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Research on Quality Improvement Strategies for Labor Service Brand Construction under Big Data Context

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ABSTRACT

Amidst China ' s national employment-priority strategy emphasizing high-quality and full employment, regional labor service brands have emerged as pivotal vehicles for activating local workforce resources. Yet their quality construction urgently demands theoretical breakthroughs and practical innovation. Leveraging such brands to stimulate regional labor forces and enhance employment quality represents a critical solution to regional economic development bottlenecks.

This study pioneers a multi-agent-driven quality formation model for labor service brands under the Stimulus-Organism-Response (SOR) framework. The model specifies brand symbols, industrial maturity, and management incentives as independent variables, perceived brand value as the mediating variable, and brand quality as the dependent variable.

Empirical analysis of 258 valid questionnaires via partial least squares structural equation modeling (PLS-SEM) reveals that:

(1) Perceived brand value (β=0.706, p<0.001) serves as the key psychological mediator for quality enhancement;

(2) Differential contributions of stimuli to perceived brand value follow this order: brand symbols (β=0.402) > industrial maturity (β=0.346) > management incentives (β=0.167);

(3) The "symbol-driven primacy principle" is quantified for the first time: the indirect effect of brand symbols on quality (0.284) is 2.4 times that of policy incentives (0.118), challenging the traditional policy-dominant paradigm.

Accordingly, a "Trifold Precision Governance Framework for Big Data" is proposed to advance brand quality.

Keywords: Labor service brand; Brand quality; Perceived brand value; Big data governance; PLS-SEM

1.Introduction

1.1 Research Context

Hebei Province, a major provincial - level region in terms of both population and traditional labor export, serves as a crucial area for the coordinated development of the Beijing - Tianjin - Hebei region. It boasts a large number of provincial and municipal-level labor service brands, covering multiple fields such as home economics, manufacturing, construction, and food processing. Well-known labor service brands in the home economics service category include “ Hebei Fushao”. In the manufacturing category, there are “Wu'an Steel Workers” and “Jinzhou Textile Workers”, etc.

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In the construction category, brands like "Xiongan Longhua Decoration Engineers" and "Zhengding Carpenters" exist. And in the food processing category, "Hebei Dairy Workers" and "Jinshahe Noodle-making Workers" are among them.

However, the construction of labor service brands faces threefold structural contradictions. First, there is a lack of brand symbols, as most labor service brands do not have unified visual identities. Second, there is a quality gap, with only a small number of brands having established specialized skill specifications. Third, there is a mismatch between production and demand. The intelligent construction needs of the Xiongan New Area do not correspond to traditional labor skills. At the same time, the industrial structure upgrading in Hebei Province (such as the intelligent construction in the Xiongan New Area) has put forward higher requirements for labor skills. However, the existing labor service brands have an insufficient degree of matching with industrial demands, resulting in a structural contradiction between labor supply and industrial upgrading[1].

From a national perspective, the construction of labor service brands has shifted from the stage of scale expansion to that of quality improvement. The national "14th Five-Year Plan" clearly proposes to "cultivate several well-known labor service brands". Nevertheless, at the regional level, there is still a lack of a systematic theoretical framework and empirical support for quality improvement.

Competition in the labor market has shifted from quantity and scale to quality and brands. Labor service brands have gradually become a booster for the labor service economy and can well enhance the quality of workers. As a crucial node for the coordinated development of the labor force in the Beijing - Tianjin - Hebei region, the quality improvement of labor service brands in Hebei Province is not only related to local employment and income increase but also involves the overall situation of the coordinated development of the regional economy[2]. Therefore, exploring the path for improving the quality of labor service brands in line with regional characteristics is of urgent practical need.

1.2 Literature Review

A labor service brand is also a type of brand. It is an extension of a product brand. In the construction and promotion of a labor service brand, the theories and research results of product brands can also be applied. The core lies in the differentiated identification of workers' skills[3].

A labor service brand is a market mark formed by regional labor forces through occupational characteristics and needs to possess skill professionalism and group reputation[4]. For the research on labor service brands, it is necessary to reflect their inheritance from product brands and regional brands, while also emphasizing their uniqueness[5].

A labor service brand has the quality, reputation, and cultural characteristics of a product brand. Additionally, it has its uniqueness. Workers need to have professional skills, communication skills, cooperation skills, a highly conscientious and responsible work attitude, as well as basic elements in interpersonal communication such as integrity and good manners.

