

## Research Article

# The Influence of E-Marketing on Performance of Real Estate Enterprises: Based on Super-Efficiency DEA and Grey Entropy Methods

Zhong-Huan Wu <sup>1</sup> and Hong-jie Chen <sup>2</sup>

<sup>1</sup>School of Management, Guangzhou Huashang College, Guangzhou, China

<sup>2</sup>School of Business Administration, South China University of Technology, Guangzhou, China

Correspondence should be addressed to Zhong-Huan Wu; [m18819453269\\_1@163.com](mailto:m18819453269_1@163.com)

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E-marketing is an important tool for real estate enterprises. We evaluate 3 online marketing channels of 44 Chinese real estate companies. Super-efficiency DEA and grey entropy methods are applied to analyse the influence of E-marketing on the performance of real estate enterprises. We find that E-marketing will affect the business performance of real estate companies. Real estate company managers should adopt more strategies to improve corporate performance.

## 1. Introduction

The Internet is a basic marketing tool, which has brought many new opportunities. To gain more competitive advantage in the market, many enterprises have established their websites and APPs and promoted it through social networks. In the online market, E-marketing is very helpful to the company's performance growth and development [1]. An efficient operating model [2] absorbing external information and knowledge [3], managing customer relationships [4, 5], and exploring other market information [6] can improve the performance of enterprises. Merono-Cerdan and Soto-Acosta [7] evaluated 228 Spanish firms and found a positive relationship between web content and firm performance. Despite these findings, other research has produced mixed results concerning the relationship between Internet marketing and firm performance. Shang et al. [8] found that there are no significant differences in efficiency owing to different e-commerce adoption statuses.

As a main industry in China, real estate enterprises have employed the online marketing and spend millions on E-marketing. It is increasingly important to the operation and development of enterprises, and the evaluation of

E-marketing performance also attaches great practical significance to companies. What is the relationship between E-marketing and real estate enterprises performance? What are the effects of online marketing between different channels? Whether the E-marketing can be the strategic resource of the enterprises? In this paper, we will try to explore whether real estate companies' E-marketing can influence operation performance using the data envelopment analysis (DEA). The study first constructs a new variable IMT to evaluate Internet marketing for Chinese real estate enterprises. Next, we study the impact of IMT on the performance of real estate enterprises in two scenarios. Thirdly, we use the grey entropy method to sort the four inputs. Finally, to further study the influencing factors of IMT, we bring the six attributes of IMT into the DEA model.

The paper is organized as follows. In the next section, we motivate our work by reviewing some related works in the literature. In Section 3, we present the methodology we use in this paper. Section 4 will design the research and set out the data collected related to the real estate companies we study. We will present the results obtained in Section 5. Finally, we draw some conclusions and put some future research in Section 6.

## 2. Literature Review

**2.1. Internet Marketing.** In recent years, E-marketing is becoming popular in academia. The study mostly focuses on the following three areas: (1) the subject of Internet marketing; (2) Internet marketing focuses on industry research; (3) the elements of Internet marketing. Firstly, the subject of Internet marketing mostly focused on consumers, especially the searching behaviour of consumers. Information search plays a very critical role in consumer decision-making. A large amount of information can be obtained online. Optimizing search becomes a hot topic. For example, Ghose et al. [9] proposed a structured econometric model to understand consumer preferences and then improve the user experience of social media. Du et al. [10] established a hierarchical Bayesian model to study how keyword categories and matching types affect customer. Secondly, Internet marketing research on the industry mainly focuses on online word-of-mouth. For example, in book industry, Chevalier and Mayzlin [11] found an improvement in book's reviews that lead to an increase in relative sales at that site. Jeong and Chung [12] have proved that the film has a greater sense of confidence in word of mouth information and influences consumers' choice. And, in the restaurant industry, the financial impact of online customer reviews in the restaurant industry and the restaurant eWOM (review volume and review rating) contributed to restaurant profitability [13]. Thirdly, there are more literature on the attributes of online marketing research focusing on user satisfaction and emotional analysis [14, 15].

Above all, research subject of Internet marketing is mostly related to consumer and rarely from the E-marketing implementer. And, there are few literature on elements of Internet marketing, such as the online information, online transactions, and online interaction. We will study Internet marketing from the provider of network marketing and put the network information, online transactions, and other network interaction factors into the evaluation system.

**2.2. Real Estate Performance Measurement.** Performance measurement refers to the relationship between inputs and outputs. Evaluating organizational efficiency units is usually difficult, especially when the inputs (resources and costs) and outputs (services and products) are multiple variables [16]. Data envelopment analysis (DEA) is a nonparametric method to empirically measure the relative efficiency of multiple decision-making units (DMU). It is a valuable analysis tool for performance evaluation. DEA can analyse and quantify the efficiency of each DMU without a specific function. El-Mashaleh et al. [17] used data envelopment analysis (DEA) to establish a benchmark for evaluating the

construction company performance. Some scholars also have modified previously established benchmark models, such as Fisher et al., Hudson, and Construction Industry Association (2000). Horta et al. [18] used DEA to evaluate a web-based job performance. The performance indicators are organizational performance indicators (productivity, profitability, accident rate, and unchecked invoices) and operational performance indicators (contractor-customer cooperation, contractor's satisfaction with payment, and contractor satisfaction with cooperation and predictability of cost). These may be proved to be a benchmark to improve their organization management. Tsolas [19] also integrated DEA and ratios to evaluate construction companies' performance in profitability and effectiveness. Jia-Jane et al. (2011) used DEA and grey entropy to study the influence of E-marketing on hotel performance. There are few literature studies on the impact of Internet marketing on the performance of real estate enterprises by DEA.

