Network Learning Platform Evaluation System Design and Case Capital Budget

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Abstract: In order to comprehensively evaluate the explosive growth of e-learning platform in recent years, this paper constructs the evaluation system design and case capital budget of e-learning platform on the basis of extensive research, uses analytic hierarchy process (AHP) to construct the judgment matrix of evaluation index, determines the weight of each index, tests the consistency of the judgment matrix, and calculates the weight of secondary index. Based on this index system, an online learning platform in China is analyzed and evaluated. The results show that the evaluation system and method are effective.

1 INTRODUCTION

In the National Medium and Long-term Educational Reform and Development Project Summary (2010-2020) promulgated 2010, the construction of lifelong education system and learning-oriented society is overall planned and the goal of "basic realization of education modernization, basic formation of learning-oriented society and becoming a human resource power" is established [see State council 2010]. E-learning platform is undoubtedly an important carrier in the construction of a learning society, as well as an important means of practicing lifelong education and lifelong learning. In recent years, as internet-study is surging countrywide, various E-learning platforms are emerging.

Scientific and reasonable evaluation on the E-learning platform can improve the customer satisfaction, the quality and efficiency as well as the sustainable and healthy development of the platform. The existing website platform evaluations fall into two categories: the evaluation aims to general website platform and the evaluation aims to specific types of website platform. The researches on the latter mostly focus on the e-commerce website platform evaluation, government website platform evaluation, and university website platform evaluation. However, the researches on the evaluation of E-learning platform websites are rare.

2 RELATIVE STUDY

Currently, the main body of the website platform evaluation mainly includes the evaluation agencies and scholars, whose evaluation criteria are not uniform. Lots of world famous evaluation agencies like comScore, Nile Company, Argus Associate can provide website evaluation services. ComScore [see comScore] is the world's leading internet and digital media data statistic analysis agency. Based on its MediaMetrix index, the agency releases the website traffic rankings, and provides the most comprehensive digital measurement solutions to the industry website. Nile Company [see Nielsen ratings] is a well known American internet market survey and statistics company. The Nielsen ratings system evaluates a website through its navigation, response time, credibility, and content, etc., and provides reference data for a company to formulate its media delivery plan. Argus Associate [see Argus Associate] proposed the evaluation of a website should base on the site resource description, subjective evaluation, design level, organization, and resource guidelines.

Scholars from all over the world put forward website platform evaluation methods from different perspectives. Some view website as a information system and evaluate the site from the perspective of internet information resource. Richmond [see Richmond] proposes "10C" indices for internet information resource evaluation. The "10C" means

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Content, Credibility, Critical thinking, Copyright, Citation, Continuity, Censorship, Connectivity, Comparability and Context. Some evaluate a website from the perspective of usability. Aziz and his team [see Aziz et al.] suggest evaluate a website from the aspects of utility, benefit, learnability, satisfaction, equal accessibility, etc. Ke Qing and her team [see Ke Qing et al.2011] construct an index system to evaluate the usability of the website platform, which includes website size, website quality, website promotion, website assistant function, user emotion and so on. Some evaluate a website from the perspective of user-perception. Pei Ling and her team [see Pei Ling et al. 2009] design a user-oriented measurement site information service quality evaluation system based on the principle of service quality management. The system includes general impression, customer service indices, future forecasts, technical indices, information indices, interface indices and functional indices. While some of the scholars evaluate a website form the perspective of integrity. Gan Liren and his team [see Gan Liren and Cai Lei 2003] evaluate a website from its organization, symbol, website navigation, retrieval system design, etc., based on information architecture (IA) theory. Feng Yingjian [see Feng Yingjian 2016] indicates that a complete corporate website, no matter how complex it is, can be divided into four components: structure, content, function and service, and the website can be evaluated from the four aspects.

The existing evaluation systems are mostly set up from the manager's point of view. Most of them are based on the following foundations: one is the actual data. For example, the resources the site has, the number of students registered (rate), students' participation in learning, course selection status quo, etc., these data are generally provided by the respondents. The other is expert grading. The experts grade every evaluation index according to the grading requirement after the establishment of stratified evaluation index, such as resource type, function provision [see Sun Meng 2015].