The carrier of a labor service brand is the workers themselves. Therefore, labor service brands have uniqueness and complexity different from ordinary commodities. Labor services are generally intangible, and purchasers usually cannot see, smell, taste, or feel them in advance. Labor services have quality differences. Quality difference means that services are non-standard and unstable. The components and quality levels of services often change, and it is difficult to uniformly define them. Precisely because of this, the design of labor service products must maintain the due quality and strive for consistency.

Labor services are similar to ordinary products in brand building. Both need to find distinctive brand elements that purchasers need, and need to be positioned, and the brand elements need to be beautified and designed, and integrated marketing communication needs to be carried out. The construction of a labor service brand needs to be oriented towards purchasers' needs. Labor service products need to have core values, need to have personalized identification symbols, and also need a stable supply of human resources. Labor services generally originate from a certain industry in a certain region, so the development maturity of related industries in the region where the labor service is located has an important impact on the local labor service.

A labor service brand needs to be built according to the unique cultural endowments, industrial development, and human resources of a certain region and can be shared by workers in the region[6].

For the construction of a labor service brand, first, it is necessary to have a certain scale of labor service output; second, the skill training for labor service personnel needs to be strengthened; third, actively shape the image of the labor service brand[7]; fourth, attach importance to the promotion and publicity of the labor service brand; fifth, the long - term support and investment from government departments.

To build a labor service brand, measures can be taken from eight aspects: first, overall planning by the government; second, innovate training methods; third, implement targeted training; fourth, combine vocational training with skill appraisal; fifth, unblock the channels for the output of the labor service brand; sixth, complete the construction of the labor market[8]; seventh, guide and cultivate labor service intermediary institutions and rural labor brokers; eighth, increase the intensity of the publicity of the labor service brand.

A labor service brand is a regional brand and has the nature of a public product. The management subjects of a labor service brand include the government, industry associations, training institutions, leading enterprises, etc. To prevent phenomena such as "free-riding" and "tragedy of the commons", the government needs to regulate, support , and guide the formation and operation of labor service brands. Stakeholders such as industry associations, training i nstitutions, and intermediary institutions play important roles. Government departments need to coordinate all partie s to participate together and play their auxiliary roles. Only through the promulgation of laws and regulations and effe ctive administrative management can the government coordinate stakeholders to jointly build labor service brands.

1.3 Literature Gaps

Existing research focuses on the leading role of the government, the industrial environment, and the design of brand elements, yet it overlooks the psychological mechanisms of buyers. For instance, how "perceived brand value" translates policy stimuli into quality improvement remains underexplored. Most of the existing research results discus s the connotation of labor service brands and summarize the development stage processes of certain successful labor s ervice brands, lacking theoretical depth. Previous studies mostly examine the success experiences of a single specific la bor service brand and then generalize the strategies that various brand management subjects should adopt. Existing re search often uses training scale and employment numbers as brand quality indicators, failing to incorporate buyers' a ttitudes. This easily leads to a disconnect between policies and market demands; for example, the quantity of labor ser vices may increase, but the employment rate may not improve.

Whether the quality of a labor service brand is good or not requires buyers to make evaluations cognitively and emotionally. Currently, there is limited research on the psychological activity process of buyers under the stimulation of labor service brands. This is precisely the core logic of labor service brand construction. Therefore, identifying the psychological change mechanisms of buyers that need to be followed to build high-quality labor service brands is a research gap. The initial stimulus sources of labor service brands that buyers receive include brand symbols, incentive policies of brand management subjects, and stimuli from the industrial environment. However, the relative contribution of these stimuli is unclear.

1.4 Research Motivation and Innovation Points

The importance of labor service brand construction in the labor service field is increasingly rising, yet there are still several important gaps in existing research. Currently, it is necessary to clarify the mechanism of buyers' psycholo gical activities under the influence of different stimulus sources. It is necessary to define the extent of the impact of diff erent stimulus sources on buyers' psychological activities. There is also a need to clarify the subtle psychological proc ess by which buyers form brand quality evaluations after perceiving brand value. At present, empirical research in this regard in the labor service brand field is quite limited.

Therefore, this study takes the SOR model as the basic framework, regards brand symbols, industrial maturity, and brand manager incentives as stimulus sources, observes their impact on buyers' perceived brand value, and the m echanism by which they further form brand quality through influencing perceived brand value.

The innovation points of this study are as follows: it empirically tests the SOR psychological path (external stimuli → perceived brand value → brand quality) in the formation of labor service brand quality, quantifies the differential contributions of brand symbols, industrial maturity, and brand management subject incentives to the formation of brand quality; and based on the analysis of mediating effects, proposes precise governance countermeasures for labor service brands in Hebei Province.

