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Analysis of Key Factors Influencing Smart Court Development Based on Decision Making Trial and Evaluation Laboratory

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This paper analyzes the state of the art in the development of smart courts in China since 2016 and explores the factors affecting the development of smart courts in China based on DEcision MAking Trial and Evaluation Laboratory (DEMATEL) and Interpretive Structural Modeling (ISM) models. The direct influence relationships between the factors were determined by data extracted from a questionnaire survey. Based on the resulting composite influence matrix, it was deduced that the factors that influence smart court development involve three groups: intrinsic factors, including pre-planning, promotion, network service, and the five main functional systems; transitional factors, including data collection, operation and maintenance, update; and proximate factors, including investment intention, equipment, and monitoring system. Drawing on the conclusion, this paper argues that the development of data collection, equipment, and monitoring system should be the priority in the smart court development, and a benign circulation will be achieved when the five main systems of smart courts are well-established as they can attract talents, investment, and other important factors.

ACM CCS (2012) Classification: Human-centered computing → Collaborative and social computing → Collaborative and social computing design and evaluation methods

Keywords: Smart court, DEMATEL, ISM, influencing factors

1. Introduction

The concept of *smart court* has piqued the interest of the legal community and the relevant policymakers [1]. For a long time, China attaches great importance to the national development strategy [2]. The smart court, founded on the Internet of things (IoT) and artificial intelligence (AI), is as time passes an inevitable trend [3, 4], and offers a new mechanism for settlement of disputes [5]. In recent years, the development of smart courts has gained momentum [6].

Since 2016, the Supreme People's Court of China has established a trial management information system that connects all courts in the country, aiming to realize online, transparent, and intelligent trials. The system contributes greatly to the information flow between courts [7]. Thanks to the application of emerging techniques (*e.g.*, big data, cloud computing, and Internet AI), much progress has been made in civil litigation procedures, especially in terms of intelligent judgment, online service, smart court, and Internet court development [8].

On June 8, 2017, a keynote speech was made at the China-ASEAN Justice Forum, clarifying the concept of a smart court: Smart court is an organization, development, operation, and management of people's courts that realizes online handling of all businesses, lawful disclosure of the whole process, and all-dimensional intelligence services. Relying on modern AI, the smart court highlights justice for the people and judicial justice, respects the laws of the legal system, and integrates institutional reform and technological change, providing highly digital support to judicial trials, litigation services, and judicial management. At present, the key to smart court lies in case hearings. The de-

velopment of a smart court is the focal point of smart court development.

Despite the materialization of the concept, the smart court concept has some limitations. So far, the smart court has only been applied in operational tasks. There is a long way to go before applying this concept to complex activities [9]. Currently, the development of the smart court is challenged by the mismatch between data usage and devices [10], talents, or techniques [11], as well as information barriers [12]. Many factors could affect smart court development, including, but not limited to, network control platform [13], litigation counseling robot, case filing platform, natural language processing (NLP) [14] and information semantic processing [15], digital video server and dual backup [14, 16, 17], blockchain proof support [14, 15, 17], online dispute resolution (ODR) [15, 18, 19], decision models [20, 21], and intelligent decision systems [22, 23].

To date, the smart court has been studied from different angles at home and abroad, yielding fruitful results. However, there are not yet mature measuring indices of the key factors affecting the development of smart courts [24]. Most of the existing studies are quantitative. There is little information available on the logical relationship between the various factors affecting smart court development in China. Apart from a fixed spatial relationship, the different influencing factors (system elements) should have a fixed quantity relationship. If the degree of their mutual influence is identified, it would be possible to understand the detailed structural relationship between system elements more intuitively. Therefore, it is of theoretical and practical significance to study the factors affecting the smart court concept in China. After a review of domestic and foreign literature, this paper provides a questionnaire based research of the factors affecting smart court development in China through the DEcision MAking Trial and Evaluation Laboratory (DEMATEL) and Interpretive Structural Modeling (ISM).

2. Identification of Influencing Factors

Since the smart court carries some features of infrastructure development projects, this paper treats the it as the object of project development and considers the standards for project development and acceptance. There are relatively few studies on the factors affecting the smart court. To find as much high-quality literature as possible, the following works were selected for the strong relevance of topics and high reference value.

