matrix, it is necessary to check the consistency of the

matrix to see if it meets the standard, which is helpful for timely correction.

First judge the maximum eigenvalue of matrix  $\partial(k)$ :

$$\partial(k)_{\max} = \left( k_{ij}^{(t)} \right)^2. \quad (4)$$

Then, compared with the consistency index [13], if the average random consistency test of each index all passes, there is no need to modify it and the final weight result is shown in Table 3.

**3.3. Evaluation Algorithm of Social Capital Influence of Enterprise Network Marketing Based on AHP.** According to the obtained evaluation index weights, a social capital influence evaluation algorithm for corporate network marketing based on AHP [14] is designed. In this algorithm, a criterion layer is set, and the criterion layer contains  $m$  criteria [15]. The specific evaluation process is introduced.

*Step 1.* Input criterion level  $U$  and target level  $V$ .

*Step 2.* Calculate the maximum eigenvalue  $\alpha$  of the target layer  $V$  and the corresponding normalized eigenvector  $\beta$ .

*Step 3.* Carry out the consistency check. If  $\beta \leq 0.1$ , it means to pass the check. At this time, let  $f = \beta$  and go to the next step. If it does not pass the check, go back to Step 1 [16].

*Step 4.* Input the  $m \times m$  comparison matrix  $U'_i$  of scheme layer  $T$  to criterion  $U_i$ .

*Step 5.* Calculate the maximum eigenvalue of  $U'_i$  and the corresponding normalized eigenvector.

*Step 6.* Consistency check, if  $\alpha \leq 0.1$ , means to pass the check; at this time, let  $f = \alpha$ , and go to the next step; if it does not pass the check, go back to Step 4.

*Step 7.* Calculate the combined weight vector of plan layer  $T$  to target layer  $V$ ; the calculation formula is

$$S_v = s(s_1, s_2, \dots, s_n) = \begin{pmatrix} t_1 \\ t_2 \\ \dots \\ t_m \end{pmatrix}. \quad (5)$$

*Step 8.* Find the maximum value  $t_{\max}$  of  $t_1, t_2, \dots, t_m$ , which is the optimal evaluation plan [17], that is, the evaluation result of the social capital influence of enterprise network marketing.

## 4. Example Verification and Result Discussion

In order to verify the effectiveness of the proposed social capital influence evaluation algorithm for enterprise network marketing, a numerical example is carried out. In the verification process, in order to highlight the advantages of

this method, the improved microblog user influence evaluation algorithm in [4] and the microblog user influence calculation method integrating users' own factors and interactive behavior in [5] are used as comparative methods for comparative analysis.

**4.1. Data Collection and Preprocessing.** In order to test the validity and rationality of the social capital influence evaluation algorithm of corporate network marketing, this paper takes a certain company as the research object and collects its social capital index attribute data. The experiment uses days as the observation unit, and the data collection cycle lasts for six months, starting on June 1, 2019, and ending on November 30, 2019.

KMO statistics are indicators for measuring effectiveness. When the KMO value is small, it means that the results may be unsatisfactory if performing factor analysis on these variables. Conversely, if the KMO value is larger, it means that factor analysis can be performed. The Bartlett sphere test can be used to test the assumption that multiple variables are mutually independent; that is, the overall correlation matrix is a unit matrix. According to the KMO test standard, it can be known that the larger the KMO value, the better the validity of the statistical data. The value of KMO is between 0 and 1. The larger the value is, the more suitable it is for factor analysis. When the KMO value is greater than 0.7, it is more suitable, while the value is less than 0.7 and greater than 0.6, it is barely possible for factor analysis. When the KMO value is less than 0.6, it is not suitable for factor analysis.

Table 4 shows the KMO and Bartlett test results of the experimental data.