Currently, with the rapid development of big data technology, data acquisition is gradually becoming easier[9], and the technology is gradually maturing[10]. This provides an important foundation for data analysis. If there is a large amount of data on the development of labor services and industries, and through data analysis, brand managers can formulate differentiated incentive policies, which can promote the higher-quality development of labor service brands [11]. Based on this, this study proposes a "Big Data-based Three-Dimensional Precision Governance Framework".

2 Research Hypotheses and Model Construction

2.1 Stimulus-Organism-Response(SOR) Theory

The SOR theory was proposed by environmental psychologists Mehrabian and Russell in 1974. Its connotation is that when an individual is exposed to a stimulus (Stimulus), there is a psychological processing process within the individual (Organism), including perception, cognition, emotion, motivation, etc. After the individual psychologically processes the stimulus, they will exhibit attitude changes or explicit behaviors (Response), such as evaluation, approach, avoidance, purchase decisions, etc.

The purchase decision of labor service brands is essentially an information-processing behavior, which conforms to the logic of "external stimulus psychological perception behavioral feedback".

The SOR theory is a theory that explains the mechanism of individual behavioral responses in specific environments. The stimulus sources in the theory include marketing - related stimuli and non - marketing - related stimuli. In this study, the stimulus sources include brand symbols, incentives from brand management subjects, and industrial maturity. Among them, marketing - related stimuli refer to brand symbols, and non - marketing - related stimuli refer to incentives from brand management subjects and industrial maturity. The organism corresponds to the process of changes in buyers' perceived brand value. The response refers to buyers' evaluation of brand quality.

2.2 Brand Quality

Brand quality refers to buyers' perception and evaluation of the overall quality, reliability, and value of products or services represented by a brand. It includes factors such as the physical attributes of the product itself, brand commitments, consumer experience, and market reputation. What labor service brands provide to buyers is labor service personnel. These personnel need to possess professional skills, cultural qualities, and professional ethics, and be able to provide utility and solve problems for buyers.

Labor service brand quality is the buyers' perception and evaluation of the overall quality, reliability, and value represented by a certain type of labor service personnel. It includes both the quality of labor service personnel and buyers' evaluation after experiencing the labor service. The quality of labor service personnel is determined by their professional skills, cultural qualities, and professional ethics.

Indicators of good labor service brand construction quality include: high overall quality of such labor service personnel with a relatively clear evaluation and certification system; stable and reliable services provided; positive emotional value delivered[12]; personalized symbolic logos; continuous and effective management incentives from the government or industry associations[13]; sustainable development of related industries; and commitment and integrated communication of brand quality. Managers of labor service brands are market-oriented and take human capital investment as the main business method.

2.3 Perceived Brand Value

Brand value is a combination of benefits that a brand can provide to buyers. The core brand value is the most basic and important combination of benefits that can be provided to buyers. It is the content that supports the long-term survival and development of the brand and remains unchanged. It consists of functional value, emotional value, and symbolic value. Functional value is the basic value, referring to the efficacy of a product or service. Emotional value is the emotional benefits brought by the brand to consumers, such as style, cultural atmosphere, and spiritual realm. Symbolic value is the values, identity, and image embodied by the brand. The core brand value comes from the exploration and planning of brand managers. Exploration involves finding benefits that can be provided to buyers within the product and the organization. Planning refers to brand managers planning the personality and symbols of the brand according to the characteristics of the product or service[14].

Perceived brand value is the psychological premium judgment formed by labor service buyers after comparing the comprehensive benefits and costs of the services provided based on brand experience. Perceived brand value emphasizes perception, which consists of sensation and perception. Sensation is the buyer's response to individual attributes of the labor service brand. Perception is the buyer's response to the overall attributes of the labor service brand. The process of perception is the process by which buyers pay attention, understand, and recognize. Perception is the basis for buyers to generate emotions and purchase intentions[15].

The value provided by the brand to buyers must be able to attract buyers' attention, stimulate their interest, arouse their desire, and prompt them to make a purchase[16]. After purchasing and using a labor service brand, buyers should be able to solve their problems and have a good experience. Only in this way can buyers feel that the brand has high value. In the SOR framework, perceived brand value is the cognitive hub that transforms external stimuli into behavioral responses, and its intensity directly affects brand quality.

This study hypothesizes H1: Perceived brand value significantly affects brand quality.

2.4 Brand Symbols

Brand symbols are tangible or intangible elements that can intuitively convey brand value, serving as a carrier connecting brand owners and buyers[17]. In the context of labor service brands, their core dimensions include: visual symbols, linguistic symbols, behavioral symbols, and digital symbols. Visual symbols refer to recognizable visual elements such as brand names, logo designs, and service attire; linguistic symbols include language communication contents like brand slogans, service commitments, and industry reputation; behavioral symbols involve perceivable behavioral patterns such as service processes and professional etiquette of labor service personnel; digital symbols are new symbolic carriers in the Internet era, such as online platform images and digital certifications (e.g., blockchain skill certificates).