Since the world's first Internet court was established in Hangzhou, China has seen big progress made in the development of the smart court. Feng was among the first in China to pay attention to this area, as he proposed to set up a "one mouse-click" control system including audio, microphone, multi-media, automatic tracking, and recording of all the stages of the trial [9]. Some scholars also pointed out the technology's role in smart court development, such as Tai, who emphasized the alarm function of a digital video server in a smart court, especially in emergencies [15]. Zhang *et al.* aimed to build a legal intelligent auxiliary discretionary system for predicting the penalty and damage compensation values with the help of a genetic algorithm-backpropagation (GA-BP) neural network (NN) based on the current Chinese legal system [19]. The same was done by Koc, who focused on natural language processing (NLP) [24]. Schmitz *et al.* fixed their eyes on the net service of the smart court [1]. Rusakova identified various obstacles and techniques in the judicial system development after expecting the trend during this process of digitalization of civil proceedings [5]. Shi *et al.* believed more techniques such as big data use, blockchain formation, and advisory and determinative forms of artificial legal intelligence should be introduced to ensure a quick dispute resolution when developing the smart court system [22].

In addition, some scholars put forward the theoretical foundation for smart courts. Gaivoronskaya *et al.* considered that the judicial information platform has made it possible to conduct proceedings in a way that the courts of all levels are in constant interaction, and the provision of judicial protection is carried out without any intermediate links [21]. According to Wang *et al.*, a remote court system can increase the effectiveness of the trial, freeing the public prosecutor from going to and from the court, so that judicial resources can be saved [3]. Sung paid attention to the e-commerce disputes and copyright infringements from the physical courts to

the Internet [16]. Sourdin also believed that we should be mindful of possible tech-related issues that can impact justice objectives [17]. Xu found that there was a risk of private data leakage, which restricts the performance of judges' discretion and at the same time has a certain impact on the traditional litigation culture [7]. Cai argued that transnational judicial dialogue can accelerate the delivery of justice in China and exhibit Chinese judicial wisdom to other BRI countries, thereby increasing the confidence in the Chinese judiciary [2].

Some scholars proposed a framework or model of a smart court system through case studies. Based on grassroot courts in China, Zhu *et al.* roughly outlined China's internal and external smart court development and analyzed the information barriers, normative and theoretical barriers, scattered and repeated development, conceptual obstacles, and insufficient financial security in China's smart court development [11]. Xia's study contributed to the development of a comprehensive evaluation framework for the e-justice system, serving as a foundation for future development and study of the e-justice services [25]. Sousa and partners collected documents and conducted interviews for content analysis. They proposed a framework model that combines resources and impacts of AI on the velocity of legal decisions. The result demonstrated how and what solutions contribute to judgment, pre-trial, and legal support [8].

Scholars like Vlasenko and Kim pointed out the key roles of court and government in smart court development. Vlasenko *et al.* examined the concretization of law which is performed by judicial organs and the concretization of rules of law in the presence of gaps in normative legal acts [23]. Huang pointed out that one problem of smart court development in China lies in the lack of talents, technology, and data [10]. She argued that it is necessary to share the data through the networking of government at every level and relevant department. Kim mentioned the job of the government in promoting the development of smart courts, as their study emphasized the management of the nation's action towards intelligent information society as the main agent [14].

Table 1 displays the factors summarized from these studies: a total of 15 alternative influencing factors were collected from four dimensions: project development, basic conditions, system development, and platform management. An explanation is given for each factor (Table 1).

3. Evaluation of Influencing Factors

3.1. Questionnaire Design

To extract the influencing factors of the smart court in an impartial way, we designed a questionnaire about the influencing factors of the smart court based on 15 initial factors through the "Wenjuanxin" platform in an anonymous manner. The design of the questionnaire can be divided into two parts. The first part is to fill in the basic demographic information including gender, age, educational background, position, average monthly wage, working life, working or project experiences related to smart court, *etc.* The second part, also the main body of the questionnaire, is the evaluation of the importance of 15 alternative influencing factors covering 4 dimensions: project development, basic conditions, system development, and platform management. The scoring rules of the data follow the Likert-type scale, "no effect" was scored as 0, "minor effect" was scored as 1, "neutral" was scored as 2, and "major effect" was scored as 3. Finally, the data received were summarized to analyze the respondents' recognition of the factors influencing the smart court.