3 EVALUATION INDEX SYSTEM AND THE WEIGHT SETTING OF E-LEARNING PLATFORM

This research is based on the four website components scholar Feng Yingjian putting forward-structure, content, function and service. Based on wide investigation and experts interviews and combined with the characteristics of E-learning platform, we set the evaluation index system and the weight of each index by AHP.

3.1 Index System Setting

The evaluation index system built in this thesis includes six primary indices and the corresponding twenty five secondary indices. Show in diagram 1.

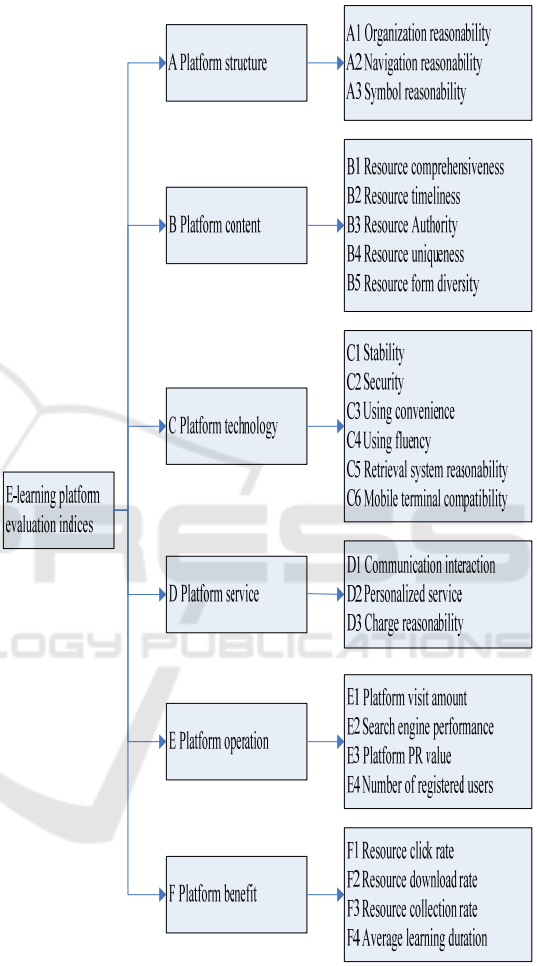

Diagram 1: The Evaluation Index model of E-learning Platform.

3.1.1 Platform Structure

Platform structure reflects the E-learning platform overall structure. It embodies in organization system, navigation system and symbol system. Table 1 is the meaning and key points of evaluation of each index.

Table 1: Platform structure index.

Name of index	Index interpretation	Key points of evaluation
A1 Organization reasonability	The organization system is responsible for the classification of information, and hierarchical division of the website content. It is the basis for building a navigation system.	Whether the organization structure is clear, the classification logic is scientific and reasonable, and whether the hierarchical tree structure is employed in information organization, whether the information guidance is of high efficiency.
A2 Navigation reasonability	Navigation system allows the users to know their location and path. The navigation system is divided into global navigation, local navigation, contextual navigation and supplementary navigation [see Chen Lanjie 2007].	Whether the content of global navigation is comprehensive and the location is consistent. Whether the content of local navigation is comprehensive and the location is consistent. Whether the content of contextual navigation is abundant and relevant. Whether the supplementary navigation is comprehensive and how is the consistency with other navigations.
A3 Symbol reasonability	Symbol is the description of the information represented by navigation elements with an appropriate vocabulary [see Wang Yongfang and Hu Yaolei 2014].	The consistency of symbol; the intelligibility of symbol; the accuracy of symbol.

3.1.2 Platform Content

Platform content is the core and soul of E-earning platform. The assessment of the platform content is reflected in five aspects: comprehensiveness, timeliness, authority, uniqueness, form diversity. Table 2 shows the key points of evaluation of each index.

Table 2: Platform content index.

Name of index	Key points of evaluation
B1 Resource comprehensiveness	Whether the platform is comprehensive or professional, and whether resources type coverage is comprehensive.
B2 Resource timeliness	How is the update frequency of platform resource, whether the content is out of date
B3 Resource authority	Whether the platform resource publishing agency is authoritative. How is the authority level of the content interpreter.
B4 Resource uniqueness	Whether the platform has a certain resource exclusively owned by itself.
B5 Resource form diversity	Resources provide the versions information, such as the video, audio, text, PPT, etc,.