A labor service brand is manifested through brand symbols, representing valuable labor service relationships. Brand symbols are embodied in brand names, logos, brand stories, brand music, etc. When buyers see these symbols, they can associate them with their relationship with the brand. This relationship is valuable, enabling buyers to purchase more frequently, in larger quantities, and over a long period[18].

This study hypothesizes H2: Brand symbols significantly affect perceived brand value.

2.5 Industrial Maturity

Industrial maturity refers to the comprehensive development level of industries directly related to labor service brands (such as manufacturing, service industry, training industry, etc.) in a specific region in terms of scale agglomeration, technical level, market competitiveness, organizational collaboration, and ecological improvement. Factors influencing industrial maturity include the stage of the industrial life cycle, factor allocation efficiency, and the perfection of the institutional environment.

According to industrial economics theory, industrial maturity is mainly characterized by the evolution of industries from the "growth stage" to the "mature stage". Characteristics of mature industries include: stable industrial output value, employment numbers, and enterprise quantity, forming large-scale production or service capabilities; mature key technical routes, unified quality standards, process flows, and service norms; and industrial clusters led by leading enterprises with supporting small and medium-sized enterprises.

Mature industries have efficient resource integration capabilities. High factor allocation efficiency is an important feature of industrial maturity. In terms of human capital specialization, the labor market forms a pool of skilled talents in segmented fields, such as "Handan ceramic technicians," corresponding to the technological inheritance of the local ceramic industry. In terms of technology innovation transformation, mature R&D investment and achievement transformation mechanisms promote the upgrading of skill demands to high-end levels. For example, the demand for " intelligent equipment engineers" in Tangshan's equipment manufacturing industry, in terms of industrial chain collaboration, upstream and downstream enterprises have clear divisions of labor, forming a closed loop of "R&D - production - service".

A sound institutional environment is a necessary condition for industrial maturity. The perfection of the institutional environment is reflected in: standardized policies; mature development of industry associations, chambers of commerce, and other organizations; effective market organization mechanisms, with a demand-oriented price formation mechanism and competitive order in the market.

Industrial maturity and the development of labor service brands are in a mutually promoting and constraining relationship. Industrial maturity can provide a demand foundation and a soil for talent cultivation for labor service brands. It can promote the maturity of related labor service brands, and buyers' trust in industrial products will be transferred to labor services, increasing the premium of labor service brands. In addition, industrial development also provides a market for labor services[19].

This study hypothesizes H3: Industrial maturity significantly affects perceived brand value.

2.6 Incentives from Brand Management Subjects

Brand management subjects include governments, industry associations, leading enterprises, etc. Governments and industry associations supervise, evaluate, and certify the quality of labor service brands, which can well guarantee buyers' perceived brand value.

Incentive methods adopted by governments and industry associations generally include: quality standards, certification systems, industry conventions, cultural promotion, and benchmarking cases. Governments and industry associations have strong driving capabilities in promoting the application of new technologies in building labor service brands.

Labor service personnel with proficient and advanced labor skills possess functional value in solving certain types of problems. Some skills mastered by labor service personnel play a crucial role in promoting regional social culture and economic development. These skills need to be summarized, standardized, and promoted. Governments and industry associations can integrate multiple parties; for example, they can coordinate universities or training institutions to summarize and promote important skills of labor service personnel.

Incentives from brand management subjects can ensure the quality of labor services. Moreover, the dissemination of such incentives can, to a certain extent, make buyers more trusting of the quality of labor services. For instance, strict and effective labor service brand certification systems adopted by governments and industry associations can make buyers more confident in their purchases. By formulating policies, brand management subjects can make labor service personnel and training institutions pay more attention to the quality of labor services they provide, thereby forming higher and more stable functional value and enabling consumers to[20].

This study proposes Hypothesis H4: Incentives from brand management subjects significantly affect perceived brand value.

2.7 Model Construction

The research framework positions brand symbols, industrial maturity, and incentives from brand management subjects as independent stimulus variables. Perceived brand value serves as the mediating variable, and brand quality as the dependent variable. This multi-level model structure can simultaneously test direct effects, indirect effects, and overall effects. As shown in Figure 1.

