Research Article

Evaluation of China's High-Advanced Industrial Policy: A PMC Index Model Approach

Ying Tian [iD],[1] **Kai Zhang** [iD],[1] **Jiayi Hong** [iD],[1] **and Fanglin Meng** [iD][2]

[1]*School of Management, University of Shanghai for Science and Technology, Shanghai 200093, China*
[2]*School of Business, Shanghai Sanda University, Shanghai 201209, China*

Correspondence should be addressed to Kai Zhang; 1913120134@st.usst.edu.cn

High-advanced industries upgraded by digital empowerment have gradually become an important support industry. Therefore, various provinces in China have issued relevant policies to support the prosperous of the digital economy and high-advanced industries. The collection and analysis of high-advanced industrial policy help to scientifically evaluate industrial policies and formulate scientific policy optimization paths. Based on a total of 168 high-advanced industrial policy documents from 26 cities in the Yangtze River Delta region from 2009–2021, this study adopts the PMC-Index model to evaluate the high-advanced industry policies in the digitalization context quantitatively. 12 representative high-advanced industry policy texts were selected for specific analysis. In addition, this study visualizes the measurement results of the internal structure and policy effectiveness of policies by PMC-Surface diagrams and then concludes that the design of high-advanced industry policies was relatively reasonable overall, with 11 policies rated as "Good Consistency" and only one "Acceptable Consistency." The sample policies lack reasonable arrangements for different period plans, lack incentives, or have relatively single incentives. The policy influence among cities in the Yangtze River Delta urban agglomerations is small, and the integration trend is not apparent. There is a particular gap in the scores between Shanghai, Zhejiang, Jiangsu, and Anhui province. This study provides references and suggestions for formulating and revising high-advanced industrial policies.

1. Introduction

Digital technology is dramatically changing industrial production and organizational activities [1, 2]. The digitization of industries is providing the impetus for economic development in various countries. Each country has different directions and motivations for using digital technology to promote economic development, so the impact of digitization on national economies is also different [3]. Digitization refers to using digital technology to create new business models, new business formats, and industrial production models, thereby improving product quality, production quantity, and production efficiency [4]. Digitization empowers and embeds industries to help industrial transformation and technological innovation [5, 6].

China is gradually shifting its economic focus from rapid GDP growth to high-quality economic development,

considering transforming from the world's factory to an innovative powerhouse with leading-edge technologies [7]. China needs to transform and upgrade its industry with the help of the digital empowerment of industry [8]. The high-advanced industry, closely linked to digitalization, has become the main target of industrial transformation and upgrading [9]. High-advanced industries characterized by high technological knowledge density, high intensity of R&D investment, and high added value have gradually become essential support industries for national economic development and are an important symbol of a country's core competitiveness [10]. This study takes the advanced industry proposed by the American Brookings Institution as the core definition of a high-advanced industry. The study "America's Advanced Industries," released by the Brookings Institution in February 2015, states that industries that meet the following two criteria are defined as the high-advanced

industry: First, the industry must use at least 80% of the expenditure for research and development each year. Each worker must spend more than $ 450 on research and development. Secondly, the proportion of workers in the industry that requires high-level STEM (science, technology, engineering, and mathematics education) knowledge should also be higher than the national average, or 21% of all workers [11].

For the sake of meeting the trend of digital economy and realizing the transformation from low advanced industries to high advanced industries, the governments of various regions in China have adopted relevant industrial policies. However, in the policy playing a role, there are also some problems: the security measures and incentives of the policy are ineffective, there is a lack of mechanism for policy implementation and supervision, the content of the policy is incomplete, and the effect of policy implementation is not obvious. Therefore, it is necessary to scientifically evaluate and judge the high-advanced industrial policy, test the effectiveness of the policy, reasonably allocate the policy resource base, and provide a scientific governance basis [12].

The PMC-Index model can evaluate policies based on establishing a system of relevant indicators and calculate each policy's score composition to effectively evaluate policies [13]. This study creatively puts forward the concept of China's high-advanced industry, evaluates the effectiveness of policies by the PMC-Index model, taking the Yangtze River Delta region of China as an example.

The remaining structure of this study is as follows. Section 2 reviews the relevant literature. Section 3 introduces the research samples and research methods. Section 4 demonstrates the empirical results and analysis. Section 5 puts forward the conclusions and limitations.

2. Literature Review

Existing research on high-advanced industry mainly focuses on three categories. One is the research conducted with high-advanced industry as the subject term. Since the concept of the high-advanced industry mentioned above is not clearly defined, fewer studies directly use the high-advanced industry as a subject term [14]. The second is the study of a specific industry in the high-advanced industry [15]. Wu et al. processed and modeled the data through spatial econometric models to derive the impact of regional financial resources on the cluster of high-advanced horizontal service industries [16]. The third is the study of strategic emerging industries [17]. Prud'homme examined technological specialization in strategic emerging industries and found that China's economic decentralization system ensures, to some extent, the effectiveness of provincial industrial policy making [18].

Policy evaluation is the development of appropriate evaluation criteria through scientific methods to examine policies in multiple dimensions and provide references for policy improvement and new policy development. It can assess the usefulness and value of the policy itself and check the results and effectiveness of its implementation [19]. The first policy evaluation studies were the five-category

assessment model proposed by Suchman [20] and the "Three E" Evaluation Model Architecture proposed by Poland [21]. Jun proposed a classical policy evaluation approach to policy analysis through causality [22]. At present, the commonly used policy evaluation methods include the hierarchical analysis process (HAP), BP neural network, and fuzzy comprehensive evaluation method [23, 24].

The policy modeling consistency index (PMC-Index) model was proposed by Estrada, which can evaluate any social policy to analyze the results and impacts of implementation and the reasons for the results or impacts [25]. The model provides policy researchers with a new tool for policy analysis that can detect policy strengths and weaknesses. The model has been applied to the evaluation of the arable land protection policy [26], pork price policy evaluation [13], and the new energy vehicle policy evaluation [27].

3. Materials and Method

3.1. Data Source and Sample Selection. To obtain high-advanced industry policy texts in a digital context systematically and comprehensively, the following search strategy is used in this study. Taking 2009 as the policy starting point, the policy and regulation databases such as "Beida Fabao" (http://www.pkulaw.cn/) and "Beida Fayi" (http://www.lawyee.net/) were used as data sources, supplemented by the official websites of cities in the Yangtze River Delta. We searched for "high-advanced industry" and "digitalization" as keywords to filter the policy texts of high-advanced industry in the context of digitalization in each city of the Yangtze River Delta. After the above screening, 168 policy texts were retrieved from 26 cities in the Yangtze River Delta region from January 1, 2009, to April 19, 2021. Based on the retrieved policies, these policy texts were sorted out to eliminate those that were irrelevant and repetitive to high-advanced industries, and finally, 44 policy texts with strong relevance were screened out.