The questionnaire was distributed from November 25 to December 6, 2021, on multiple social platforms, such as WeChat, WeChat Moments, QQ Vblog, Weibo, Douban, WeChat Group, and QQ Group Chat. After 13 invalid samples were excluded, a total of 294 questionnaires were recovered, at a recovery rate of 93.6%.

3.2. Descriptive statistical analysis

Descriptive statistical analysis of basic information. The descriptive statistical analysis covers aspects such as gender, age, highest educational background, position, average monthly wage, and working life, as well as questions: "Have you ever heard of the smart court?", "Have you engaged in work related to the smart court?", and "How long has your work been related to the smart court?". The results are shown in Table 2.

Table 1. Factors affecting smart court.

Primary indicator	Secondary indicator	Code	Description	Factor source
Project development	Pre-planning	*S1*	Plans and arrangements for smart court	Cai(2021), Wang(2020), Schmitz(2019), Huang(2020), Zhu(2019), Sousa(2022), Koc(2021), Xia(2021), Huang(2020), Kim(2020), Sourdin(2020)
	Investment Intention	*S2*	Financing capacity and investment popularity of the smart court	
	Promotion	*S3*	Promotion of smart court	
Basic conditions	Equipment	*S4*	Hardware and facilities required for the smart court	Guo(2021), Sung(2020), Wang Qun (2018), Zhang(2018), Schmitz(2019), Sousa(2022), Koc(2021), Feng (2012), Tai(2017), Gaivoronskaya(2019), Xu(2020)
	Network service	*S5*	Network services for users in smart court	
	Talent development	*S6*	Development of compound talents of technology and law	
	Data collection	*S7*	Legal database and artificial intelligence database of smart court	
System Development	Intelligent sound system	*S8*	Intelligent language-assisted expert system including text recognition, speech interaction, and machine translation.	Shi(2021), Wang(2020), Schmitz(2019), Huang(2020), Xu(2020), Zhu(2019), Feng(2012), Kim(2020), Sourdin(2020), Guo(2021), Rusakova(2021), Sung(2020)
	Intelligent litigation system	*S9*	Prosecution robot, filing platform, natural language processing (NLP) and information semantic processing system, *etc.*	
	Judicial service system	*S10*	Judicial service operating system, data storage and legal document service system, legal provision search and historical case reference system, claim system, *etc.*	
	Intelligent trial system	*S11*	Decision model and intelligent decision system that includes digital video server and dual-computer backup, blockchain evidence support, trial procedure and real-time trial management, *etc.*	
	Intelligent dispute resolution system	*S12*	Appeal system, video mediation, expert assistance system, risk assessment system, online dispute resolution (ODR), *etc.*	
Platform Management	Monitoring system	*S13*	Network control platform, technical support, backstage supervision, publicity and promotion system, *etc.*	Zhu(2019), Feng(2012), Sousa(2022), Koc(2021)
	Operation and maintenance	*S14*	Maintenance of smart court platform in daily operation	
	Update	*S15*	Update and iterate over the operating system and database of the smart court	

Note: The same factor may be described differently in the literature. Thus, sporadic and similar factors have been summarized, sorted out, and merged.

Table 2. Basic information and statistics of the survey.

Items		Frequency	Percentage
Gender	Male	185	62.9
	Female	109	37.1
Age	Under 24	31	10.5
	24-30	111	37.8
	Age	83	28.2
	Over 60	69	23.5
Academic degree	Junior college and below	102	34.7
	Undergraduate	106	36.1
	Academic degree	86	29.3
Position	General staff	53	18.0
	Grass-roots leadership	54	18.4
	Position	105	35.7
	Senior leader	82	27.9
Average monthly wage (CNY)	Below 6000	62	21.1
	6000-8000	79	26.9
	Average monthly wage (CNY)	97	33.0
	Over 12000	56	19.0
Working Years	Below 3	64	21.8
	4-10	125	42.5
	Working Years	72	24.5
	Over 30	33	11.2
Have you ever heard of the smart court	No	61	20.7
	Yes	233	79.3
Have you ever worked in smart court	No	83	28.2
	Yes	211	71.8
Number of working projects related to the smart court	1-2	31	14.7
	3-10	166	78.7
	Over 10	14	6.6

From the perspective of gender, males accounted for 62.9% in this questionnaire, while females 37.1%, showing that more males were surveyed in this questionnaire.