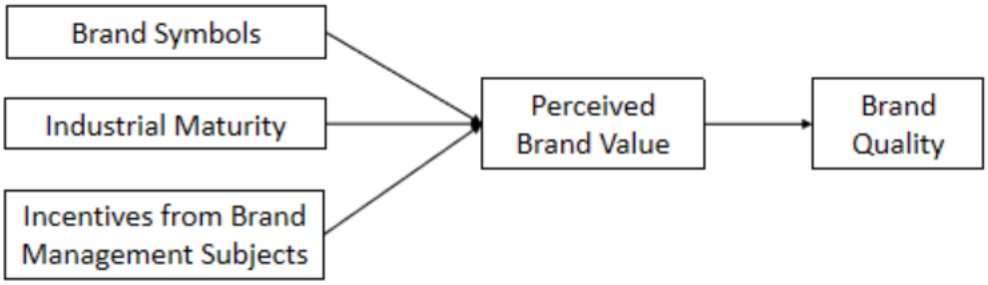


Figure 1: Research Model

3 Research Design and Methods

(1) First, conduct an in-depth analysis of the research background, then review previous studies to identify literature gaps, and formulate hypotheses based on relevant theories. (2) Design and distribute reliable and valid survey scales, followed by collecting, retrieving, and screening valid scales. (3) Adopt the Partial Least Squares Structural Equation Modeling (PLS-SEM) method to statistically analyze the collected data and evaluate the validity of the dimensions included in the model. The PLS-SEM method is suitable for exploratory research and validation of complex relationship models, as it can simultaneously handle latent variables and manifest variables, as well as complex multi-cause and multi-effect relationships. In summary, the overall research method flowchart is shown in Figure 2.

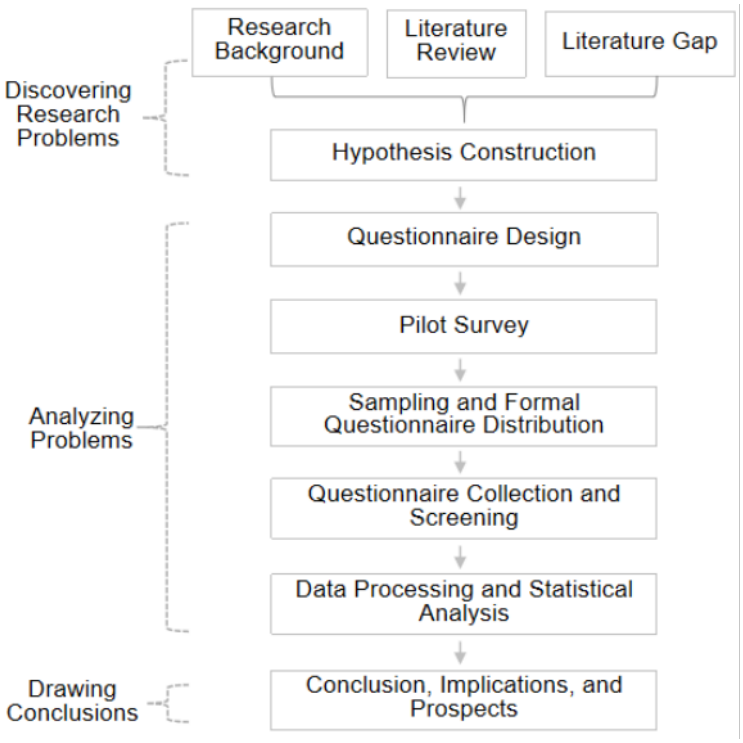


Figure 2: Research Methodology Flowchart

3.1 Sampling and Data Collection

Sampling methods are divided into probability sampling and non-probability sampling. This study adopts non-probability sampling, collecting data from easily accessible respondents, which ensures the breadth and representativeness of the research sample. To ensure the quality of the questionnaire, 35 respondents were invited to pre-test the questionnaire before its official distribution. Based on their feedback, the questionnaire was optimized.

For the official distribution, all respondents had previously received paid labor services. They were invited to participate in the survey by scanning the questionnaire QR code or filling out the questionnaire directly, ensuring that the respondents had diverse backgrounds in terms of gender, age, occupation, and education. After collecting the questionnaires, invalid ones were excluded, resulting in 258 valid questionnaires, with 20 items in each questionnaire. The ratio of the number of questionnaires to the number of items per questionnaire meets the sample size requirements for PLS-SEM analysis, as shown in Table 1.