3.2. Establishment of PMC-Index Model. As shown in Figure 1, there are five steps to construct the PMC-Index model: Policy text mining is used to classify variables, identify parameters, and then determine this evaluation system's main variables and subvariables. Multi-input-output tables are then constructed based on variable classification and parameter identification to form the framework for data analysis. The results are further analyzed by calculating the PMC-Index to quantify the analysis and visualize the PMC-Surface diagram.

3.2.1. Word Division and Word Frequency Statistics. In this study, the policy text is processed with the help of the text mining tool ROST software. First, the core keywords of the policy text are obtained by reading the policy text, and then the keywords are imported into the word separation table of ROST for the next word separation and word frequency statistics. Next, 44 high-advanced industry policy texts were input into the ROST, and the obtained text sets are word-
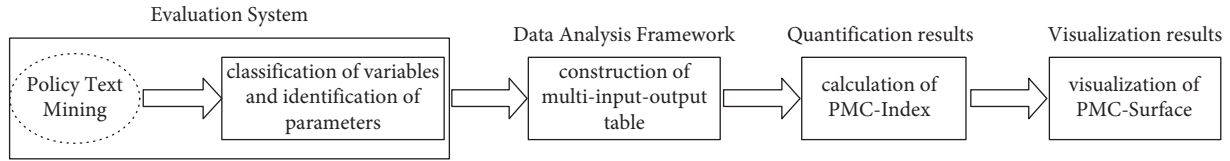
Figure 1: PMC-index model construction framework.

sorted and word frequencies are counted in the order from highest to lowest. Since ROST software automatically identifies keywords with no practical meaning, it is necessary to filter out high-frequency words such as "provide" and "above" that have no practical meaning for policy analysis. After eliminating the redundant words, the valid keywords are screened out and a list of the top 50 keywords in terms of word frequency is compiled as shown in Table 1.

3.2.2. Analysis of Social Networks. Reimport statistical keywords above into the Rost software and extract the high-frequency words and row features from the cooccurrence matrix. Based on the cooccurrence matrix, the visualization network diagram of China's high-advanced industrial policy is drawn by Ucinet software.

As shown in Figure 2, each node represents a keyword, and the line between nodes represents the existence of a correlation between two nodes. In the social network, the node at the center is more important, can be interconnected with more nodes, and has more influence on the whole social network. In this social network, technology, innovation, R&D, etc., are at the center position, indicating that these keywords have a vital influence on the policy guidance in high-advanced industries. The digitization of high-advanced industry and technological innovation are inseparable. Relying on R&D to increase the added value of technology can realize the transformation and digitization of technology from low-advanced to high-advanced and realize industrial layout and growth. Keywords around the center are talent, market, entrepreneurship, industry chain, etc. That is, the transformation and digitalization of high-advanced industry cannot be separated from the support of talents, the improvement of the market, the vitality of entrepreneurship, and the construction of the industrial chain. Talents bring intellectual capital to the high-advanced industries. The perfection and development of the market realize the supply and demand balance. Entrepreneurship brings new growth points, creates a new pattern of high-advanced industrial chain development through industrial complementary cooperation, and lays out the industrial chain around the innovation chain, so as to enhance international competitiveness. These keywords are in between the central and marginal positions and have a relatively strong influence. They are both influenced by main keywords and can influence marginal keywords. The keywords in marginal positions are less influential and have even weaker interconnections with other keywords.

Table 1: Key words of China's high-advanced industry regulation policy text.

Number	Keyword	Frequency
1	Technique	4815
2	Enterprise	4311
3	Innovation	3674
4	Technology	2782
5	Service	1874
6	Industry	1758
7	Research and development	1573
8	Project	1317
9	Manufacturing	1238
10	Nurturing	1068
11	Engineering	1058
12	Equipment	1057
13	Key	1019
14	Economy	1011
15	Center	978
16	Talents	973
17	Material	934
18	Resource	928
19	System	927
20	Management	810
21	New	764
22	Development	754
23	Intelligence	740
24	Entrepreneurship	731
25	Mechanism	719
26	Research	684
27	Software	659
28	Bases	643
29	Core	632
30	Encourage	629
31	Environment	627
32	Policy	626
33	Institution	623
34	Industrialization	615
35	Basis	593
36	Integration	593
37	New energy	590
38	Market	583
39	Scope	549
40	Investment	536
41	Feature	531
42	Planning	527
43	Strategic emerging industry	527
44	Gather	517
45	Cooperation	495
46	Breakthrough	492
47	Strategy	492
48	Electronic	486
49	Energy saving	482
50	Biology	477

Figure 2: The social network of China's high-advanced industry regulation policy.

3.2.3. Classification of Variables and Identification of Parameters.

Based on Jin's policy evaluation variables proposed by Jin [24] and the words combined with high-frequency of policy texts and their social networks analysis results, 10 main variables and 38 subvariables are set and shown in Table 2.

The 10 main variables are as follows: (X_1) Policy type; (X_2) Policy timeliness; (X_3) Policy function; (X_4) Incentives; (X_5) Policy area; (X_6) Policy evaluation; (X_7) Policy focus; (X_8) Policy object; (X_9) Policy level and (X_{10}) Public policy. Policy type (X_1) is to evaluate whether the policy has a predictive, supervisory, advisory, descriptive, and guiding role for high-advanced industries. Policy timeliness (X_2) is to judge whether the policy has the effective duration of long-term, short-term, medium-term, or less than 1 year. Policy function (X_3) is to reveal the purpose of policy introduction and to judge whether the policy can improve the industry's quality level, promote the industry's restructuring, and promote innovation within the industry for the high-advanced industry. Incentives (X_4) refers to incentive measures of the smooth implementation and the active cooperation of policy recipients, including talent introduction, tax subsidies, R&D subsidies, and other incentive measures. Policy area (X_5) is a division based on economic, social, scientific, political, environmental, and other areas to judge the areas covered by the policy. Policy evaluation (X_6) is to evaluate the reasonableness of the policy based on four aspects: adequate basis, a clear objective, a scientific program, and explicit content. Policy focus (X_7) is to examine the focus

involved in the policy content, including innovation, talent training, the transformation of results, market leadership, and other focus. Policy object (X_8) is the object of policy action, including enterprises, financial institutions, regulatory authorities, and other objects. Policy level (X_9) indicates the scope of policy implementation, which is divided into three levels: regional cluster, province, and industry. Public policy (X_{10}) reflects whether the policy is publicly released.

If the policy text has the same content as the subvariables, the parameter of the subvariables is set to "1;" otherwise, it is set to "0." After setting the main variable and subvariable, use the text mining method to score the variables. The variable scoring criteria are shown in Table 3.

3.2.4. Constructing Multi-Input-Output Table.
This study stores, calculates, and analyzes data through multi-input-output tables and uses policy variables to evaluate the effect of the results.