In terms of age, people under the age of 24 accounted for only 10.5% in the sample. People over 60 years are the second least group, accounting for 23.5%. People aging between 20 and 30 were the most numerous in this questionnaire, accounting for 37.8%. The proportion of people in the 30-60 group was 28.2%.

As for the position, general staff accounted for 18.0%. Grassroots leaders accounted for 18.4%, and middle-level leaders and senior leadership was 35.7% and 27.9%, respectively.

As for the average monthly salary, people with living expenses of 6,000 yuan or less accounted for 21.1%, while 26.9% were in the group of 6000-8000 yuan, 33.0% spent 8000 to 12000 yuan. People that spent over 12000 yuan every month came in at 19.0%.

Looking at the work experience, according to the samples in this questionnaire, the ones with 3 years or less accounted for 21.8%, the 4-10 years' group accounted for 42.5%, 24.5% have

been working for 11 to 30 years, and those who worked for over 30 years reached 11.2%.

Among the surveyed people, 79.3% had heard of the smart court; 20.7% had never heard of a smart court. As for whether their work has been related to smart court, 71.8% of them have done so. 28.2% of the people had no relevant work in the smart court. 14.7% of the samples had one to two projects that engaged in relevant work of the smart court, 78.7% of the samples had 3-10 projects that had been engaged in the related work of the smart court, and 6.6% had more than 10 items projects related to the smart court. All these indicated that the representative sample size is acceptable.

Descriptive statistical analysis of the influencing factors. The overall descriptive evaluation of the 15 factors based on 294 samples using mean and standard deviation is shown in Table 3. 15 factors in 4 dimensions have mean values ranging from 3.07 to 3.57, indicating that the 15 selected factors have reached the "neutral" level; the standard deviation of the sample shows that the overall standard deviation fluctuates around 1.05, which is relatively low, indicating that the testees' evaluation of the factors is relatively consistent.

3.3. Reliability and Validity Test

Reliability test. The reliability test could test the reliability of the samples, and the effective sample size of this analysis is 294, a moderate size. It can meet the needs of the number of items analyzed. SPSS 26.0 was used to analyze the reliability of the data collected in this paper. As shown in Table 4, the Cronbach α coefficients of the 15 influencing factors for the four dimensions, including project development, basic conditions, system development, and platform management ranged from 0.831 to 0.877 (all

Table 3. Mean and SD of the influencing factors in the smart court.

Influencing Factors		N	Mean	SD
Project development	Pre-planning	294	3.18	1.022
	Investment Intention	294	3.19	1.016
	Promotion	294	3.16	1.072
Basic conditions	Equipment	294	3.49	1.018
	Network service	294	3.57	1.032
	Talent development	294	3.18	1.165
	Data collection	294	3.46	1.007
System Development	Intelligent sound platform	294	3.07	1.078
	Intelligent litigation platform	294	3.12	1.150
	Judicial service system	294	3.10	1.124
	Intelligent trial system	294	3.16	1.027
	Intelligent dispute resolution system	294	3.15	1.029
Platform Management	Monitoring system	294	3.13	1.076
	Operation and maintenance	294	3.12	1.035
	Update	294	3.11	1.079

Table 4. Reliability test.

	Number of questionnaires	Number of terms	Cronbach α coefficient
Project development	294	3	0.870
Basic conditions	294	4	0.834
System development	294	5	0.831
Platform management	294	3	0.877

higher than 0.8), demonstrating that the consistency of the questionnaire items was good and the reliability was high, in other words, the designed scale could be used for measurements.

Validity test. Table 5 presents the sample data collected by factor analysis – SPSS 26.0 was used to perform both the KMO and the Bartlett test. The KMO value in the table ranges from 0.732 to 0.827, which is higher than 0.7, indicating that it meets the needs of the analysis. The significant values are both 0.000 – less than 0.05, demonstrating good validity.

As shown in Table 5, the absolute value of the normalized load coefficient of each item is greater than 0.8, showing a significant measurement relationship and good structural validity of the questionnaire. Four factors with characteristic roots greater than 1 were selected, and the overall explanatory variables ranged from 60.925% to 80.388%, indicating that the selected factors better represented the information of each original variable.