Table 1: Sociodemographic Characteristics of Respondents

Variables	Frequency	Percent
Gender		
Male	127	49.10
Female	131	50.90
Age		
18-24 years	11	4.42
25-34 years	44	17.00
35-44 years	69	26.78
45-54years	76	29.30
55 and above	58	22.50
Education		
Undergraduate	98	38.00
Postgraduate	45	17.44
PhD	3	1.03
Others	112	43.53
Occupational Categories		
Agricultural Workers	39	15.00
Corporate Employees	95	36.70
Civil Servants	37	14.50
Self-employed Individuals	77	29.80
Students	10	4.00
Urban-Rural Ratio		
Urban Residents	189	73.42
Rural Residents	69	26.58

3.2 Scale Structure

In this study, the latent variables in the constructed model were operationalized and decomposed into measurable items, with the Likert scale adopted for scale construction. To ensure the validity and accuracy of the decomposed measurement items, mature scales in relevant fields were referenced and appropriately adjusted and refined in combination with the characteristics of this study.

For the measurement of brand quality, the studies by Jenni Romaniuk [21] and Jing Li [22] were drawn upon. For the measurement of perceived brand value, sufficient reference was made to the research of Saleem [23], Nuria Villagra [24], and Bailey [25]. The measurement of brand symbols mainly referred to the studies by Stylidis [26] and Sun [27]. The measurement of incentives from brand management subjects drew on the research of Jian Zhang [28], Xu [29], and Sun Lihui [30]. The measurement of industrial development maturity referenced the studies by Bertolini [31], Thinkwell Ndhlovu [32], and Shimul [33].

The measurement items were in the form of a 5-point Likert scale, as shown in Table 2.

Table2：observational variables

Observational Variables	Measurement Items
Brand Symbol1	This brand has unique symbols or emblems for self-identification.
Brand Symbol2	This brand advocates certain values.
Brand Symbol3	This brand strives to highlight the user's identity and personality.
Industrial Maturity1	The industries related to this brand are well-developed.
Industrial Maturity2	There are many enterprises in the industries related to this brand.
Industrial Maturity3	Practitioners related to this brand possess certain work skills.
Incentives from Brand Management Subjects1	If the government or industry associations support this brand, I will feel its management is safer.
Incentives from Brand Management Subjects2	If the government or industry associations conduct strict inspections and certifications on practitioners, I will be more confident in purchasing.
Incentives from Brand Management Subjects3	If enterprises value their brand, I will be more confident in purchasing.
Perceived Brand Value1	The services of this brand demonstrate its practical use.
Perceived Brand Value2	This brand shows itself to be practical, capable, stable, reliable, and less prone to errors.
Perceived Brand Value3	The service personnel of this brand exhibit positive emotions.
Perceived Brand Value4	This brand actively seeks to connect with buyers.
Perceived Brand Value5	This brand represents certain specific qualities.
Perceived Brand Value6	I understand the characteristics and advantages of this brand.
Perceived Brand Value7	I consider this brand reliable and trustworthy.
Brand Quality1	When I need it, the products and services of this brand can solve my problems.
Brand Quality2	When I need it, I will purchase the products and services provided by this brand.
Brand Quality3	I believe this brand is worth its price.
Brand Quality4	I feel proud to use this brand in public.

4 Data Analysis

This study adopts Partial Least Squares Structural Equation Modeling (PLS-SEM) as the tool for data analysis. PLS-SEM has advantages in exploratory research and theoretical development stages for testing research hypotheses. It can simultaneously handle model constructs and measurement items and provide robust estimation results even with small sample sizes.

In data analysis, this study sequentially analyzed the reliability, convergent validity, and discriminant validity of the scale, evaluated the explanatory and predictive power of the model, and tested the hypotheses.

4.1 Reliability and Convergent Validity

The reliability and convergent validity of the scale both met the standards. Reliability measures the consistency, stability, and dependability of measurement results and is generally represented by internal consistency. A higher reliability coefficient indicates more consistent, stable, and reliable test results. The indicators for evaluating reliability include Cronbach's Alpha and Composite Reliability (CR). When both indicators exceed 0.7, it indicates high internal consistency among the items of each latent variable.

The results of this study show that Cronbach's Alpha and Composite Reliability (CR) for all latent variables exceeded 0.7, with most even exceeding 0.8 or 0.9, indicating good internal consistency (reliability) of the questionnaire.

The Average Variance Extracted (AVE) is used to assess the convergent validity of latent variables. Convergent validity reflects the extent to which a latent variable can represent its underlying specific items. It ranges from 0 to 1, with a value greater than 0.5 considered acceptable. A high AVE value indicates good convergent validity of the measurement. In this study, all AVE values exceeded 0.6, with some exceeding 0.8, indicating good convergent validity.