## 3. Research Methods

**3.1. DEA.** The DEA model (also known as the CCR model) is first proposed by Charnes, Cooper, and Rhodes [20]. By using the linear planning method, the relative efficiency of the same type (DMU) is measured. Each DMU has multiple inputs and outputs. The unit of a high-efficiency DMU is 1.0, and the low-efficiency DMU is less than 1.0. DEA is a nonparametric analysing method and need not make any assumptions.

Suppose that we want to calculate a set of  $n$  decision-making units (DMUs); the DMUs may be hospitals, government departments, enterprises, or schools. The technical efficiency of  $n$  DMUs is recorded as  $DMU_j$  ( $j = 1, 2, 3, \dots, n$ ), and each DMU has  $m$  inputs, denoted as  $x_j$  ( $i = 1, 2, 3, \dots, m$ ), and the weight of the input is expressed as  $v_i$  ( $i = 1, 2, 3, \dots, m$ ); each DMU has  $q$  outputs, denoted as  $y_i$  ( $i = 1, 2, 3, \dots, q$ ), and the weight of the output is expressed as  $u_i$  ( $i = 1, 2, 3, \dots, q$ ). The DMU measured is denoted as  $DMU_k$ , and its output-input ratio is

$$h_k = \frac{u_1 y_{1k} + u_2 y_{2k} + \dots + u_q y_{qk}}{v_1 x_{1k} + v_2 x_{2k} + \dots + v_m x_{mk}} = \frac{\sum_{r=1}^q u_r y_{rk}}{\sum_{i=1}^m v_i x_{ik}}, \quad (u \geq 0; v \geq 0). \quad (1)$$

The efficiency value  $\theta_j$  obtained by the weight (1) is limited to the interval  $[0, 1]$ :

$$\frac{\sum_{r=1}^q u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1. \quad (2)$$

Formula (2) is the input-oriented CCR model, and the nonlinear planning

$$\begin{aligned}
 & \max \frac{\sum_{r=1}^q u_r y_{rk}}{\sum_{i=1}^m v_i x_{ik}} \\
 & \text{s.t. } \frac{\sum_{r=1}^n u_r y_{rj}}{\sum_{i=1}^m v_i x_{ij}} \leq 1, \\
 & \sum_{i=1}^m v_i x_{ik} = 1, \\
 & u \geq 0, v \geq 0, \\
 & i = 1, 2, \dots, m, \\
 & j = 1, 2, \dots, n, \\
 & r = 1, 2, \dots, q,
 \end{aligned} \tag{3}$$

The purpose of formula (3) is to maximize the efficiency of DMU, and all efficiency values do not exceed 1. The nonlinear planning formula with infinite optimal solutions is a problem. Therefore, formula (3) is transformed into an equivalent linear planning formula:

$$\begin{aligned}
 & \max \sum_{r=1}^q u_r y_{rk} \\
 & \text{s.t. } \sum_{r=1}^q u_r y_{rj} \leq \sum_{i=1}^m v_i x_{ij}, \\
 & \sum_{i=1}^m v_i x_{ik} = 1, \\
 & u \geq 0, v \geq 0, \\
 & i = 1, 2, \dots, m, \\
 & r = 1, 2, \dots, q, \\
 & j = 1, 2, \dots, n.
 \end{aligned} \tag{4}$$

Formula (4) is the input-oriented CCR model to find the solution of  $DMU_k$ .

**3.2. Super-Efficiency DEA.** Most DEA models (such as CCR and BCC) [20] cannot provide efficient DMU [21]. And, Banker and Gifford removed the DMU, evaluated from the reference, and developed a super-efficient DEA model to find the efficient DMU.

In the super-efficiency model, the value can be greater than or equal to 1, and the model is not affected by the marginal effects produced by other enterprises. It can measure the input-output ratio well. Therefore, we will use the super-efficiency model to analyse the technical efficiency of real estate companies. The super-efficiency DEA model of  $DMU_s$  is

$$\begin{aligned}
 & \max \sum_{r=1}^q u_{rk} y_{rk} \\
 & \text{s.t. } \sum_{\substack{r=1 \\ r \neq k}}^q u_{rj} y_{rj} \leq \sum_{i=1}^m v_{ij} x_{ij}, \\
 & \sum_{i=1}^m v_{ik} x_{ik} = 1, \\
 & i = 1, 2, \dots, m, \\
 & r = 1, 2, \dots, q, \\
 & j = 1, 2, \dots, n.
 \end{aligned} \tag{5}$$

**3.3. Grey Entropy.** Grey entropy analysis is one of the good tools for factor analysis, especially suitable for multifactor analysis where the data distribution cannot be described by common probability distributions. There are many improved versions, but the common feature of these versions is used to calculate the average point-by-point grey correlation coefficient. The grey entropy was proposed by Wen et al. [22] and Wang et al. [23]. It introduces the nature of entropy to improve the lack of grey relation.