To sum up, the 15 factors selected are objective and reasonable and meet the expectations.

Table 5. Validity test.

Project		N	Normalized load factor	Component score coefficient matrix *	Total variance of interpretation		KMO measure of sampling adequacy	Bartlett's sphericity test	
					Initial eigenvalue	% of variance		Approximate chi-square	Sig.
Project development	Pre-planning	294	0.879	0.369	2.382	79.415	0.737	434.817	0.000
	Investment Intention	294	0.903	0.379	0.341	11.381			
	Promotion	294	0.891	0.374	0.276	9.205			
Basic conditions	Equipment	294	0.887	0.326	2.719	67.970	0.749	566.361	0.000
	Network service	294	0.889	0.327	0.652	16.305			
	Talent development	294	0.694	0.255	0.450	11.260			
	Data collection	294	0.812	0.299	0.179	4.465			
System development	Intelligent sound system	294	0.600	0.197	3.046	60.925	0.827	605.999	0.000
	Intelligent litigation system	294	0.698	0.229	0.761	15.221			
	Judicial service system	294	0.844	0.277	0.565	11.310			
	Intelligent trial system	294	0.854	0.280	0.374	7.475			
	Intelligent dispute resolution system	294	0.870	0.286	0.253	5.068			
Platform management	Monitoring system	294	0.874	0.362	2.412	80.388	0.732	467.759	0.000
	Operation and maintenance	294	0.916	0.380	0.352	11.741			
	Update	294	0.899	0.373	0.236	7.871			

4. Model Specification

This paper analyzes the key factors affecting smart court by the DEMATEL-ISM model, which can assess the importance of factors in a complex system. Specifically, the direct influence matrix and composite relationship matrix were established, and the centrality and causality of factors in each dimension were calculated [26], in order to analyze the key factors affecting the smart court. The Interpretative Structural Modeling Method will be introduced first.

The Interpretative Structural Modeling Method (or ISM), proposed by Hua Faerte in 1973, was used to analyze the related issues of the complex socio-economic system in the beginning [27]. By decomposing the confusing system into several elements, ISM can use a multi-layer hierarchical structure to analyze the comprehensive problem. It demonstrates the correlation and logical hierarchy between various factors via a multi-layer hierarchical structure model and it does not involve a quantitative relationship [28]. Thus, it is a powerful interpretation model, in which the interconnectedness and importance of the influencing factors, the desired hierarchical relationship, and the inherent laws of the established system can be obtained or revealed. According to Karadayi-Usta, the calculation process of ISM includes four steps as follows:

(i) identify important factors;

(ii) identify the mutual relations of important factors;

(iii) establish the adjacency matrix;

(iv) establish a reachable matrix [29].

ISM is a perfect technique to analyze the impact of one factor on others, and can prioritize and determine the level of factors in a system. By analyzing the influence degree of factors on each other, ISM can only identify the interrelationships among the factors, but does not quantify the intensity of interactions and relationships among the factors. However, this deficiency can be resolved when ISM is combined with DEMATEL, which is applied to determine the priority and intensity of quantified relationships among factors. Hence, the DEMATEL method will be introduced next.

The DEMATEL method, originally developed in the 1970s by the Science and Human Affairs Program of the Battelle Memorial Institute of Geneva [30], refers to a system element analysis approach that parses the logical relationship between system elements, builds up a direct influence matrix, and then computes how much each element affects and is affected by any other element. In this way, the centrality and causality of each factor can be solved [31], and the structural relationship of the system can be further revealed. DEMATEL has been applied extensively to examine the importance of the weight of the factors in various complex systems [32–35]. The basis of the method is a questionnaire survey of the influence of various factors by researchers, scholars, or interviewees to study the importance and connection of various factors in a system, with an aim to analyze the sophisticated issues through complex evaluation criteria [36]. So far, the DEMATEL method has been successfully applied in various fields, including business management, engineering, strategy making, and so on.