3.2.5. Calculation of the PMC-Index.
Step 1: place the main variables and subvariables into a multi-input-output table. Step 2: evaluate the subvariables based on the variable scoring criteria for text mining. Expression (1) is used to determine the subvariables to be evaluated. Step 3: integrate the values of each subvariable obtained in step 2 according to Expression (1) and calculate the value of variables. Step 4: measure the final PMC-Index according to Expression (2).

$$X \sim N[0, 1],$$

$$X = XR: \ [0 \sim 1],$$

$$X_a = \left(\sum_{b=1}^{n} \frac{X_a b}{T(X_a b)} \right) \quad a = 1, 2, 3, 4, 5 \ldots, \tag{1}$$

a = main variables; b = subvariables:

$$
\begin{aligned}
\text{PMC} - \text{Index} = {} & X_1 \left(\sum_{o=1}^{5} \frac{X_1 o}{5} \right) + X_2 \left(\sum_{p=1}^{4} \frac{X_2 p}{4} \right) + X_3 \left(\sum_{q=1}^{3} \frac{X_3 q}{3} \right) + X_4 \left(\sum_{r=1}^{4} \frac{X_4 r}{4} \right) + \\
& X_5 \left(\sum_{s=1}^{6} \frac{X_5 s}{6} \right) + X_6 \left(\sum_{t=1}^{4} \frac{X_6 t}{4} \right) + X_7 \left(\sum_{u=1}^{5} \frac{X_7 u}{5} \right) + X_8 \left(\sum_{v=1}^{4} \frac{X_8 v}{4} \right) + X_9 \left(\sum_{w=1}^{3} \frac{X_9 w}{3} \right) + X_{10}.
\end{aligned}
\tag{2}
$$

3.2.6. Evaluation the Consistency of Policy Value. The PMC index value can reflect the strategic model's consistency level. As shown in Table 4, when the PMC index value is 0–4.99, the consistency of policy is low. When the PMC index value is 5–6.99, the consistency of policy is acceptable. When the PMC index value is 7–8.99, the consistency of policy is good. When the PMC index value is 9-10, the consistency of policy is entirely perfect. The higher the PMC index value is, the more perfect the content of the policy text is. Then, the policy can have strong operability in practice.

To make the policy assessment more objective and reduce subjective errors, the corresponding score is increased only when the assessment indicators are clearly and explicitly described in the policy text; otherwise, no points are added. When there are indeterminable or highly subjective assessment indicators, discuss them with other researchers before deciding whether to add points. This will make the assessment results more objective and have higher credibility.

3.2.7. Visualization of the PMC-Surface. By visualizing the PMC index value, this study draws a PMC surface diagram, which can intuitively and clearly perspective the policy model, so as to judge the effectiveness of the policy. Draw PMC surface diagram according to PMC matrix in Expression (3). PMC matrix is a 3×3 matrix mainly composed of nine variables, namely (X_1–X_9). Because the number of rows and columns in the matrix are the same, these variables have a certain balance and symmetry. Among them, $X_1, X_2,$ and X_3 are series 1, $X_4, X_5,$ and X_6 are series 2, $X_7, X_8,$ and X_9 are series 3.

$$
\text{PMC} - \text{Surface} = \begin{pmatrix} X_1 & X_2 & X_3 \\ X_4 & X_5 & X_6 \\ X_7 & X_8 & X_9 \end{pmatrix}. \tag{3}
$$

4. Results

Considering that the policy priorities issued by government agencies and the commonality and respective characteristics of policies in different regions are different, this study selects 12 representative policy texts according to the provinces or municipalities to which the Yangtze River Delta cities belong. As shown in Table 5, $P_1 - P_3$ is the policy of Shanghai, $P_4 - P_6$ is the policy of Anhui, $P_7 - P_9$ is the policy of Jiangsu, and $P_{10} - P_{12}$ is the policy of Zhejiang.

According to the PMC index model of the above high-advanced industrial policy evaluation, this study uses the text mining method to construct multi-input-output tables for 12 policies and thus calculates scores for each policy. Finally, the PMC-Index and evaluation level of the policies is constructed and shown in Table 6.

As shown in Table 6, the mean value of the 12 policies is 8.09. Among the 12 policies, only the level of P_5 is acceptable, while the level of the PMC-Index for the rest of the policies is good. The overall quality of the 12 policies is excellent. No low consistency policies, with a certain degree of scientific and rationale, can provide guidance for the rapid growth of the high-advanced industry. Nevertheless, the lack of perfect, consistency policies also mean there is still a need and room for further improvement in the design of the policies in terms of content. According to the policies divided by different regions, the mean PMC-Index of Shanghai is 8.24, the mean PMC-Index of Anhui is 7.57, the mean PMC-Index of Jiangsu is 8.35, and the mean PMC-Index of Zhejiang is 8.20. The policy with the highest PMC-Index score is in Jiangsu province, Zhejiang and Shanghai, while Anhui's policy performs poorly compared to other provinces.

To facilitate comparisons between policies, this study plots PMC-Surface for each of the 12 policies by using PMC-

TABLE 2: High-advanced industry policy evaluation variable settings.

Main variables	Sub variables	References
(X_1) policy type	$(X_{1\text{-}1})$ predictive role $(X_{1\text{-}2})$ supervisory role $(X_{1\text{-}3})$ advisory role $(X_{1\text{-}4})$ descriptive role $(X_{1\text{-}5})$ guiding role	[24]
(X_2) policy timeliness	$(X_{2\text{-}1})$ long term (>5 years) $(X_{2\text{-}2})$ medium term (3–5 years) $(X_{2\text{-}3})$ short term (1–3 years) $(X_{2\text{-}4})$ less than 1 year (<1 years)	[24]
(X_3) policy function	$(X_{3\text{-}1})$ improving the quality of industry $(X_{3\text{-}2})$ promoting industrial restructuring $(X_{3\text{-}3})$ promoting technology innovation	Due to social network
(X_4) incentives	$(X_{4\text{-}1})$ talent introduction $(X_{4\text{-}2})$ tax subsidy $(X_{4\text{-}3})$ R&D subsidy $(X_{4\text{-}4})$ other	Due to social network
(X_5) policy area	$(X_{5\text{-}1})$ economy $(X_{5\text{-}2})$ society $(X_{5\text{-}3})$ technology $(X_{5\text{-}4})$ politics $(X_{5\text{-}5})$ environment $(X_{5\text{-}6})$ other	[24]
(X_6) policy evaluation	$(X_{6\text{-}1})$ adequate basis $(X_{6\text{-}2})$ clearly defined goals $(X_{6\text{-}3})$ scientific programs $(X_{6\text{-}4})$ detailed content	[12]
(X_7) policy focus	$(X_{7\text{-}1})$ technological innovation $(X_{7\text{-}2})$ talent cultivation $(X_{7\text{-}3})$ achievement transformation $(X_{7\text{-}4})$ market-leading $(X_{7\text{-}5})$ other	Due to social network
(X_8) policy object	$(X_{8\text{-}1})$ enterprise $(X_{8\text{-}2})$ financing institution $(X_{8\text{-}3})$ management department $(X_{8\text{-}4})$ other	[12]
(X_9) policy level	$(X_{9\text{-}1})$ regional cluster $(X_{9\text{-}2})$ province $(X_{9\text{-}3})$ industry	[24]
(X_{10}) public policy		[12]

Index and PMC-Matrix and conducts a detailed analysis which are shown in Figures 3(a)–3(l). The different colors in the graph represent different segments, with a depression indicating that the variable has a lower score than the other variables and a bump indicating that the variable has a higher score than the other variables.