In this study, the data was imported into the SPSS 20.0 statistical software, the KMO value was calculated through the validity analysis, and the Bartlett sphere test and confirmatory factor analysis were performed. It can be seen from Table 4 that the value is 0.884. According to the KMO test standard, this study can analyze variables through factor analysis. At the same time, the chi-square approximate value of Bartlett's sphere test statistic is 8659.326, the degree of freedom is 435, and the significance probability is less than 0.1, which proves that the data obtained in this study is suitable for factor analysis.

It can be seen from the above verification that the data used in this paper can be used for experimental verification, which can ensure the validity and accuracy of the experimental results.

## 4.2. Discussion of Results

**4.2.1. Algorithm Performance Verification.** (1) *Comparison of Social Capital before and after Enterprise Network Marketing.* Taking the social capital generated by the enterprise before and after the network marketing as a comparison, the influence of the network influence is analyzed, and the result is shown in Figure 2.

According to the experimental results shown in Figure 2, the total value of social capital changes with iteration, the change rates are different, and there is no obvious law.

TABLE 3: Evaluation index weight.

First-level indicator $A$	Secondary index $B$	Weight
$A_1 = 0.21$	Number of online marketing ads $B_1$	0.093
	Number of users following $B_2$	0.040
	User clicks $B_3$	0.026
	Can quantify the number of ads monitored $B_4$	0.051
$A_2 = 0.34$	Subject sensitivity $B_5$	0.078
	Target users $B_6$	0.104
	Audience analysis $B_7$	0.158
$A_3 = 0.19$	Transaction contribution rate $B_8$	0.047
	Forwarding rate $B_9$	0.019
	Marketing advertising awareness $B_{10}$	0.091
$A_4 = 0.16$	Marketing advertising efforts $B_{11}$	0.033
	Content usefulness $B_{12}$	0.080
	Content novelty $B_{13}$	0.080
$A_5 = 0.10$	User browsing time $B_{14}$	0.034
	Durability $B_{15}$	0.066

TABLE 4: KMO and Bartlett test results of experimental data.

KMO value		0.836
Bartlett test	Approximate chi-square	8657.315
	Degree of freedom	429
	Significance probability	0.001

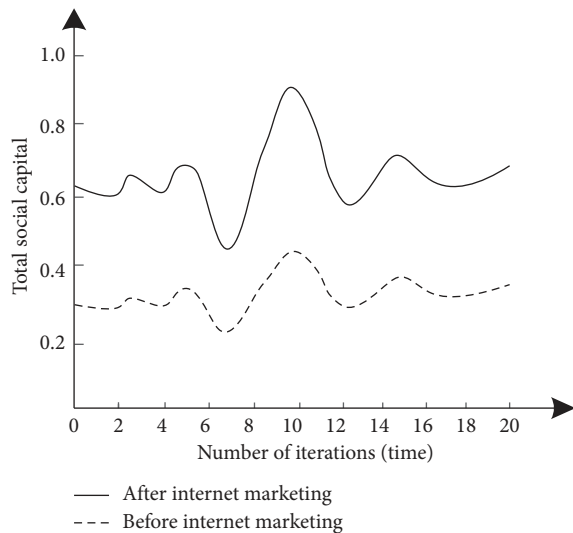


FIGURE 2: Comparison of social capital before and after enterprise network marketing.

Comparing the social capital before and after enterprise network marketing, it can be seen that, after enterprise network marketing, the total amount of social capital is large, which is significantly higher than that without network marketing, which can be reflected in the growth rate of personality charm value, social ability value, and total social capital. Therefore, it can be seen that the social capital influence of enterprise network marketing is large.

(2) *Recognition of Impact Evaluation Results.* 300 users were selected to score the impact evaluation results in the form of a questionnaire. A total of 300 questionnaires were recovered, with a recovery rate of 100%. Some objective

evaluation results were obtained through the statistics of the recovered data. After sorting out the 300 questionnaires collected, the results are shown in Table 5.

According to the data in Table 5, it can be seen that 300 investigators scored the impact evaluation results in the form of scoring and achieved higher scores, indicating that most people can recognize the results obtained by the algorithm. Although there will be some differences between the survey results and the results obtained through algorithm calculations, they can basically reflect the user's recognition of the evaluation results.