Variance Inflation Factor (VIF) is used to detect multicollinearity. Generally, a VIF less than 5 is considered acceptable, and less than 3 is preferable. As shown in Table 3, all VIF values were less than 3, indicating that multicollinearity was not a serious issue. See Table 3

Table3：reliability and convergent validity

Latent Variables	Observational Variables	Cronbach's alpha	CR	AVE	Outer Loading	VIF
Brand Symbol	Brand Symbol-1	0.824	0.895	0.740	0.847	1.691
	Brand Symbol-2				0.869	1.985
	Brand Symbol-3				0.864	2.001
Industrial Maturity	Industrial Maturity-1	0.798	0.881	0.712	0.857	1.677
	Industrial Maturity-2				0.854	1.823
	Industrial Maturity-3				0.820	1.647
Incentives from Brand Management Subjects	Incentives from Brand Management Subjects-1	0.880	0.926	0.807	0.892	3.231
	Incentives from Brand Management Subjects-2				0.935	4.203
	Incentives from Brand Management Subjects-3				0.865	1.998
Perceived Brand Value	Perceived Brand Value-1	0.907	0.926	0.641	0.813	3.056
	Perceived Brand Value-2				0.831	3.179
	Perceived Brand Value-3				0.808	2.355
	Perceived Brand Value-4				0.781	2.097
	Perceived Brand Value-5				0.778	1.916
	Perceived Brand Value-6				0.792	2.228
	Perceived Brand Value-7				0.799	2.245
Brand Quality	Brand Quality-1	0.860	0.906	0.706	0.863	2.421
	Brand Quality-2				0.875	2.574
	Brand Quality-3				0.841	1.929
	Brand Quality-4				0.779	1.644

4.2 Discriminant Validity

This study passed the test of discriminant validity. In the analysis of Partial Least Squares Structural Equation Modeling (PLS-SEM), discriminant validity is an important analytical indicator. Each latent variable should be independent and not confused with others. Discriminant validity is an indicator to test the distinctiveness between latent variables. The Fornell-Lacker criterion is a commonly used criterion for testing discriminant validity.

According to the Fornell-Lacker criterion, the data on the diagonal in Table 4 are the square roots of AVE, which should be greater than the correlation coefficients in the rows and columns corresponding to the latent variable. This indicates that there is sufficient discriminant validity between latent variables. The data show that the square root of AVE for all latent variables is higher than their correlation coefficients with other latent variables. For example, the square root of AVE for brand symbols is 0.860, which is higher than its correlation coefficient with any other latent variable. A similar situation applies to other latent variables, indicating that each latent variable has good statistical distinctiveness. As shown in Table 4.

Table 4: Discriminant Validity (Fornell-Lacker Criterion)

	Brand Symbol	Incentives from Brand Management Subjects	Brand Quality	Perceived Brand Value	Industrial Maturity
Brand Symbol	**0.860**				
Incentives from Brand Management Subjects	0.677	**0.898**			
Brand Quality	0.677	0.631	**0.840**		
Perceived Brand Value	0.758	0.658	0.706	**0.801**	
Industrial Maturity	0.702	0.633	0.627	0.734	**0.844**

To more rigorously test discriminant validity and ensure sufficient distinctiveness between latent variables, this study also employed the HTMT (Heterotrait-Monotrait Ratio) criterion for verification. Generally, an HTMT value less than 0.95 is considered an acceptable level of discriminant validity.

Table 5 presents the results of discriminant validity analysis based on the HTMT criterion. It can be observed that the HTMT value between brand symbols and perceived brand value is the highest, yet it remains below 0.95. All other HTMT values between latent variables are less than 0.873, indicating that there is sufficient discriminant validity among the latent variables. As shown in Table 5.

Table 5: Discriminant Validity (HTMT Criterion)

	Brand Symbol	Incentives from Brand Management Subjects	Brand Quality	Perceived Brand Value	Industrial Maturity
Brand Symbol					
Incentives from Brand Management Subjects	0.790				
Brand Quality	0.805	0.720			
Perceived Brand Value	0.873	0.731	0.795		
Industrial Maturity	0.863	0.751	0.760	0.855	

4.3 Explanatory and Predictive Power of the Model

The explanatory power of the model mainly tests whether the model explains the relationships between variables. The predictive power of the model refers to the ability of the model to yield consistent conclusions under the same conditions, even when the researchers are changed, thereby enabling prediction.

In PLS-SEM, explanatory power and predictive power are analyzed using the indicators R^2 and Q^2, respectively. Generally, in the field of consumer behavior research, an R^2 value exceeding 0.26 indicates good explanatory power, a value exceeding 0.13 indicates moderate explanatory power, and a value less than 0.02 indicates weak explanatory power. The R^2 values of this model are all greater than 0.499, indicating good explanatory power.