Most of the 10 main variables scored high and achieved good performance. Among them, X_{10} (Public policy) has a score of 1 with perfect consistency, which is since the implementation of the country's policies is based on the people, so an open-ended approach is taken to the policies. In comparison, X_2 (Policy timeliness) and X_4 (Incentives) have poorer scores, which differ significantly from the mean. Since most of these policy texts play a guiding role in the policy implementation, the specific arrangements for

different periods are not described in great detail. It is also because these policy texts describe the policy in general terms that they do not describe in detail the incentives for the development of the high-advanced industry. Relevant institutions need to improve these, make more detailed and reasonable arrangements for the content of the policy texts, and add some incentives to make the guidance and role of the policy text clearer. To facilitate the comparison of the degree of depression between each principal variable, plot the average depression index of each principal variable in the PMC-Surface as a radar plot in Figure 4. In Figure 4, the mean values of concavity indices for X_2 and X_4 are 0.60 and 0.52, respectively, which are significantly more concave than the other main variables. The mean value of the depression index for X_9 is similarly higher than the overall

TABLE 3: Variable scoring criteria.

	Variables	Scoring criteria
X_1	(X_{1-1}) predictive role	If the policy is predictive, it is 1. If not, it is 0.
	(X_{1-2}) supervisory role	If the policy is regulatory, it is 1. If not, it is 0.
	(X_{1-3}) advisory role	If the policy makes recommendations, it is 1. If not, it is 0.
	(X_{1-4}) descriptive role	If the policy is descriptive, it is 1. If not, it is 0.
	(X_{1-5}) guiding role	If the policy is instructive, it is 1. If not, it is 0.
X_2	(X_{2-1}) long term	If the policy involves long-term content (more than 5 years), it is 1. If not, it is 0.
	(X_{2-2}) medium term	If the policy involves medium-term content (3–5 years), it is 1. If not, it is 0.
	(X_{2-3}) short term	If the policy involves short-term content (1–3 years), it is 1. If not, it is 0.
	(X_{2-4}) within 1 year	If the policy involves the content within 1 years, it is 1. If not, it is 0.
X_3	(X_{3-1}) improving the quality of industry	If the policy has elements to improve the quality of the industry, it is 1. If not, it is 0.
	(X_{3-2}) promoting industrial restructuring	If the policy has elements to promote industrial restructuring, it is 1. If not, it is 0.
	(X_{3-3}) promoting technology innovation	If the policy has elements to promote technology innovation, it is 1. If not, it is 0.
X_4	(X_{4-1}) talent introduction	If the policy involves talent introduction incentives, it is 1. If not, it is 0.
	$(X_{4.2})$ tax subsidy	If the policy involves tax subsidy incentives, it is 1. If not, it is 0.
	(X_{4-3}) R&D subsidy	If the policy involves R&D subsidy incentives, it is 1. If not, it is 0.
	(X_{4-4}) other	If the policy involves other incentives, it is 1. If not, it is 0.
X_5	(X_{5-1}) economy	If the policy is related to the economic field, it is 1. If not, it is 0.
	(X_{5-2}) society	If the policy is related to the social field, it is 1. If not, it is 0.
	(X_{5-3}) technology	If the policy is related to the technology field, it is 1. If not, it is 0.
	(X_{5-4}) politics	If the policy is related to the political field, it is 1. If not, it is 0.
	(X_{5-5}) environment	If the policy is related to the environmental field, it is 1. If not, it is 0.
	(X_{5-6}) other	If the policy is related to the other field, it is 1. If not, it is 0.
X_6	(X_{6-1}) adequate basis	If the policy is well founded, it is 1. If not, it is 0.
	(X_{6-2}) clearly defined goals	If the policy is clear, it is 1. If not, it is 0.
	(X_{6-3}) scientific programs	If the policy is scientific, it is 1. If not, it is 0.
	(X_{6-4}) detailed content	If the policy is exhaustive, it is 1. If not, it is 0.
X_7	(X_{7-1}) technological innovation	If the policy pays attention to technological innovation, it is 1. If not, it is 0.
	(X_{7-2}) talent cultivation	If the policy pays attention to talent cultivation, it is 1. If not, it is 0.
	(X_{7-3}) achievement transformation	If the policy pays attention to achievement transformation, it is 1. If not, it is 0.
	(X_{7-4}) market-leading	If the policy pays attention to market-leading, it is 1. If not, it is 0.
	(X_{7-5}) other	If the policy pays attention to other, it is 1. If not, it is 0.
X_8	(X_{8-1}) enterprise	If the policy involves enterprises, it is 1. If not, it is 0.
	(X_{8-2}) financing institution	If the policy involves financing institutions, it is 1. If not, it is 0.
	(X_{8-3}) management department	If the policy involves management departments, it is 1. If not, it is 0.
	(X_{8-4}) other	If the policy involves other, it is 1. If not, it is 0.
X_9	(X_{9-1}) regional cluster	If the policy focuses on Yangtze river delta, it is 1. If not, it is 0.
	(X_{9-2}) province	If the policy focuses on a province, it is 1. If not, it is 0.
	(X_{9-3}) industry	If the policy involves an industry, it is 1. If not, it is 0.
X_{10}		If the policy is open, it is 1. If not, it is 0.

TABLE 4: Policy evaluation criteria.

PMC-index	0–4.99	5–6.99	7–8.99	9-10
Evaluation	Low	Acceptable	Good	Perfect

mean. The concavity indices of the remaining main variables are all smaller than the mean, indicating that these policy texts are more consistent and dominant in these areas.

When divided by region, there is convergence in the approach of policies introduced by local institutions, and there is some similarity in the values of the resulting PMC-Index. However, there is some variability in the PMC-Index of policies between regions. At a macro level, this is due to the economic, political, and cultural influences of different regions, which lead to differences in the level of policies

introduced. At a micro level, the level of policies introduced is limited by the scope of authority of different institutions and their level of competence.

Most of the 12 policy texts have good consistency with a mean value of 1.91 for the degree of concavity of the PMC-Surface. Only the policy level of P_5 is acceptably consistent, and the degree of depression is much greater than the average degree of depression. This study compares the P_5 with the best-performing P_{10} to compare where the gap exists between the two, and to arrive at the same advantages or disadvantages. As shown in Figure 5, P_5 has a particular gap with P_{10} overall. The scores of the main variables X_1, X_9, and X_{10} of P_5 are the same as P_{10}, but the scores of the remaining main variables of P_5 are lower than P_{10}.

X_2 (Policy timeliness). In P_5, there is only a medium-term plan for the next 5 years, not a long-term plan or a more detailed plan for the short term. P_{10} has not only a 5-year

TABLE 5: High-advanced industry representative policy summary.