3.1.3 Platform Technology

Platform technology is the guarantee of the normal operation of the network learning platform. It's necessary to consider the following aspects on the technical side: stability, security, using convenience, using fluency, retrieval system reasonability, and mobile terminal compatibility. Table 3 shows the key points of examination of each index.

Table 3: Platform technology index.

Name of index	Key points of evaluation
C1 Stability	With professional maintenance and disaster recovery function; without missing chain and broken chain; can identify human error, with less coding error.
C2 Security	Provide a security platform for the users and resources; maintain and upgrade regularly.
C3 Using convenience	It's easy to use the platform and with high operational efficiency, do not deliberately remember its function and process.
C4 Using fluency	Platform information and resources can be downloaded fast, after corresponding processing, the users feel good.
C5 Retrieval system reasonability	The searching interface is good, with diversify searching forms, fast searching speed, and error correction capability.
C6 Mobile terminal compatibility	With mobile platform, can log in with different kinds of social platform membership accounts.

3.1.4 Platform Service

The network learning platform need interact with learners in order to play its function better. The service of platform embodies in the following three aspects: communication interaction, personalized service, charge reasonability. Table 4 shows the key points of evaluation of each index.

Table 4: Platform service index.

Name of index	Key points of evaluation
D1 Communication interaction	Platform provide the communication interface for the first users to log in, provide the communication platform for learners, such as learning group, forum, etc., provide the communication interface between learners and teachers.
D2 Personalized service	Set up personal learning file for the learners, recommend personalized learning materials. The learners can customize their own learning content.
D3 Charge reasonability	The ratio of the free resource, the price reasonability of the charged resource.

3.1.5 Platform Operation

Platform operation is the guarantee of the sustainable and healthy development of E-learning platform. Platform operation embodies in the visits amount growth, the search engine performance, the platform PR value and the number of registered users. The key points of examination of each index are shown in table 5.

Table 5: Platform operation index.

Name of index	Key points of examination
E1 The visits amount situation	The platform visits amount, the growth rate of PV values in fixed cycle, the amount of independent identity visitors, the quantity of per capita page visit, average page visit depth, the bounce rates.
E2 The performance of search engine	Whether be included by the main search engine and ranks in the front places.
The platform PR value	Whether the PR values or weight are greater than 4.
E4 The number of registered users	The overall number of registered users; the growth rate of registered users.

3.1.6 Platform Benefit

Platform benefit directly reflects the use situation of E-learning platform. It is reflected in the resource click rate, download rate, collection rate and the user average learning duration. The key points of evaluation of each index are shown in Table 6.

Table 6: Platform benefit index.

Name of index	Key points of evaluation
F1 Resource click rate	The click frequency of resource in fixed cycle; the average click duration; the click rate.
F2 Resource download rate	The download frequency of resource in fixed cycle; the download rate.
F3 Resource collection rate	The collection frequency of resource in fixed cycle; the collection rate.
F4 Users average learning duration	The average learning duration of registered users.

3.2 Index Weight Setting

The index weight of this evaluation system was set by AHP based on the investigation. The procedures are as follows:

3.2.1 The Construction of Judgement Matrix

Take the secondary indices under "B Platform Content" as an example. We set the evaluation factors as {B1, B2, …, Bm}, and B represent the target, then the judgement matrix is:

$$B = \begin{pmatrix} b_{11} & b_{12} & \cdots & b_{1m} \\ b_{21} & b_{22} & \cdots & b_{2m} \\ & & \vdots & \\ b_{m1} & b_{m2} & \cdots & bmm \end{pmatrix}$$

In the weight calculation of platform content B (B1, B2, B3, B4, B5), the respondent has to make a judgement on Bi and Bj, to decide which is more important and how much it is important. And the importance of each index is evaluated according to the 1-9 proportion scale [see Qiu Junping 2009] shown in Table 7. The final judgment matrix is given in Table 8.

Table 7: 1-9 Proportion scale.