To sum up, ISM splits the factors into different clusters and analyzes the system in a holistic way, while DEMATEL examines the direct or indirect cause-effect relationships in a part-based approach; in other words, both ISM and DEMATEL can be used to analyze complex and intricate problems through the hierarchical and communicative structure. Both ISM and DEMATEL methods appear to be suitable techniques for empowering hierarchical structures, and both methods provide a clear display of the relationships within the system [37]. A complementary analysis of the two methods enables a researcher to grasp the degree of influence and influence relationships among the elements in a comprehensive way.

The analysis steps of the DEMATEL-ISM model are as follows:

1. establish language evaluation sets S, S = {0 (no effect), 1 (minor effect), 2 (neutral), 3 (major effect)}; the language evaluation set S is used to describe the influence degree of each factor index in the whole system;
2. establish an n-th order direct influence matrix D:

$$D = (d_{ij})_{n\times n} = \begin{bmatrix} 0 & d_{12} & \cdots & d_{1n} \\ d_{21} & 0 & \cdots & d_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ d_{n1} & d_{n2} & \cdots & 0 \end{bmatrix}; \quad d_{ij} = \frac{W_i^{'}}{W_j^{'}};\ i, j = 1, 2, \cdots, n \tag{1}$$

3. normalize the direct influence matrix into matrix C:

$$C = (c_{ij})_{n\times n} = \frac{d_{ij}}{\max\limits_{1\le i\le n}\sum\limits_{j=1}^{n} x_{ij}}; i, j = 1, 2, \cdots, n \tag{2}$$

4. analyze the composite influence matrix G, further determine the degree of influence f_i, the degree of being influenced e_i, centrality m_i, and causality n_i:

$$G = C(E - C)^{-1} \tag{3}$$

$$f_i = \sum\nolimits_{j=1}^{n} g_{ij} \tag{4}$$

$$e_i = \sum\nolimits_{i=1}^{n} g_{ij} \tag{5}$$

$$m_i = f_i + e_i \tag{6}$$

$$n_i = f_i - e_i \tag{7}$$

where the influence degree f_i indicates the composite influence degree of the indicator i on other indicators, the influenced degree e_i indicates the degree of the indicator i being influenced comprehensively by other indicators, the centrality m_i reflects the importance degree of the indicator i in the system, and the causality ni shows the function of the indicator i in the system [26].

5. determine the overall influence matrix H.

$$H = G + E \tag{8}$$

where H refers to the unit matrix.

6. determine the threshold c through the mean a and the standard deviation b obtained from the composite influence matrix G; the overall influence matrix is then processed to obtain the reachable matrix K

$$c = a + b \tag{9}$$

$$k_{ij} = \{1 \mid h_{ij} \ge c\} \tag{10}$$

$$k_{ij} = \{0 \mid h_{ij} \le c\} \tag{11}$$

7. the hierarchical division of the reachable matrix is performed to obtain the initial reachable set R, prior set O, and intersection set N of each factor; the factor is drawn when R and O are the same; this process is repeated until all factors are drawn, and finally, the hierarchical structural model is obtained.

5. Analysis of Key Influencing Factors

5.1. Questionnaire Survey and Data Processing

After combing through the literature, 14 smart court influencing factors were preliminarily identified. Then, each influencing factor was measured by the DEMATEL-ISM model. Firstly, a focus group of 15 members was organized to evaluate the relationship between the influencing factors. The employment of these members are in the areas of management, development, and utilization of smart courts, here including court staff, court data analysts, court architects, court product managers, court project managers, and law researchers in colleges. All of them have rich practical or research experience. The focus team discussed the degree of influence of each factor over every other factor. The degree of influence of factor S_i over factor S_j was rated 0, 1, 2, or 3, respectively standing for "no impact", "minor impact", "neutral", and "major impact".

The scores were analyzed, and the most frequent score was taken as the degree of direct correlation for each factor. In this way, the direct influence matrix D was established for the factors affecting the smart court, see Table 6.

Next the direct influence matrix was normalized, and the composite influence matrix subsequently analyzed (see Table 7), determining the degree of influence f_i, the degree of being influenced e_i, the centrality m_i, and causality n_i. The cause-and-effect diagram is plotted in Figure 1.

Then the threshold is determined through the mean and the standard deviation is extracted from the composite influence matrix G, thus obtaining both the overall influence and the reachable matrix . After the hierarchical division of the reachable matrix, the hierarchical structural model is finally obtained, see Figure 2.