Policy	Policy name	Institution	Release date
P_1	Qingpu district to accelerate the implementation of high-tech industrialization.	Shanghai Qingpu district people's government	July 31, 2009
P_2	Supply-side structural reform to promote industrial stability and growth of the structure and transformation.	Shanghai municipal people's government	April 29, 2016
P_3	Shanghai strategic emerging industries development "the 12th five-year plan."	Shanghai municipal people's government	January 4, 2012
P_4	The 12th five-year plan for industrial development of Hefei.	The general office of Hefei municipal people's government	June 23, 2011
P_5	Accelerating the implementation of industrial transformation and upgrading.	Anqing municipal people's government	July 27, 2016
P_6	Accelerating the cultivation of strategic emerging industries.	The office of Wuhu municipal people's government	June 14, 2011
P_7	Suzhou city emerging industries multiplier development plan (2010~2012).	Suzhou municipal people's government of Jiangsu province	November 25, 2010
P_8	The Nanjing action plan for promoting innovation, promoting industrial transformation, and developing an innovative economy.	The CPC Nanjing municipal committee and the Nanjing municipal people's government	March 12, 2010
P_9	The 13th five-year plan strategic emerging industries development plan of Nantong city	Nantong municipal government office	December 28, 2016
P_{10}	The 13th five-year plan for the development of industry and information economy in Hangzhou"	The general office of Hangzhou municipal people's government	December 15, 2016
P_{11}	The 13th five-year industrial development plan	Shaoxing city people's government on the issuance of Shaoxing city	June 15, 2016
P_{12}	Accelerating Hangzhou guiding opinions on intelligent manufacturing for industrial transformation and development.	Hangzhou municipal people's government	August 21, 2015

TABLE 6: PMC-Index and evaluation level of 12 China's high-advanced industrial policies.

Main variables	P_1	P_2	P_3	P_4	P_5	P_6	P_7	P_8	P_9	P_{10}	P_{11}	P_{12}	Average
X_1	0.80	0.80	0.80	0.80	1.00	1.00	0.80	0.80	0.80	1.00	1.00	0.80	0.87
X_2	0.50	0.50	0.25	0.25	0.25	0.25	0.50	0.75	0.25	0.50	0.50	0.25	0.40
X_3	0.67	1.00	1.00	1.00	0.67	1.00	1.00	1.00	1.00	1.00	1.00	0.67	0.92
X_4	0.75	0.50	0.75	0.00	0.25	0.50	0.50	0.50	0.50	0.75	0.50	0.25	0.48
X_5	1.00	1.00	1.00	1.00	0.83	1.00	1.00	1.00	1.00	1.00	1.00	0.83	0.97
X_6	1.00	1.00	1.00	1.00	0.75	1.00	1.00	1.00	1.00	1.00	1.00	0.75	0.96
X_7	0.60	0.80	1.00	0.60	0.80	1.00	0.80	1.00	1.00	1.00	1.00	0.80	0.87
X_8	1.00	1.00	1.00	1.00	0.75	1.00	0.75	0.75	1.00	1.00	1.00	1.00	0.94
X_9	0.67	0.67	0.67	0.67	0.67	0.67	0.67	1.00	0.67	0.67	0.67	0.67	0.70
X_{10}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Total score	7.99	8.27	8.47	7.32	6.97	8.42	8.02	8.80	8.22	8.92	8.67	7.02	8.09
Ranking	9	6	4	10	12	5	8	2	7	1	3	11	—
Level	Good	Good	Good	Good	Acceptable	Good	Good	Good	Good	Good	Good	Good	—

medium-term plan but also a long-term plan beyond 5 years, but the description of the short-term plan is still missing in P_{10}.

X_3 (Policy function). P_5 contains the content of promoting the quality of the industry and scientific and technological innovation, but there is no clear proposal for restructuring the industry. On this issue, P_5 does not keep pace with the times and makes strategies to improve the industrial structure. P_{10}'s policy features are much more

comprehensive, providing more detailed descriptions of each of these directions.