Scale b_{ij}	Meaning
1	The two factors have the same importance
3	Factor i is slightly important than factor j
5	Factor i is obviously important than factor j
7	Factor i is strongly important than factor j
9	Factor i is extremely important than factor j
2,4,6,8	The median of the two adjacent judgments
Reciprocal	b_{ji} refers to the comparative judgment of factor i and j, there are $b_{ji}=1/b_{ij}$

Table 8: "B platform content" judgement matrix.

B platform content	B1 Resource comprehensiveness	B2 Resource timeliness	B3 Resource Authority	B4 Resource uniqueness	B5 Resource form diversity
B1 Resource comprehensiveness	1	1/4	1/5	1/2	1/3
B2 Resource timeliness	4	1	1/2	3	2
B3 Resource Authority	5	2	1	4	3
B4 Resource uniqueness	2	1/3	1/4	1	1/2
B5 Resource form diversity	3	1/2	1/3	2	1

3.2.2 Calculate the Relative Weights of the Lower-Level Indices to the Upper-Level Indices

(1) Normalize every column of judgement matrix B

$$\overline{b_{ij}} = \frac{b_{ij}}{\sum_{k=1}^{m} b_{kj}} \quad i, j = 1, 2, \cdots, m$$

(2) Add the normalized judge matrix according to rows

$$\overline{W_i} = \sum_{j=1}^{m} \overline{b_{ij}} \quad i = 1, 2, \cdots, m$$

(3) Normalize the vector

$$w_i = \frac{\overline{w_i}}{\sum_{j=1}^{m} \overline{w_j}}$$

$$\overline{W} = \left\{\overline{\omega_1}, \overline{\omega_2}, \cdots \overline{\omega_m}\right\}^T$$

The resulting vector $W = (w_1, w_2, \cdots w_m)^T$ is the required weight vector.

(4) Calculate the maximum eigenvalue of the matrix $\lambda_{\max}$

$$\lambda_{\max} = \frac{1}{m} \sum_{i=1}^{m} \frac{(AW)i}{w_i}$$

For any ($i = 1, 2, \cdots, m$), $(AW)_i$ is the i^{th} component of vector AW.

The results obtained after the above-mentioned processing on judgment matrix are shown in Table 9.

Table 9: The weight and the maximum eigenvalue of judgement matrix B.

B	B1	B2	B3	B4	B5	Row sum	Normalized weight W	AW	$\frac{(AW)_i}{w_i}$
B1	0.0667	0.0612	0.0876	0.0476	0.0488	0.3119	0.0624	0.3140	5.0345
B2	0.2667	0.2449	0.2190	0.2857	0.2927	1.3089	0.2618	1.3372	5.1080
B3	0.3333	0.4898	0.4380	0.3810	0.4390	2.0811	0.4162	2.1291	5.1154
B4	0.1333	0.0816	0.1095	0.0952	0.0732	0.4929	0.0986	0.4952	5.0234
B5	0.2000	0.1224	0.1460	0.1905	0.1463	0.8053	0.1611	0.8150	5.0603
column sum	1.0000	1.0000	1.0000	1.0000	1.0000	5.0000			
								Sum:	25.3416
								the maximum eigenvalue:	5.0683

The weights and the maximum eigenvalues of the overall matrix T and the judgement matrix A, C, D, E, F can be calculated according to the above method, as shown in Table 10, Table 11, Table 12, Table 13, Table 14 and Table 15 respectively.

Table 10: The weights and the maximum eigenvalues of the overall matrix T.

T	A	B	C	D	E	F	Row sum	Normalized weight W	AW	$\frac{(AW)_i}{w_i}$
A	0.0923	0.1020	0.0778	0.0706	0.1290	0.1429	0.6146	0.1024	0.6218	6.0694
B	0.3692	0.4082	0.4669	0.4235	0.3226	0.2857	2.2761	0.3794	2.3562	6.2111
C	0.2769	0.2041	0.2335	0.2824	0.2581	0.2381	1.4930	0.2488	1.5459	6.2126
D	0.1846	0.1361	0.1167	0.1412	0.1935	0.1905	0.9626	0.1604	0.9864	6.1486
E	0.0462	0.0816	0.0584	0.0471	0.0645	0.0952	0.3930	0.0655	0.3952	6.0335
F	0.0308	0.0680	0.0467	0.0353	0.0323	0.0476	0.2607	0.0434	0.2634	6.0639
column sum	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	6.0000			
									Sum:	36.7392
									the maximum eigenvalue:	6.1232

Table 11: The weights and the maximum eigenvalues of the judgement matrix A.