Table 6. Direct influence matrix *D*.

Factor	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}	S_{11}	S_{12}	S_{13}	S_{14}	S_{15}
S_1	0	3	3	2	1	2	0	1	1	1	1	1	2	2	1
S_2	1	0	2	3	2	2	0	2	1	2	1	2	1	1	2
S_3	0	3	0	2	2	2	1	1	1	1	1	1	1	1	1
S_4	0	1	1	0	2	1	2	2	2	2	2	2	2	3	3
S_5	0	0	0	3	0	0	2	1	1	1	1	1	2	2	1
S_6	1	2	1	0	2	0	1	2	2	2	2	2	1	2	2
S_7	0	0	0	1	1	0	0	3	3	3	3	3	1	2	3
S_8	0	1	1	0	0	0	2	0	1	1	1	1	1	2	2
S_9	0	1	1	0	0	0	3	1	0	1	1	1	1	1	2
S_{10}	0	1	1	0	0	0	3	0	1	0	1	1	1	1	2
S_{11}	0	1	1	0	0	0	3	1	2	1	0	1	1	2	2
S_{12}	0	0	1	0	0	0	2	1	1	1	1	0	1	2	2
S_{13}	0	0	0	2	3	1	2	2	2	2	2	2	0	3	2
S_{14}	0	0	0	3	3	1	3	2	2	2	2	2	2	0	3
S_{15}	0	0	0	3	3	2	3	3	3	3	3	3	2	3	0

Table 7. Composite influence matrix *X*.

Influencing factor	Degree of influence	Degree of being influenced	Centrality	Causality
S_1	0.12	1.84	1.96	–1.72
S_2	0.87	1.87	2.74	–0.99
S_3	0.86	1.56	2.42	–0.71
S_4	1.56	2.13	3.69	–0.57
S_5	1.58	1.34	2.92	0.24
S_6	0.81	1.82	2.63	–1.01
S_7	2.54	1.86	4.39	0.68
S_8	1.94	1.16	3.10	0.77
S_9	2.06	1.15	3.22	0.91
S_{10}	2.03	1.09	3.12	0.95
S_{11}	1.97	1.32	3.29	0.65
S_{12}	2.03	1.07	3.10	0.96
S_{13}	1.62	1.93	3.55	–0.31
S_{14}	2.31	2.12	4.44	0.19
S_{15}	2.47	2.52	4.99	–0.06

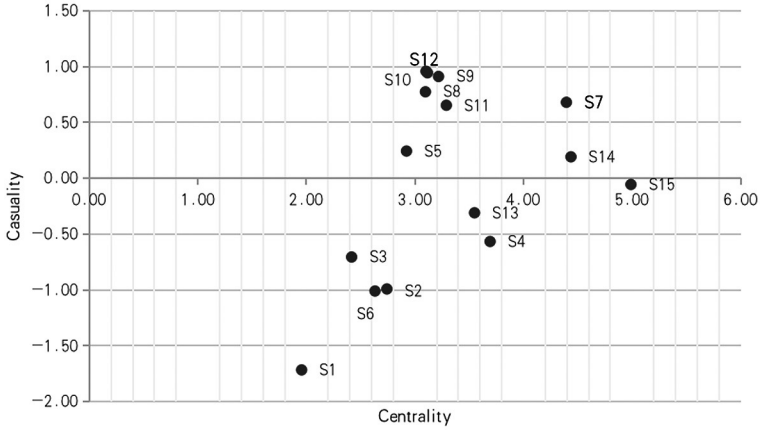

Figure 1. Cause-and-effect diagram.