X_4 (Incentives). Regarding incentives, P_5 only mentions making corresponding financial subsidies, and there are no more incentives to encourage the development of the high-advanced industry. While in P_{10}, not only financial subsidies and loan subsidies are mentioned, but also talent introduction and tax subsidies, which are more conducive to accelerating the development of the high-advanced
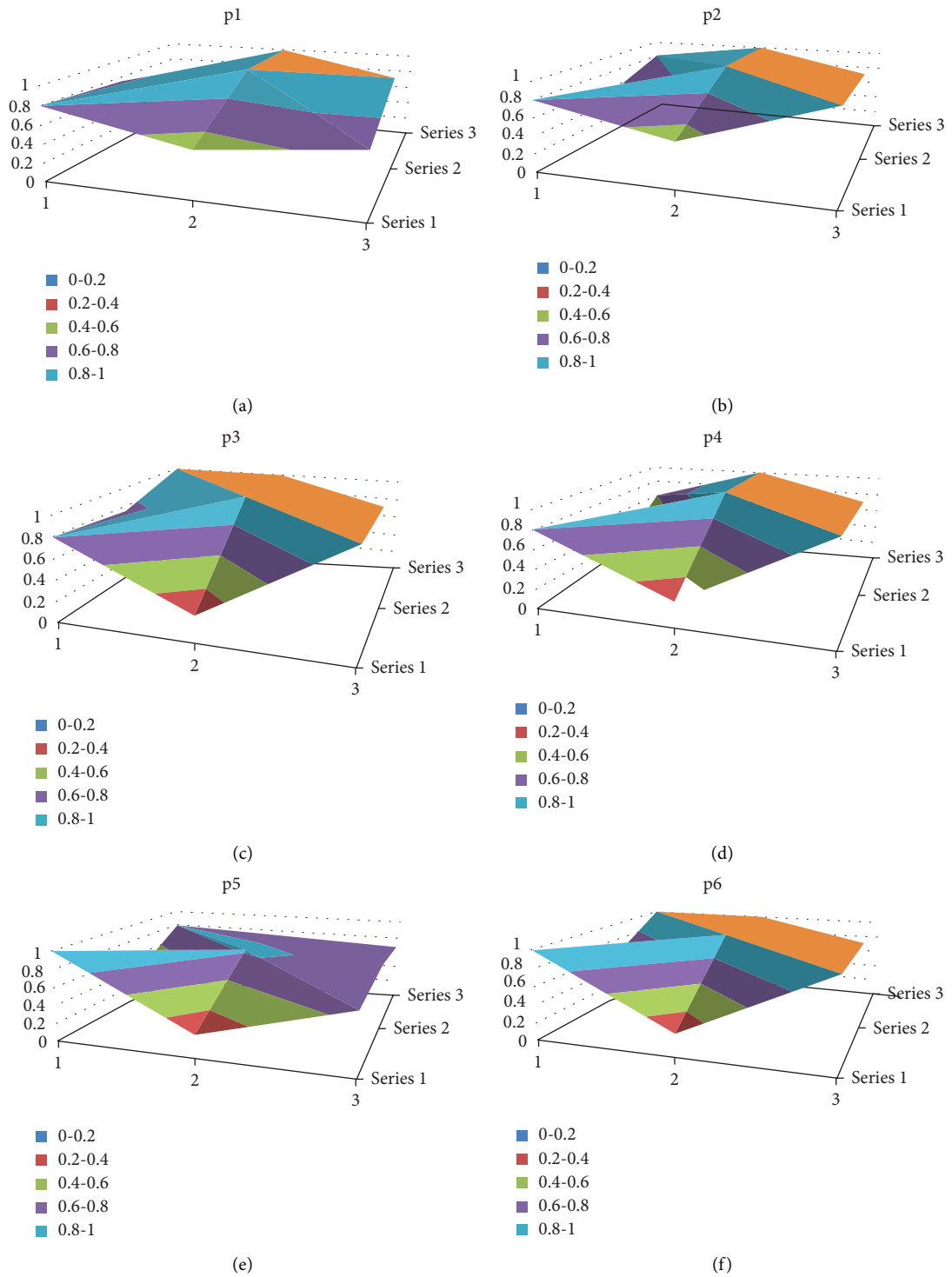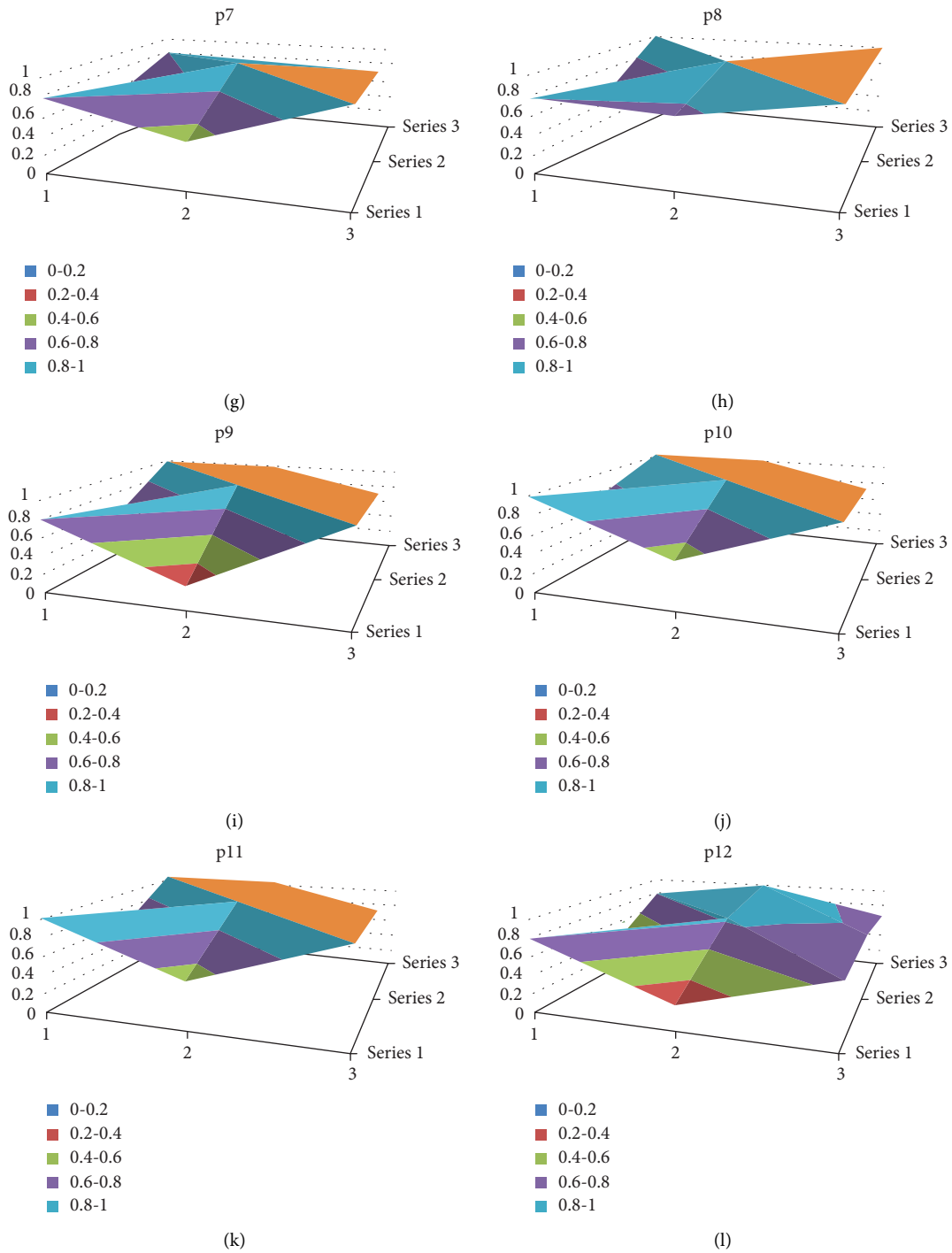
p1

Series 3
Series 2
Series 1

■ 0-0.2
■ 0.2-0.4
■ 0.4-0.6
■ 0.6-0.8
■ 0.8-1

(a)

p2

Series 3
Series 2
Series 1

■ 0-0.2
■ 0.2-0.4
■ 0.4-0.6
■ 0.6-0.8
■ 0.8-1

(b)

p3

Series 3
Series 2
Series 1

■ 0-0.2
■ 0.2-0.4
■ 0.4-0.6
■ 0.6-0.8
■ 0.8-1

(c)

p4

Series 3
Series 2
Series 1

■ 0-0.2
■ 0.2-0.4
■ 0.4-0.6
■ 0.6-0.8
■ 0.8-1

(d)

p5

Series 3
Series 2
Series 1

■ 0-0.2
■ 0.2-0.4
■ 0.4-0.6
■ 0.6-0.8
■ 0.8-1

(e)

p6

Series 3
Series 2
Series 1

■ 0-0.2
■ 0.2-0.4
■ 0.4-0.6
■ 0.6-0.8
■ 0.8-1

(f)

FIGURE 3: Continued.

(g)

(h)

(i)

(j)

(k)

(l)

FIGURE 3: (a) P_1, (b) P_2, (c) P_3, (d) P_4, (e) P_5, (f) P_6, (g) P_7, (h) P_8, (i) P_9, (j) P_{10}, (k) P_{11}, (l) P_{12}.

industry. Nevertheless, P_{10} still has no content about R&D subsidies, lacking emphasis and focus on science and technology R&D.

X_5 (Policy area). P_5 covers various areas such as economy, politics, ecology, etc., but the description of the social

area is less clear, so it does not get the corresponding score. P_{10}, on the other hand, clearly articulated each area and received a score of 1.