Let  $X$  be a factor set of grey relation, and one sequence can be denoted as

$$x_i = (x_i(1), x_i(2), x_i(3), \dots, x_i(k)), \tag{6}$$

where  $i = 0, 1, 2, \dots, m$  and  $k = 1, 2, \dots, n$ .

Compute the summation of each attribute's value for all sequences (AGO):

$$D_k: D_k = \sum_{i=1}^m x_i(k). \tag{7}$$

Compute the normalization coefficient  $K$ :

$$K = \frac{1}{(e^{0.5} - 1)n}, \tag{8}$$

where  $n$  represents the number of attributes.

Find the entropy for the specific attribute  $e_k$ :

$$e_k = K \sum_{i=1}^m W_e(z_i), \tag{9}$$

where,

$$\begin{aligned}
 W_e(z_i) &= z_i e^{(1-z_i)} + (1-z_i) e^{z_i} - 1, \\
 z_i &= \frac{x_i(k)}{D_k}.
 \end{aligned} \tag{10}$$

Compute the total entropy value  $E$ :

$$E = \sum_{k=1}^n e_k. \quad (11)$$

Determine the relative weighting factor  $\lambda_k$ :

$$\lambda_k = \frac{1}{n - E} (1 - e_k). \quad (12)$$

The normalized weight of each attribute can be calculated as

$$\beta_k = \frac{\lambda_k}{\sum_{i=1}^n \lambda_i}. \quad (13)$$

## 4. Performance of Internet Marketing and Research Design

### 4.1. The Conceptual Framework of Internet Marketing Tools.

The inputs and outputs of DEA are all quantitative variables, and the impact of the qualitative variable of Internet marketing is unknown. Therefore, we will add Internet marketing tools (IMT) as a qualitative variable to evaluate performance. Angel and Nath [24] developed a conceptual framework to evaluate Internet marketing strategies with three dimensions: electronic information, communication, and transaction. Our framework was built upon the work of Angel and Nath [24] and Cherif and Grant [25], covering effective real estate company website design and E-marketing [26, 27].

IMT is a qualitative variable. There are three first-level indicators, 6 second-level indicators, and 26 third-level indicators. The information includes 3 second-level indicators (1. company information. 2. Real estate information. 3. Promotions), communication includes 2 second-level indicators (1. interaction. 2. Multilingual capabilities), and transaction includes a second-level indicator (online trading). And, the second-level indicators are divided into 6 groups:

- (1) Company information includes 6 third-level evaluation indicators: company introduction; photos of company features; financial statements; employment opportunities; relevant business information; new media links
- (2) Real estate information includes 6 third-level evaluation indicators: availability price information; 3D tour; real estate introduction; real estate address; surrounding facilities; transportation
- (3) Promotion includes 3 third-level evaluation indicators: any promotion mentioned; up-to-date information; banner advertisement
- (4) Interaction includes 5 third-level evaluation indicators: contact details; customer service centre; online comments; suggestion feedback; search capabilities
- (5) Multilingual capabilities includes 3 third-level evaluation indicators: simplified Chinese; English; others

- (6) Online transactions includes 3 third-level evaluation indicators: online appointment; online shopping mall; online payment

4.2. *Data Collection.* The E-marketing evaluation, a structured form, consisting of 44 companies, was developed to access the contents of the three marketing channels for real estate companies in China.

The data is divided into two parts: (1) IMT data comes from the public annual reports or the websites and new media platforms (Table 1 shows the content evaluation of Internet marketing tools); (2) input-output data of 44 companies comes from the CREIS in 2019. And, we also use special reports and annual data from companies to ensure the confidence of data (the data are shown in Table 2).

4.3. *Research Steps.* Firstly, we develop a structured evaluation form (IMT) with 26 evaluation indicators in 3 online marketing channels (website, WeChat official account, and Applet). There are 78 elements in the table, and each element is measured by a binary variable (0 or 1), which represents whether or not a company has the particular marketing feature. "IMT" contains 78 indicators to check whether the real estate websites or new media provide certain features or services, and each item is 0 or 1. The statistical results are to assess the current usage of network marketing tools. However, there are no new media links on WeChat official account and Applet, and the total score is 76 points.

Second, construct the super-efficiency DEA model. The three basic inputs that generate profit are the area of land acquired, the amount of land acquired, and the number of employees, and the two outputs, sales area and sales amount, represent most of company revenue. To test the relationship between Internet marketing and the performance, we add "Internet marketing tools" (IMT) as the fourth input to the super-efficiency DEA model. Among these inputs and outputs, only the IMT is a composed variable and a qualitative variable. The super-efficiency DEA evaluation model is shown in Figure 1.

At last, analyse the data obtained with three methods: super-efficiency DEA, paired-sample *t*-test, and grey entropy method. First, the super-efficiency DEA model is employed to calculate the relative efficiency of 44 real estate companies for two scenarios (A and B). The outputs of two scenes are the same (sales area and sales amount), but the inputs of scenarios A and B are different, and the difference is that IMT is added to scenario B. Next, the paired-sample *t*-test is used to test the difference between two scenarios. Then, grey entropy is employed to calculate the weighting of four inputs, and it represents the relations between enterprises performance and E-marketing characteristics. Finally, to explore the impact of various attributes of IMT, we put 6 attributes (company information, real estate information, promotion, interaction, multilingual capabilities, and online transactions) to the super-efficiency DEA model.