4.2.2. *Comparison with Other Influence Evaluation Algorithms.* Most of the existing studies choose the number of fans or a small number of other characteristics as the influence evaluation factors, which has the problems of comprehensiveness and accuracy of the evaluation results and the low number of marketing advertisements forwarded. Therefore, this paper verifies the effectiveness of this algorithm from three aspects: the comprehensiveness, accuracy, and the number of marketing advertisements forwarded.

(1) *Comprehensiveness of Evaluation Results.* In order to better compare the evaluation effects of different methods, the comprehensiveness of the evaluation results is used as an experimental indicator, and the algorithm in this paper is compared with the traditional method. The result is shown in Figure 3.

As shown in Figure 3, it can be found that the algorithm in this paper is significantly better than other methods in evaluating the effect of user influence, which shows that the algorithm in this paper can evaluate the real influence of users more effectively, and the evaluation results are more comprehensive. It can also be seen from Figure 3 that when

TABLE 5: Recognition of impact evaluation results.

Survey number/person	Brand recognition (0.1-1)	Impact score (10 points system)
30	0.7	7.5
60	0.7	7.7
90	0.8	7.8
120	0.8	8.0
150	0.8	8.0
180	0.9	8.1
210	0.9	8.7
240	0.9	8.9
270	1.0	9.
300	1.0	9.5

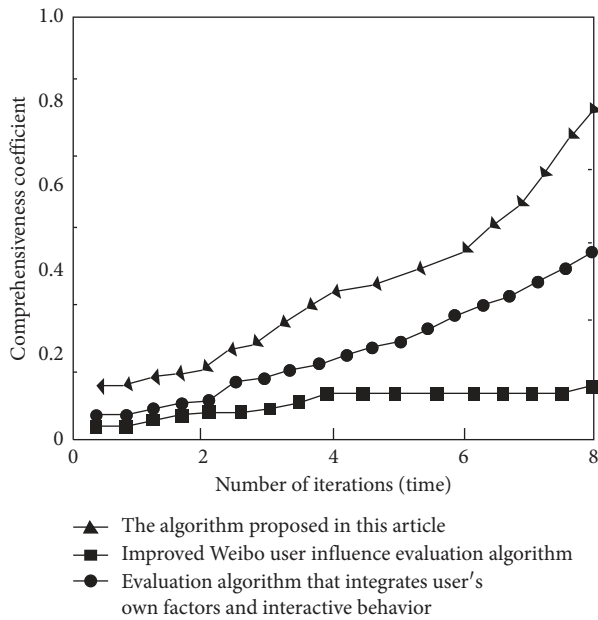


FIGURE 3: Comprehensive comparison of evaluation results.

the number of iterations is less than 2, the evaluation results of the improved Weibo user influence evaluation algorithm and the Weibo user influence calculation method that integrates the user's own factors and interactive behavior are relatively close. The improved Weibo user influence evaluation algorithm has a slightly less comprehensive evaluation effect, and the evaluation effect of the Weibo user influence calculation method that integrates the user's own factors and interactive behavior is second. This shows that the algorithm in this paper can effectively improve the comprehensiveness of the impact evaluation results, and the evaluation results can provide references for corporate network marketing.

(2) *Accuracy of Evaluation Results.* In order to better compare the evaluation effects of different methods, the accuracy of the evaluation results is used as an experimental indicator, and the algorithm in this paper is compared with the traditional method. The result is shown in Figure 4.