X_6 (Policy evaluation). P_{10} has sufficient basis, clear objectives, scientific arrangement, and detailed description.
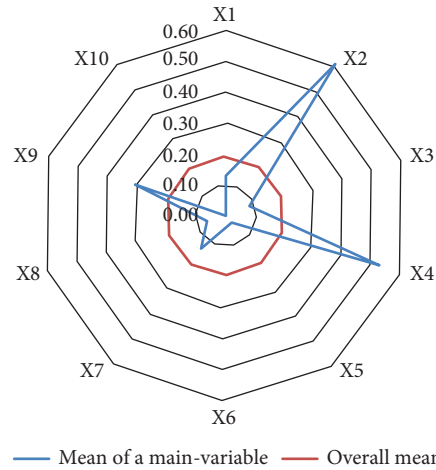
Figure 4: Radar chart of main variables depression index.
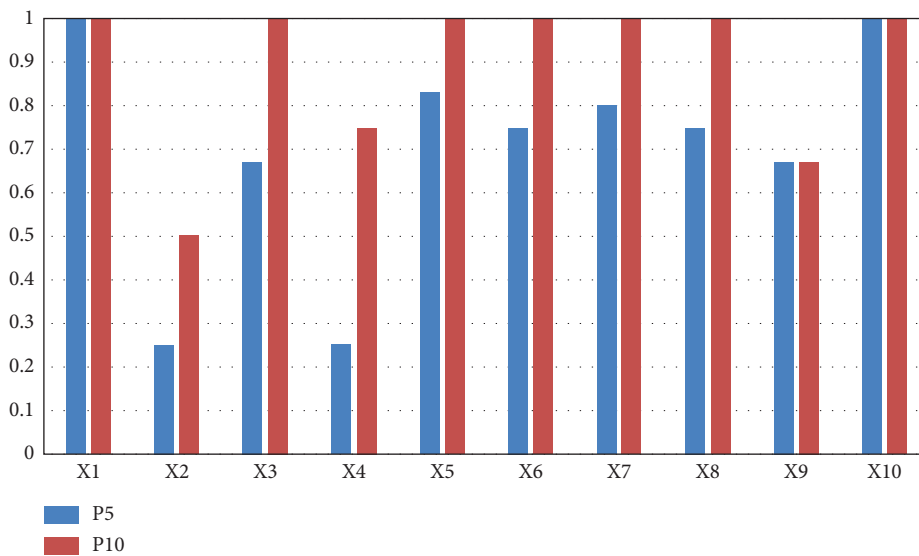
Figure 5: Scores of each main-variable for P_5 and P_{10}.

The content of P_5 seems to be general and cursory, and the short length does not describe clearly in detail, but other aspects of the performance are not bad.

X_7 (Policy focus). The content of P_5 has the focus on policies such as innovation, the transformation of achievements, and market leadership. In addition to these elements, P_{10} also mentions the introduction of human resources and the importance of being people-oriented.

X_8 (Policy object). P_5 mentions enterprises, financial institutions, management agencies, and other policy objects, but the descriptions are cursory and there are no other policy objects. P_{10} then clearly and explicitly states these policy objects, on top of which other policy objects such as service organizations are also mentioned.

5. Discussion and Conclusions

5.1. Conclusion and Implications. This study adopts the content analysis method and text mining method, combined with the PMC-Index model to evaluate high-advanced industry policies in Yangtze River Delta region quantitatively and selects 12 representative high-advanced industry policy texts for specific analysis. The study found that the design of high-advanced industry policies was relatively reasonable overall, with 11 policies rated as "Good Consistency" and only one policy rated as "Acceptable Consistency." In general, the high-advanced industry policy has, to some extent, promoted the industrial restructuring and the development of high-

advanced industry in China, but there are still some problems to be improved.

First, the policy lacks reasonable arrangements for different period plans. The mean value of X_2 (policy duration) is only 0.4, and most of the policy samples have only planned arrangements for one or two periods. Although the formulation is detailed and precise, there is no mention of arrangements for other periods. The establishment of planning arrangements for different periods is beneficial for enterprises, local governments, and relevant departments to have clear objectives at different periods of high-advanced industrial development. It also needs to optimize "guidance" in X_1 and "detailed content" in X_6.

Second, the sample policies lack incentives or have relatively single incentives. Most of the sample policies contain incentives in the form of financial subsidies and loan subsidies, but almost all of them do not mention R&D subsidies, reflecting China's insufficient incentive policy support for R&D in high-advanced industries. The level of R&D subsidies in China has increased in recent years, but most of them are provided directly to state-owned enterprises, with only a tiny percentage allocated to private and triple-funded enterprises. As a result, there is little mention of R&D subsidies in the sample policies. In the subsequent policy development and modification, attention should be paid to the related issues, and resources should be allocated rationally to improve the effectiveness of incentives.

Third, the policy influence among cities in the Yangtze River Delta urban agglomerations is small, and the integration trend is not apparent. The score for the subvariable "regional cluster" in X_9 is almost 0. The synergy effect of high-advanced industry policies between different regions is relatively low, and the advantages of integrated development of the Yangtze River Delta urban agglomerations have not been shown. There is a certain gap in the scores of high-advanced industrial policies between Shanghai, Zhejiang, Jiangsu, and Anhui. The policy with the highest PMC-Index score is in Jiangsu, Zhejiang, and Shanghai, while Anhui's policy performs poorly compared to other provinces' policies, which means there is still a need and room for further improvement in the design of the policies in terms of content. Partners between urban agglomerations can benefit from the dynamic synergies of mutual growth through reciprocity, knowledge exchange, and realizing significant economies of scope.

5.2. Limitation. There are still some limitations in this study. First, further research is still needed for the dimensionality and extension of the variable selection [28–32]. On the one hand, some variables with universal applicability can be set according to the basic attributes of the policy [33]. On the other hand, some variables with targeted nature can be set out according to the special attributes of the studied policies, which can be analyzed for specific directions [34]. Second, although this study integrates the results of content analysis and text mining, the evaluation of policies and the set of variables are still somewhat subjective [35, 36]. Third,

because the PMC-Index model needs to take into account all global variables, the model does not enable a detailed analysis for a particular direction.

Data Availability

The data supporting the conclusions of this research can be obtained from the corresponding author upon request.

Conflicts of Interest

The authors declare that there are no conflicts of interest in this study.

Acknowledgments

References

[1] B. D'Ippolito, A. Messeni Petruzzelli, and U. Panniello, "Archetypes of incumbents' strategic responses to digital innovation," *Journal of Intellectual Capital*, vol. 20, no. 5, pp. 662–679, 2019.

[2] R. Ceipek, J. Hautz, A. M. Petruzzelli, A. De Massis, and K. Matzler, "A motivation and ability perspective on engagement in emerging digital technologies: the case of Internet of Things solutions," *Long Range Planning*, vol. 54, no. 5, Article ID 101991, 2021.

[3] N. K. Hanna, "Mastering digital transformation," *Mastering Digital Transformation (Innovation, Technology, and Education for Growth)*, Emerald Publishing, Bingley, UK, 2016.

[4] V. Parida, D. Sjödin, and W. Reim, "Reviewing literature on digitalization, business model innovation, and sustainable industry: past achievements and future promises," *Sustainability*, vol. 11, no. 2, p. 391, 2019.

[5] T. J. Sturgeon, "Upgrading strategies for the digital economy," *Global Strategy Journal*, vol. 11, no. 1, pp. 34–57, 2019.