The research steps are shown in Figure 2.

TABLE 1: Conceptual framework of Internet marketing tools for real estate companies.

Marketing features	Category	Items	References
Information	Company information	Company introduction; photos of company features; financial statements; employment opportunities; relevant business information; new media links	Meroño-Cerdan and Soto-Acosta [7]; Cherif & Grant. [25]; Ullah et al. [26]; Ipoo et al. [28]; Shuai and Wu [27]
	Real estate information	Availability price information; 3D tour; real estate introduction; real estate address; surrounding facilities; transportation	
	Promotion	Any promotion mentioned; up-to-date information; banner advertisement	
Communication	Interaction	Contact details; customer service center; online comments; suggestion feedback; search capabilities	
	Multilingual capabilities	Simplified Chinese; English; others	
Transaction	Online transactions	Online appointment; online shopping mall; online payment	

TABLE 2: The input-output data of real estate enterprises in 2019.

DMU	Amount of land acquired	Area of land acquired	The number of employees	IMT	Sales amount	Sales area
DMU1	1610.00	2996.00	131505	47	6260.30	4035.90
DMU2	1303.00	4253.00	101784	41	7715.00	8630.30
DMU3	1034.00	813.00	6200	26	3371.20	1787.10
DMU4	1000.00	1965.00	50834	30	5556.00	3808.50
DMU5	813.00	1328.00	46518	13	2425.00	1367.00
DMU6	804.00	3577.00	39091	32	3880.00	3420.00
DMU7	759.00	1011.00	24107	21	2425.00	1432.00
DMU8	644.00	1055.00	34227	28	2106.00	1077.50
DMU9	569.00	495.00	7418	40	2001.00	1055.70
DMU10	521.00	768.00	49014	23	2205.50	1130.00
DMU11	517.00	803.00	11370	32	1608.10	748.40
DMU12	493.00	1688.00	28058	33	2747.80	2436.90
DMU13	472.00	1132.00	13693	31	1526.00	1582.30
DMU14	459.00	847.00	7870	41	2090.00	1261.00
DMU15	437.00	2138.00	131694	40	6205.60	5990.90
DMU16	411.00	1307.00	22812	26	1803.40	1968.90
DMU17	405.00	828.00	16420	20	1980.20	550.40
DMU18	377.00	806.00	9414	26	870.80	681.60
DMU19	343.00	492.00	1092	20	434.50	245.60
DMU20	338.00	581.00	286242	31	1002.00	742.20
DMU21	327.00	293.00	13658	33	347.60	185.40
DMU22	323.00	654.00	14413	38	1011.40	1011.70
DMU23	313.00	391.00	1902	41	1607.00	1058.60
DMU24	312.00	768.00	38313	38	1185.10	893.70
DMU25	309.00	428.00	18540	40	678.20	363.20
DMU26	303.00	1097.00	17378	14	1219.00	1285.70
DMU27	292.00	663.00	26779	20	1510.00	1366.80
DMU28	289.00	367.00	2999	30	1037.80	696.60
DMU29	268.00	825.00	24054	20	1207.50	1149.90
DMU30	257.00	453.00	10854	22	2607.80	1470.60
DMU31	253.00	400.00	7566	8	922.70	401.40
DMU32	247.00	310.00	6698	33	783.60	532.40
DMU33	200.00	201.00	7537	35	751.20	488.70
DMU34	191.00	355.00	9462	23	758.00	274.10
DMU35	184.00	248.00	11400	42	861.00	492.40
DMU36	181.00	182.00	62305	28	808.00	316.30
DMU37	180.00	646.00	62305	39	1381.90	1360.90
DMU38	170.00	401.00	3488	25	1174.70	1076.30
DMU39	166.00	381.00	11631	20	610.40	381.30

TABLE 2: Continued.

DMU	Amount of land acquired	Area of land acquired	The number of employees	IMT	Sales amount	Sales area
DMU40	154.00	411.50	2059	33	1020.00	376.70
DMU41	152.00	210.00	17100	28	923.50	648.90
DMU42	144.00	177.00	11571	19	468.00	254.00
DMU43	87.00	219.00	16723	27	1180.60	1178.50
DMU44	338.45	480.00	3527	19	921.20	91.50

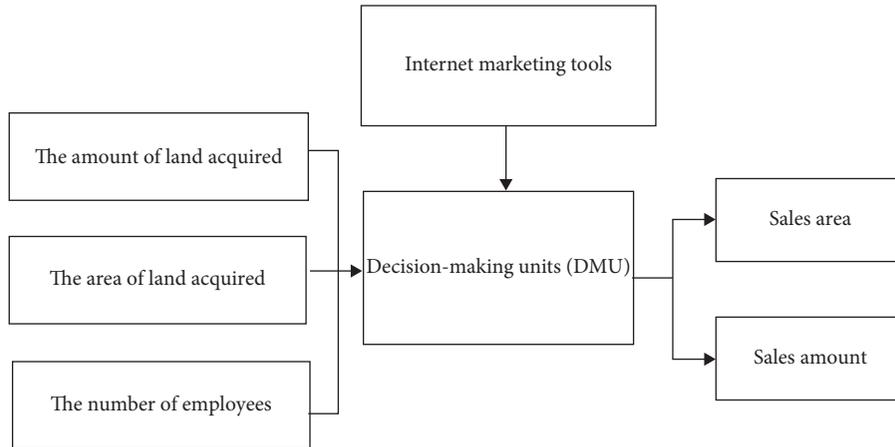


FIGURE 1: Super-efficiency DEA evaluation model.