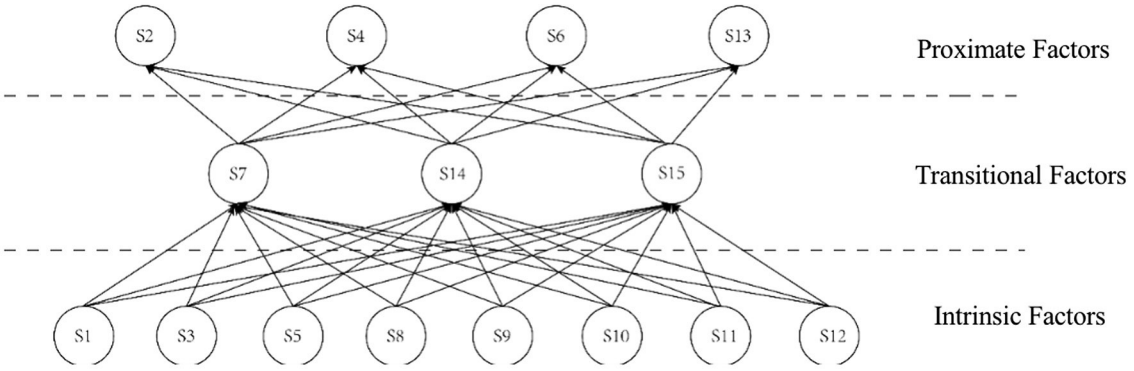

Figure 2. Hierarchical structural model.

5.2. Results analysis

Centrality analysis. According to the degree of influence and the degree of being influenced by each factor affecting the smart court (see Table 7), the following factors had high degrees of influence: data collection (S_7), operation and maintenance (S_{14}), update (S_{15}). Other factors with a relatively high degree of influence include equipment (S_4) and monitoring system (S_{13}).

From the perspective of centrality, update (S_4) ranked first in terms of centrality, followed by pre-planning (S_1) and data collection (S_7). This result echoes with the state of the art of smart court development, noticing that date collection and update should be put on the agenda during the development of the smart court.

Causality analysis. As shown in Table 7, cause factors (causality > 0) refer to the five main function systems of the smart court (S_8–S_{12}) and data collection (S_7). Effect factors (causality < 0) refer to pre-planning (S_1), talent development (S_6), and investment intention (S_2). This demonstrates that the function strength of the smart court determines the investment of human resources, finance, and other resources in the early stage of smart court development.

Hierarchical structural model analysis. As shown by the hierarchical structural model (see Figure 2), the intrinsic factors in the system include pre-planning (S_1), promotion (S_3), network service (S_5), and the five main functional systems (S_8–S_{12}), which directly or indirectly affect the development of the smart court. Data collection (S_7), operation and maintenance (S_{14}), and update (S_{15}) belong to transitional factors, which are controlled by the intrinsic factors and affect smart court development. Investment intention (S_2), equipment (S_4), and monitoring

system (S_{13}) belong to proximate factors, which are closely related to smart court development with a direct influence on it.

6. Conclusion

Based on statistical analysis, and following literature review, this paper identifies the factors influencing the development of the smart court and quantifies each factor by the DEMATEL-ISM model. In this way, we clarified the mutual influence and dependence among the influencing factors. Relying on the said model, a thorough analysis was carried out on centrality, degree of influence, degree of being influenced, causality between factors, and hierarchical structural model. On this basis, the key cause factors to the development of the smart court were recognized, laying a theoretical basis for smart court projects in China.

Drawing on the research findings, the following suggestions were provided for smart court development:

1. with the expansion of artificial intelligence, it is imperative to construct the smart court; the research on smart court development should not merely consider the acceptance of its indices, but the management of data collection and sharing, operation and maintenance, and update should also be paid attention to; these factors lay the foundation for the healthy operation of a smart court;
2. to continuously improve the quality and level of the smart court development, it is necessary to model the factors influencing it and speed up the development of the five main functional systems, including intelligent sound system, intelligent litigation system, judicial service system, intelligent trial system, and intelligent dispute resolution system; these systems will in turn attract talents and investment so that smart court development will enter a benign dissemination;
3. the development of data collection, equipment, and monitoring system should be the top priority, as they are closely related to the smart court development directly influencing it; in the meantime, it is necessary to set up pre-planning, build up a well-functioned network service, and optimize the main five systems for smart court development, aiming to better meet the increasing demand for a quick, convenient, and efficient court.

In short, human society is moving into a new era of artificial intelligence. The judicial practice in China calls for faster development of the smart court, and better use of an intelligent judicial system. Due to the lack of institutional support, the smart court development may encounter some problems in the early phase, which hinders judicial efficiency. Therefore, it is crucial and inevitable to develop perfect smart courts. During the development of smart courts, it is important to explore the various factors affecting the this process, grasp the key factors, and create a precise and efficient service environment for the judicial system, both according to local conditions and current importance.

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