According to the experimental results shown in Figure 4, the three methods have different accuracy of evaluation results in the experiment. The accuracy of the evaluation results of the improved microblog user influence evaluation

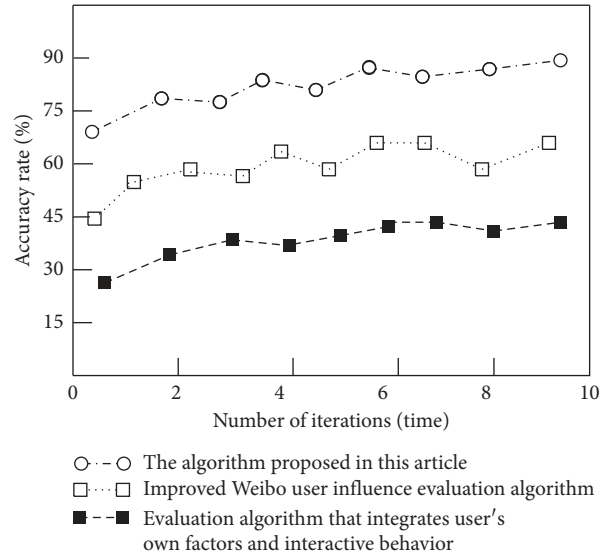


FIGURE 4: Comparison of the accuracy of evaluation results.

algorithm and the microblog user influence calculation method integrating users' own factors and interactive behavior is significantly lower than that of this algorithm, which shows that the evaluation results of this algorithm are more ideal. The experimental data verify that this algorithm meets the practical application requirements in this field.

(3) *Number of Marketing Advertisements Being Forwarded.* In order to further compare the evaluation effects of different methods, the number of forwarded marketing advertisements is taken as the experimental index, and the algorithm in this paper is compared with the traditional method. The results are shown in Figure 5.

According to the analysis of Figure 5, with the increase of the number of iterations, the number of forwarded marketing advertisements under different methods shows a continuously increasing trend. The number of forwarded marketing advertisements under the algorithm in this paper is significantly higher than that of the traditional method, which shows that the evaluation result of the algorithm in this paper is better.

The above three characteristics are also consistent with people's daily cognition, which shows that this algorithm can comprehensively evaluate the influence of social capital on enterprise network marketing and has achieved good results.

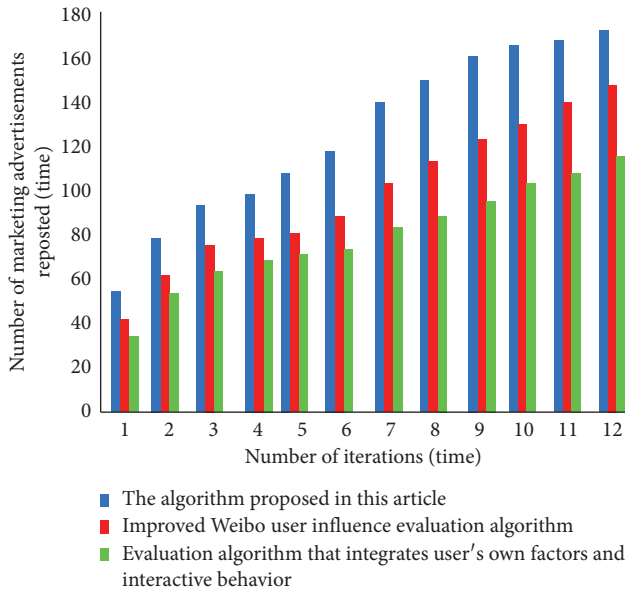


FIGURE 5: Comparison of the number of marketing advertisements being forwarded.

## 5. Conclusion

The Internet is an important platform for enterprises to implement network marketing. With the convenience of the Internet, through the release, dissemination, and interaction of various valuable information, build a controllable social relationship network, integrate and utilize social resources and relationships, and accumulate and use social capital, so as to exert network influence on other users in values, lifestyle, and information selection behavior. This influence plays a vital role in network marketing and the psychological decision-making process from consumers' acceptance of advertising to the implementation of purchase behavior. This paper studies a social capital influence evaluation algorithm for enterprise network marketing. The results show that the evaluation result of the algorithm is accurate and comprehensive, which fully verifies the algorithm's effectiveness.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The author declares that he has no conflicts of interest.

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