A	A1	A2	A3	Row sum	Normalized weight W	AW	$\frac{(AW)_i}{w_i}$
A1	0.1667	0.1818	0.1429	0.4913	0.1638	0.4921	3.0044
A2	0.5000	0.5455	0.5714	1.6169	0.5390	1.6248	3.0147
A3	0.3333	0.2727	0.2857	0.8918	0.2973	0.8943	3.0085
column sum	1.0000	1.0000	1.0000	3.0000			
						Sum:	9.0276
						the maximum eigenvalue:	3.0092

Table 12: The weights and the maximum eigenvalues of the judgement matrix C.

C	C1	C2	C3	C4	C5	C6	Row sum	Normalized weight W	AW	$\frac{(AW)_i}{w_i}$
C1	0.0923	0.0706	0.1020	0.0778	0.1429	0.1290	0.6146	0.1024	0.6218	6.0694
C2	0.1846	0.1412	0.1361	0.1167	0.1905	0.1935	0.9626	0.1604	0.9864	6.1486
C3	0.3692	0.4235	0.4082	0.4669	0.2857	0.3226	2.2761	0.3794	2.3562	6.2111
C4	0.2769	0.2824	0.2041	0.2335	0.2381	0.2581	1.4930	0.2488	1.5459	6.2126
C5	0.0308	0.0353	0.0680	0.0467	0.0476	0.0323	0.2607	0.0434	0.2634	6.0639
C6	0.0462	0.0471	0.0816	0.0584	0.0952	0.0645	0.3930	0.0655	0.3952	6.0335
column sum	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	6.0000			
									Sum:	36.7392
									the maximum eigenvalue:	6.1232

Table 13: The weights and the maximum eigenvalues of the judgement matrix D.

D	D1	D2	D3	Row sum	Normalized weight W	AW	$\frac{(AW)_i}{w_i}$
D1	0.5455	0.5000	0.5714	1.6169	0.5390	1.6248	3.0147
D2	0.1818	0.1667	0.1429	0.4913	0.1638	0.4921	3.0044
D3	0.2727	0.3333	0.2857	0.8918	0.2973	0.8943	3.0085
column sum	1.0000	1.0000	1.0000	3.0000			
						Sum:	9.0276
						the maximum eigenvalue:	3.0092

Table 14: The weights and the maximum eigenvalues of the judgement matrix E.

E	E1	E2	E3	E4	Row sum	Normalized weight W	AW	$\frac{(AW)_i}{w_i}$
E1	0.2609	0.3077	0.3000	0.2400	1.1086	0.2771	1.1201	4.0416
E2	0.1304	0.1538	0.2000	0.1600	0.6443	0.1611	0.6469	4.0160
E3	0.0870	0.0769	0.1000	0.1200	0.3839	0.0960	0.3853	4.0152
E4	0.5217	0.4615	0.4000	0.4800	1.8633	0.4658	1.8872	4.0513
column sum	1.0000	1.0000	1.0000	1.0000	4.0000			
							Sum:	16.1242
							the maximum eigenvalue:	4.0310

Table 15: The weights and the maximum eigenvalues of the judgement matrix F.

F	F1	F2	F3	F4	Row sum	Normalized weight W	AW	$\frac{(AW)_i}{w_i}$
F1	0.2609	0.3000	0.3077	0.2400	1.1086	0.2771	1.1201	4.0416
F2	0.0870	0.1000	0.0769	0.1200	0.3839	0.0960	0.3853	4.0152
F3	0.1304	0.2000	0.1538	0.1600	0.6443	0.1611	0.6469	4.0160
column sum	1.0000	1.0000	1.0000	1.0000	4.0000			
							Sum:	16.1242
							the maximum eigenvalue:	4.0310

3.2.3 Consistency Test

Consistency test is the weight reasonable test of each judgement matrix after the weights are calculated.

The Calculation formula for CR (Consistency ratio):

$$CR = \frac{CI}{RI}$$

The Calculation formula for CI (Consistency index) (m is the order of the judgement matrix):

$$CI = \frac{\lambda \max - m}{m - 1}$$

RI refers to the average random consistency index, the value table shown in table 16 [see Qiu Junping 2009].