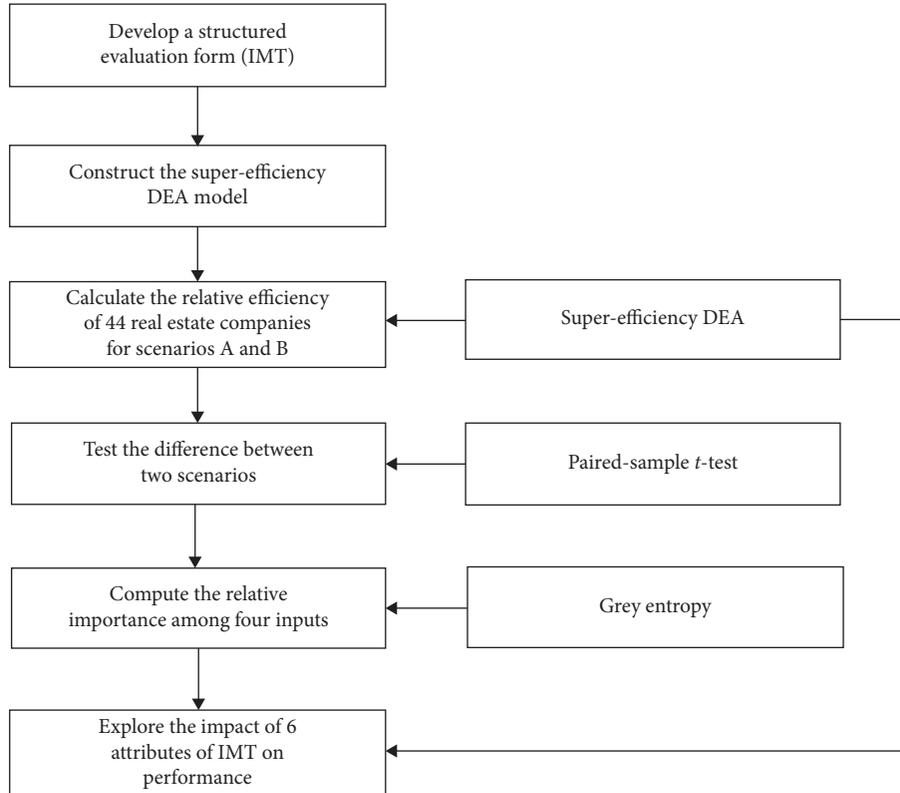


FIGURE 2: Research steps.

## 5. Results and Discussion

*5.1. Internet Marketing Tools Analysis.* Internet marketing tools (IMT) evaluate the online marketing content, services, and features of 44 real estate enterprises (as shown in Table 3). There are three marketing channels for evaluation: websites, WeChat official accounts, and Applets. In 44 real estate companies, 42 enterprises own websites, 41 enterprises have WeChat official accounts, 35 enterprises have Applets, and 32 enterprises have three marketing channels.

Website marketing is mature, focusing on company information, promotion, and interaction; more than 95% of companies on the site will introduce the company and related business. Perhaps, a self-operated website provides a complete introduction to improve the corporate brand image. The maturity of WeChat official account and Applet is similar, but their marketing focuses are different. WeChat official account, which focuses on company information, promotion, and interaction, is a platform for displaying the overview of the company, introducing the main products and communicating with consumers. The Applet focuses on buildings information, promotion, and online transaction. Traditionally, real estate sales are offline, but Applets broke this marketing model. It can show various listings information online, including price, surrounding environment, traffic, and location. When the clients see the property through Applets, then they can make an appointment and pay a deposit to see the house. The applet is a good promotional channel for companies.

The 3D tour indicator and the online trading indicator in the “real estate information” have a lower score. Due to the particularity of real estate products, it is difficult to achieve transactions online. With the development of virtual technology, it can simulate or restore “real” houses and build a virtual 3D stereoscopic environment to help buyers see the overall environment for real time. This function deserves to be paid attention by the manager.