[6] H. Wen, Q. Zhong, and C. C. Lee, "Digitalization, competition strategy and corporate innovation: e," *International Review of Financial Analysis*, vol. 82, Article ID 102166, 2022.

[7] Y. Yang, M. Liang, S. Sun, and Y. Zou, "Strengthening top–down design? Mapping science, technology and innovation policy developments in China in the age of COVID-19," *Asian Journal of Technology Innovation*, pp. 1–22, 2022.

[8] S. Zeng, J. Zhou, C. Zhang, and J. M. Merigó, "Intuitionistic fuzzy social network hybrid MCDM model for an assessment of digital reforms of manufacturing industry in China," *Technological Forecasting and Social Change*, vol. 176, Article ID 121435, 2022.

[9] O. Ellingsen and K. E. Aasland, "Digitalizing the maritime industry: a case study of technology acquisition and enabling

advanced manufacturing technology," *Journal of Engineering and Technology Management*, vol. 54, pp. 12–27, 2019.

[10] J. Ye, Q. Wan, R. Li, Z. Yao, and D. Huang, "How do R&D agglomeration and economic policy uncertainty affect the innovative performance of Chinese high-tech industry?" *Technology in Society*, vol. 69, Article ID 101957, 2022.

[11] M. Muro, J. Rothwell, S. Andes, K. Fikri, and S. Kulkarni, *America's Advanced Industries: What They Are, where They Are, and Why They Matter*, Brookings, Washington, DC, USA, 2015.

[12] Y. A. Zhang and Z. Geng, "The quantitative evaluation of regional science and technology innovation policy: based on the index of PMC model," *Science and Technology Management Research*, vol. 35, pp. 26–31, 2015.

[13] Y. Li, R. He, J. Liu, C. Li, and J. Xiong, "Quantitative evaluation of China's pork industry policy: a PMC index model approach," *Agriculture*, vol. 11, no. 2, p. 86, 2021.

[14] X. Liu and T. Buck, "Innovation performance and channels for international technology spillovers: evidence from Chinese high-tech industries," *Research Policy*, vol. 36, no. 3, pp. 355–366, 2007.

[15] T. Li, L. Liang, and D. Han, "Research on the efficiency of green technology innovation in China's provincial high-end manufacturing industry based on the Raga-PP-SFA model," *Mathematical Problems in Engineering*, vol. 2018, Article ID 9463707, 13 pages, 2018.

[16] D. Wu, X. Tong, L. Liu, and J. Wang, "Do regional financial resources affect the concentration of high-end service industries in Chinese cities?" *Finance Research Letters*, vol. 42, Article ID 101935, 2021.

[17] C. Miao, D. Fang, L. Sun, Q. Luo, and Q. Yu, "Driving effect of technology innovation on energy utilization efficiency in strategic emerging industries," *Journal of Cleaner Production*, vol. 170, pp. 1177–1184, 2018.

[18] D. Prud'homme, "Dynamics of China's provincial-level specialization in strategic emerging industries," *Research Policy*, vol. 45, no. 8, pp. 1586–1603, 2016.

[19] I. Sanderson, "Evaluation, policy learning and evidence-based policy making," *Public Administration*, vol. 80, no. 1, pp. 1–22, 2002.

[20] E. Suchman, *Evaluative Research: Principles and Practice in Public Service and Social Action Programs*, Russell Sage Foundation, Manhattan, NY, USA, 1968.

[21] O. F. Poland, "Program evaluation and administrative theory," *Public Administration Review*, vol. 34, no. 4, p. 333, 1974.

[22] W. E. N. Jun, "Fuzzy comprehensive evaluation of risk in airline safety system," *Journal of Safety Science and Technology*, vol. 6, no. 1, pp. 44–48, 2010.

[23] S. Wang, Y. Wang, and L. I. Chao, "Application of BP neural network in inherent safety degree evaluation of aviation maintenance personnel," *Journal of Safety Science and Technology*, vol. 6, no. 6, pp. 35–39, 2010.

[24] J. L. Jin, Y. M. Wei, and J. Ding, "Fuzzy comprehensive evaluation model based on improved analytic hierarchy process," *Journal of Hydraulic Engineering*, vol. 3, no. 3, pp. 65–70, 2004.

[25] M. A. Ruiz Estrada, "Policy modeling: definition, classification and evaluation," *Journal of Policy Modeling*, vol. 33, no. 4, pp. 523–536, 2011.

[26] B. Kuang, J. Han, X. Lu, X. Zhang, and X. Fan, "Quantitative evaluation of China's cultivated land protection policies based on the PMC-Index model," *Land Use Policy*, vol. 99, Article ID 105062, 2020.

[27] T. Yang, C. Xing, and X. Li, "Evaluation and analysis of new-energy vehicle industry policies in the context of technical innovation in China," *Journal of Cleaner Production*, vol. 281, Article ID 125126, 2021.

[28] L. Yan, S. Yin-He, Y. Qian, S. Zhi-Yu, W. Chun-Zi, and L. Zi-Yun, "Method of reaching consensus on probability of food safety based on the integration of finite credible data on block chain," *IEEE Access*, vol. 9, pp. 123764–123776, 2021.

[29] S. Liu, J. Zhang, B. Niu, L. Liu, and X. He, "A novel hybrid multi-criteria group decision-making approach with intuitionistic fuzzy sets to design reverse supply chains for COVID-19 medical waste recycling channels," *Computers & Industrial Engineering*, vol. 169, Article ID 108228, 2022.

[30] J. Yan, H. Jiao, W. Pu, C. Shi, J. Dai, and H. Liu, "Radar sensor network resource allocation for fused target tracking: a brief review," *Information Fusion*, vol. 86-87, pp. 104–115, 2022.

[31] W. Zheng, X. Liu, and L. Yin, "Research on image classification method based on improved multi-scale relational network," *PeerJ Computer Science*, vol. 7, p. e613, 2021.

[32] Z. Ma, W. Zheng, X. Chen, and L. Yin, "Joint embedding VQA model based on dynamic word vector," *PeerJ Computer Science*, vol. 7, p. e353, 2021.

[33] W. Zheng, L. Yin, X. Chen, Z. Ma, S. Liu, and B. Yang, "Knowledge base graph embedding module design for Visual question answering model," *Pattern Recognition*, vol. 120, Article ID 108153, 2021.

[34] L. Yao, X. Li, R. Zheng, and Y. Zhang, "The impact of air pollution perception on urban settlement intentions of young talent in China," *International Journal of Environmental Research and Public Health*, vol. 19, no. 3, p. 1080, 2022.

[35] B. Wu, A. Monfort, C. Jin, and X. Shen, "Substantial response or impression management? Compliance strategies for sustainable development responsibility in family firms," *Technological Forecasting and Social Change*, vol. 174, Article ID 121214, 2022.

[36] P. Ghimire, "Digitalization of indigenous knowledge in Nepal—review article," *Acta Informatica Malaysia*, vol. 5, no. 2, pp. 42–47, 2021.