Table 16: The average random consistency index.

order	1	2	3	4	5	6	7	8	9	10	11
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51

When CR ≤ 0.1, that the weight order of the level has a satisfactory consistency, otherwise the elements value of the judgement matrix need to be re-adjusted.

Based on the formula, the CR of matrix T, A, B, C, D, E, F are 0.0199, 0.0079, 0.0152, 0.0199, 0.0079, 0.0115, 0.0115 respectively. The weight order of the level obviously has a satisfactory consistency.

3.2.4 The Synthetic Weight Calculation

The calculation of synthetic weight of each level index to the system target is the secondary index weight multiplied by the primary index it belonged. The results are shown in table 17.

Table 17: Evaluation index weight table.

Primary index (weight)	Secondary index	Secondary index relative weight	Synthetic weight W_i	The certain platform grade Y_i	$W_i Y_i$
A Platform structure (0.1024)	A1 Organization reasonability	0.1638	0.0168	90	1.512
	A2 Navigation reasonability	0.539	0.0552	80	4.416
	A3 Symbol reasonability	0.2973	0.0304	80	2.432
B Platform content (0.3794)	B1 Resource comprehensiveness	0.0624	0.0237	88	2.0856
	B2 Resource timeliness	0.2618	0.0993	85	8.4405
	B3 Resource Authority	0.4162	0.1579	90	14.211

	B4 Resource uniqueness	0.0986	0.0374	70	2.618
	B5 Resource form diversity	0.1611	0.0611	70	4.277
C Platform technology (0.2488)	C1 Stability	0.1024	0.0255	90	2.295
	C2 Security	0.1604	0.0399	85	3.3915
	C3 Using convenience	0.3794	0.0944	88	8.3072
	C4 Using fluency	0.2488	0.0619	85	5.2615
	C5 Retrieval system reasonability	0.0434	0.0108	87	0.9396
	C6 Mobile terminal compatibility	0.0655	0.0163	90	1.467
D Platform service (0.1604)	D1 Communication interaction	0.539	0.0865	86	7.439
	D2 Personalized service	0.1638	0.0263	80	2.104
	D3 Charge reasonability	0.2973	0.0477	80	3.816
E Platform operation (0.0655)	E1 Platform visits amount	0.0106	0.0182	90	1.638
	E2 Search engine performance	0.1611	0.0106	90	0.954
	E3 Platform PR value	0.096	0.0063	86	0.5418
	E4 Number of registered users	0.4658	0.0305	90	2.745
F Platform benefit (0.0434)	F1 Resource click rate	0.2771	0.0120	85	1.02
	F2 Resource download rate	0.096	0.0042	80	0.336
	F3 Resource collection rate	0.1611	0.0070	85	0.595
	F4 Average learning duration	0.4658	0.0202	88	1.7776
Total	84.6203				

4 CASE STUDY ANALYSIS

According to the established evaluation system design of e-learning platform and the case capital budget, evaluate a popular e-learning platform in China. For the four indicators A, B, C and D, ten people who often study on the platform are invited to score the second-level evaluation indicators with full marks, and the average value is calculated as the score of each indicator. For the two indexes E and F, we interviewed the management and maintenance personnel of the platform, searched relevant data through professional tools, and comprehensively gave the scores of each secondary index. As shown in Table 17, the comprehensive score of this platform can be calculated as 84.6203, which is also consistent with our subjective judgment.

5 CONCLUSION AND PROSPECTS

This paper draws on the theoretical and methodical achievements of the academic circles at home and abroad in the evaluation of the website platform, especially the online education website platform. According to the characteristics of network learning platform and the intensive research, an online study platform index system is built from six aspects and each index weigh is set by Analytic Hierarchy Process. Then a case study based on one certain online study platform is conducted according to the system.

For the survey sample data is limited in the process of index setting and case study, the accuracy of the weight and grade needs to be improved in the future. In the next step, we will expand the survey and interview samples to have a further research. Meanwhile, we will develop automatic evaluation

tools to improve the efficiency of the evaluation and make the process of the evaluation more exercisable.

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