*5.2. The Super-Efficiency DEA and Grey Entropy Analysis.* To evaluate whether IMTs improve the performance, the data analysis is performed through DEA and grey entropy. First, the super-efficiency DEA model calculates the relative efficiency of 44 real estate companies in the two cases (A and B). Scenario A consists of three inputs (amount of land acquired, area of land acquired, and number of employees) and two outputs (sales area and sales amount), while scenario B consists of four inputs (amount of land acquired, area of land acquired, number of employees, and IMTs) and same outputs. As shown in Table 4, Score 1 is the relative efficiency of scenario A and Score 2 is the relative efficiency of scenario B. The average value of Score 2 is 80.68%, which is higher than the average value of Score 1 of 64.10%. The difference is 16.58%, a big difference. The efficiency difference between Scores 1 and Scores 2 is tested by the paired-sample *t*-test, and the result of the paired-sample *t*-test reached a significant level ( $t$  value =  $-0.4966$ ,  $df = 44$ , and two-tailed significance  $< 0.001$ ). We believe that there is a positive correlation between Internet marketing tools and

real estate company performance; in other words, the E-marketing can advance real estate company's performance. Given the increasing popularity of new media, managers should take full advantage of it. For large-scale companies, they should increase investment in E-marketing and develop new online marketing models. For small and medium enterprises, they can choose low-cost channels or third-party platforms for E-marketing.

Secondly, we use grey entropy to find the weighting of four inputs. For the grey entropy is an objective weighting technique with strict rules and requirement, we employ it to calculate the relative weighting of four inputs, and the results show that the IMT is 0.9959, which is slightly lower than the area of land acquired (0.9984), followed by the amount of land acquired (0.9956) and the number of employees (0.9905). Although the best performer to real estate performance is the area of land acquired rather than IMT, the weight of IMT is not too different from these three inputs. In fact, the network marketing has become the essential investment for real estate companies. Real estate company managers should adopt more strategies to improve corporate performance.

*5.3. Attributes in Internet Marketing Tools Analysis.* To explore the impact of various attributes of IMT (shown as Table 1), we put 6 attributes (company information, real estate information, promotion, interaction, multilingual capabilities, and online transactions) to the super-efficiency DEA model, and the results are shown in Table 5. There are 7 real estate companies whose efficiency of company information, real estate information, promotion, interaction, and multilingual capabilities are greater than 1, including DMU3, DMU15, DMU23, DMU30, DMU38, DMU40, and DMU43. The average efficiency value of six attributes is higher than Score 1 (Table 4), so we believe that six attributes have a positive impact on the performance of real estate companies. The various attributes affecting the performance of companies in the descending order are online transactions, real estate information, interaction, company information, and multilingual capabilities and promotions.

“Online transaction” shows that a customer has a certain degree of loyalty to the real estate company. It can promote user's willingness to buy and is benefitted from output. From the three dimensions of online transaction, we make the following recommendations: (1) real estate enterprises pay attention to this function and make its identification to be clear, while simplifying the process; (2) online shopping malls can put on shelves some characteristic or peripheral products, increase consumers' online experience, and thus change consumers' stereotyped image of the company; (3) expand the channels of payment while ensuring payment security.

“Interactive function” reflects the interaction with users. There are five subattributes: contact details, online comments, suggestion feedback, keyword search, and customer service centre. In Table 3, to facilitate users to contact the company, most companies have contact details in each channel. And, the popularity of keyword search is high, for

TABLE 3: Content evaluation of Internet marketing tools.

First-level indicators	Second-level indicators	Evaluation content	Website		WeChat official account		Applet		
			N (42)	Percentage (%)	N (41)	Percentage (%)	N (35)	Percentage (%)	
Information	Company information	Company introduction	42	95.45	30	68.18	14	31.82	
		Photos of company features	34	77.27	23	52.27	13	29.55	
		Financial statements	27	61.36	27	61.36	2	4.55	
		Employment opportunities	40	90.91	21	47.73	3	6.82	
		Relevant business information	42	95.45	32	72.73	13	29.55	
		New media links	38	86.36	—	—	—	—	
	Buildings' information	Availability price information	6	13.64	3	6.82	28	63.64	
		3D tour	0	0.00	4	9.09	17	38.64	
		Building introduction	32	72.73	24	54.55	26	59.09	
		Surrounding facilities	15	34.09	9	20.45	28	63.64	
	Promotion	Real estate address	31	70.45	18	40.91	30	68.18	
		Transportation	16	36.36	5	11.36	25	56.82	
		Any promotion mentioned	0	0.00	9	20.45	22	50.00	
		Up-to-date information	40	90.91	36	81.82	25	56.82	
	Communication	Interaction	Banner advertisement	34	77.27	5	11.36	30	68.18
			Contact details	40	90.91	20	45.45	35	79.55
Online comments			1	2.27	41	93.18	3	6.82	
Suggestion feedback			15	34.09	4	9.09	5	11.36	
Multilingual capabilities		Search capabilities	27	61.36	41	93.18	24	54.55	
		Customer service center	13	29.55	8	18.18	7	15.91	
		Simplified Chinese	23	52.27	0	0.00	0	0.00	
		English	27	61.36	1	2.27	0	0.00	
		Others	0	0.00	0	0.00	0	0.00	
		Transaction	Online transactions	Online appointment	4	9.09	0	0.00	19
Online shopping mall	0			0.00	8	18.18	11	25.00	
Online payment	0			0.00	6	13.64	13	29.55	

TABLE 4: DEA model results.

DMU	Input 1	Input 2	Input 3	Output 1	Output 2	Input 4 (IMT)	Scores 1 (%)	Scores 2 (%)
DMU 1	1610.00	2996.00	131505	6260.30	4035.90	47	36.76%	72.95%
DMU2	1303.00	4253.00	101784	7715.00	8630.30	41	75.68%	152.31%
DMU 3	1034.00	813.00	6200	3371.20	1787.10	26	95.37%	176.92%
DMU 4	1000.00	1965.00	50834	5556.00	3808.50	30	57.94%	116.80%
DMU 5	813.00	1328.00	46518	2425.00	1367.00	13	31.72%	99.20%
DMU 6	804.00	3577.00	39091	3880.00	3420.00	32	58.12%	86.33%
DMU 7	759.00	1011.00	24107	2425.00	1432.00	21	43.30%	72.76%
DMU 8	644.00	1055.00	34227	2106.00	1077.50	28	34.68%	52.27%
DMU 9	569.00	495.00	7418	2001.00	1055.70	40	81.13%	81.13%
DMU10	521.00	768.00	49014	2205.50	1130.00	23	49.88%	69.72%
DMU11	517.00	803.00	11370	1608.10	748.40	32	42.21%	48.02%
DMU12	493.00	1688.00	28058	2747.80	2436.90	33	64.53%	78.96%
DMU13	472.00	1132.00	13693	1526.00	1582.30	31	50.12%	75.41%
DMU14	459.00	847.00	7870	2090.00	1261.00	41	67.50%	73.99%
DMU15	437.00	2138.00	131694	6205.60	5990.90	40	104.65%	177.04%
DMU16	411.00	1307.00	22812	1803.40	1968.90	26	61.41%	78.52%
DMU17	405.00	828.00	16420	1980.20	550.40	20	49.19%	71.34%
DMU18	377.00	806.00	9414	870.80	681.60	26	30.37%	42.42%
DMU19	343.00	492.00	1092	434.50	245.60	20	47.09%	50.45%
DMU20	338.00	581.00	286242	1002.00	742.20	31	30.79%	36.32%

TABLE 4: Continued.

DMU	Input 1	Input 2	Input 3	Output 1	Output 2	Input 4 (IMT)	Scores 1 (%)	Scores 2 (%)
DMU21	327.00	293.00	13658	347.60	185.40	33	20.61%	20.61%
DMU22	323.00	654.00	14413	1011.40	1011.70	38	47.58%	49.00%
DMU23	313.00	391.00	1902	1607.00	1058.6	41	187.20%	187.20%
DMU24	312.00	768.00	38313	1185.10	893.70	38	31.69%	33.87%
DMU25	309.00	428.00	18540	678.20	363.20	40	27.53%	27.53%
DMU26	303.00	1097.00	17378	1219.00	1285.70	14	53.86%	74.30%
DMU27	292.00	663.00	26779	1510.00	1366.80	20	52.20%	71.46%
DMU28	289.00	367.00	2999	1037.80	696.60	30	67.17%	69.96%
DMU29	268.00	825.00	24054	1207.50	1149.90	20	46.64%	57.90%
DMU30	257.00	453.00	10854	2607.80	1470.60	22	143.54%	170.25%
DMU31	253.00	400.00	7566	922.70	401.40	8	43.35%	75.50%
DMU32	247.00	310.00	6698	783.60	532.4	33	52.39%	52.39%
DMU33	200.00	201.00	7537	751.20	488.70	35	65.80%	65.80%
DMU34	191.00	355.00	9462	758.00	274.10	23	38.48%	38.48%
DMU35	184.00	248.00	11400	861.00	492.40	42	60.38%	60.38%
DMU36	181.00	182.00	62305	808.00	316.30	28	77.12%	77.12%
DMU37	180.00	646.00	62305	1381.90	1360.90	39	55.51%	55.51%
DMU38	170.00	401.00	3488	1174.70	1076.30	25	146.67%	146.67%
DMU39	166.00	381.00	11631	610.40	381.30	20	34.10%	34.21%
DMU40	154.00	411.50	2059	1020.00	376.70	33	107.78%	107.78%
DMU41	152.00	210.00	17100	923.50	648.90	28	78.05%	78.05%
DMU42	144.00	177.00	11571	468.00	254.00	19	45.93%	45.93%
DMU43	87.00	219.00	16723	1180.60	1178.50	27	177.12%	177.12%
DMU44	338.45	480.00	3527	921.20	91.50	19	47.13%	60.27%
Mean	430.67	896.44	32310	1890.67	1357.20	28	64.10%	80.68%

TABLE 5: Evaluate the effect of attributes.

DMU	Company information	Real estate information	Promotions	Interaction	Multilingual language	Online transactions
DMU 1	93.10%	62.00%	61.99%	61.12%	39.99%	48.58%
DMU2	152.51%	141.22%	163.87%	126.01%	93.41%	95.92%
DMU 3	150.70%	186.25%	202.57%	169.81%	197.92%	157.13%
DMU 4	101.64%	108.56%	77.68%	136.29%	60.94%	79.87%
DMU 5	57.88%	80.02%	46.75%	100.00%	31.72%	66.80%
DMU 6	83.15%	95.15%	71.87%	96.85%	69.89%	71.51%
DMU 7	63.97%	72.02%	67.48%	63.82%	43.31%	62.48%
DMU 8	51.79%	49.91%	34.68%	48.50%	34.68%	73.22%
DMU 9	81.66%	81.87%	81.13%	81.13%	81.13%	81.13%
DMU10	78.44%	66.14%	49.88%	53.69%	49.88%	96.53%
DMU11	50.57%	46.96%	45.36%	49.29%	42.21%	76.14%
DMU12	78.88%	82.52%	76.47%	83.08%	76.60%	65.99%
DMU13	71.76%	77.32%	65.62%	85.45%	69.69%	58.29%
DMU14	73.24%	76.05%	71.34%	74.51%	68.48%	74.53%
DMU15	204.32%	125.86%	142.20%	185.70%	186.21%	236.75%
DMU16	67.92%	85.65%	75.14%	88.77%	74.15%	117.74%
DMU17	69.53%	79.30%	50.13%	56.16%	49.76%	117.05%
DMU18	34.79%	53.33%	37.61%	39.76%	34.92%	59.40%
DMU19	59.46%	47.09%	49.64%	47.20%	78.03%	49.37%
DMU20	37.89%	34.48%	30.79%	38.64%	31.53%	43.44%
DMU21	20.61%	20.61%	20.61%	20.61%	20.61%	29.90%
DMU22	48.43%	54.12%	48.33%	48.63%	48.39%	47.58%
DMU23	187.20%	187.20%	187.20%	187.20%	187.20%	187.20%
DMU24	35.09%	32.09%	32.10%	36.05%	32.59%	36.79%
DMU25	27.53%	27.53%	27.53%	27.53%	27.53%	27.53%
DMU26	64.22%	77.47%	69.03%	70.41%	74.15%	90.41%
DMU27	62.19%	99.26%	64.92%	65.00%	81.80%	124.18%
DMU28	69.37%	77.25%	67.17%	67.76%	77.71%	120.56%
DMU29	52.13%	65.20%	55.53%	56.60%	74.98%	91.06%
DMU30	169.31%	157.01%	185.96%	168.87%	232.93%	148.93%

TABLE 5: Continued.

DMU	Company information	Real estate information	Promotions	Interaction	Multilingual language	Online transactions
DMU31	45.89%	100.00%	100.00%	59.28%	46.73%	85.82%
DMU32	52.39%	52.71%	52.39%	52.39%	55.48%	52.39%
DMU33	65.80%	65.80%	65.80%	65.80%	65.80%	112.95%
DMU34	38.48%	61.68%	38.48%	38.48%	38.48%	46.13%
DMU35	60.38%	60.38%	60.38%	60.38%	60.38%	60.38%
DMU36	77.12%	77.12%	77.12%	77.12%	77.12%	118.83%
DMU37	62.19%	55.51%	55.51%	58.35%	59.73%	58.77%
DMU38	146.67%	146.67%	146.67%	146.67%	146.67%	153.90%
DMU39	34.61%	34.24%	34.10%	34.58%	34.10%	72.79%
DMU40	107.78%	107.78%	107.78%	107.78%	107.78%	108.44%
DMU41	78.05%	78.05%	78.05%	78.05%	95.18%	84.37%
DMU42	45.93%	45.93%	45.93%	45.93%	45.93%	79.36%
DMU43	177.12%	177.12%	177.12%	177.12%	177.12%	177.12%
DMU44	56.25%	61.50%	57.04%	67.98%	66.37%	56.33%
Mean	78.36%	81.23%	76.29%	79.64%	76.12%	88.72%

the users can find information quickly. The other three have lower penetration rates, with the lowest being online comment. Online comment is a communication channel before forming a community. In all the enterprise-owned websites, there is almost no online comment, and the enterprise should add this function.

Real estate information, company information, multilingual capabilities, and promotional activities display the relevant information of enterprises so that users have a basic understanding of enterprises. Table 3 shows that company information is comprehensive, but the indicators of 3D tour and promotion are bad. Real estate enterprises should use 3D tour online because compared to text and pictures, 3D tour is convenient for users to receive information, and they can truly “experience” the environment. Moreover, real estate companies should increase new promotional activities because users or potential consumers can understand companies’ characteristics, achievements, and core products through these activities.

## 6. Conclusion

We have studied the relationship between Internet marketing and operational performance of real estate companies in China and developed real estate Internet marketing tools (IMT) so that the evaluation becomes more comprehensive. And, IMT as a qualitative input was added to the super-efficient DEA model. The results suggest that the Internet marketing tool positively affect firm performance. Furthermore, not only we study the correlation between the Internet marketing and the performance but also study the impact of six attributes of IMT on performance. The results show that six attributes can influence the enterprise performance. Thus, managers should take advantage of full range of features of the Internet to interact with customers rather than simply appearing on the Internet (only information). The companies should increase the investment in online marketing, for example, provide AR guide, increase promotional activities, and build user community, or they can develop new online marketing models. However, the best performer to market real estate performance is the area

of land acquired rather than IMT. Although E-marketing has a positive impact on firm performance, the business focus for real estate companies is to take land.

## Data Availability

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

## Additional Points

*The Limitation.* This study only selects the input-output data in 2019. A longitudinal study could enrich the findings. And, the channels are home-owned channels rather than third-party platforms. We hope that researchers will consider the third-party platforms in the future.

## Conflicts of Interest

The authors declare there are no conflicts of interest regarding the publication of this paper.

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