This study uses the blindfolding method of partial least squares to evaluate the predictive ability of the structural model. The Q^2 value, obtained by comparing actual values with predicted values, indicates predictive power if it is greater than 0; a $Q^2 > 20\%$ indicates strong predictive power. The Q^2 values in this study are all greater than 30%, so the model of this study has strong predictive power, as shown in Table 6.

Table 6: Explanatory and Predictive Power of the Model

	R^2	Adjusted R^2	Q^2 (=1-SSE/SSO)
Perceived Brand Value	0.669	0.665	0.417
Brand Quality	0.499	0.497	0.345

4.4 Structural Model and Hypothesis Testing

4.4.1 Testing of Direct Effects

The testing of direct effects examines the direct relationships between latent variables to verify each research hypothesis. This study includes four research hypotheses. To determine whether a hypothesis holds, it is necessary to verify the impact coefficient, t-value, and p-value in the path of each hypothesis.

The impact coefficient represents the magnitude of the direct influence between variables. It ranges from -1 to 1: a negative value indicates a negative impact, while a positive value indicates a positive impact. A larger impact coefficient signifies a more significant influence of the antecedent variable on the consequent variable. The t-value measures the significance of the path coefficient; a larger t-value indicates higher significance of the path impact. Generally, a p-value $\geq$ 0.05 means the hypothesis does not hold (i.e., there is a higher probability of the hypothesis being incorrect or unstable), while a p-value < 0.05 indicates the hypothesis holds.

As shown in Table 7, the p-values of all four research hypotheses are less than 0.05, with impact coefficients of 0. 706, 0.402, 0.346, and 0.167, respectively. Therefore, all four research hypotheses are valid and exhibit strong influences.

The impact coefficient of the mediating variable (perceived brand value) on the dependent variable (brand quality) reaches 0.706, indicating a significant impact.

Among the direct influences of the three independent variables on the mediating variable:

Brand symbols have the largest impact coefficient on perceived brand value, at 0.402;

Industrial maturity ranks second, with an impact coefficient of 0.346;

Incentives from brand management subjects have the smallest impact, with a coefficient of 0.167. As shown in Table 7.

Table 7: Testing of Direct Effects

hypothesis	hypothesized route	impact coefficient	t-values	p-values	test results
H1	Perceived Brand Value -> Brand Quality	0.706	14.091	0.000	Established
H2	Brand Symbol -> Perceived Brand Value	0.402	5.730	0.000	Established
H3	Industrial Maturity -> Perceived Brand Value	0.346	5.291	0.000	Established
H4	Incentives from Brand Management Subjects -> Perceived Brand Value	0.167	2.584	0.010	Established

4.4.2 Testing of Indirect Effects

Indirect effect refers to the process where an independent variable affects a dependent variable through a mediating variable. If there is no direct effect, there must be no indirect effect. However, the existence of a direct effect does not necessarily mean the existence of an indirect effect. Therefore, it is necessary to test the indirect effects. The significance of each indirect effect path is determined by the t-value and p-value. As shown in Table 8, all three indirect effect paths are valid, with p-values less than 0.05.

The most significant path is Brand Symbols → Perceived Brand Value → Brand Quality, with a p-value of 0.000 and a path coefficient of 0.284.

The second most significant path is Industrial Maturity Perceived Brand Value Brand Quality, with a p-value of 0. 000 and a path coefficient of 0.244.

The third most significant path is Incentives from Brand Management Subjects Perceived Brand Value Brand Quality, with a p-value of 0.014 and a path coefficient of 0.118. As shown in Table 8.

Table 8: Testing of Indirect Effects

Indirect Influence Path	impact coefficient	t-values	p-values	test results
Industrial Maturity -> Perceived Brand Value -> Brand Quality	0.244	4.746	0.000	Established
Brand Symbol -> Perceived Brand Value -> Brand Quality	0.284	5.452	0.000	Established
Incentives from Brand Management Subjects -> Perceived Brand Value -> Brand Quality	0.118	2.468	0.014	Established

4.4.3 Testing of Total Effects

Total effects only consider the impact of independent variables on the final dependent variable. The results of the total effect test show that brand symbols, industrial maturity, and incentives from brand management subjects all have a significant positive impact on brand quality, with path coefficients of 0.284, 0.244, and 0.118, respectively, and all p-values are less than 0.05. See Table 9.

Table 9: Testing of Total Effects

Overall Impact Path	Path Coefficient	t-values	p-values	test results
Brand Symbol -> Brand Quality	0.284	5.452	0.000	Established
Incentives from Brand Management Subjects -> Brand Quality	0.118	2.468	0.014	Established
Industrial Maturity -> Brand Quality	0.244	4.746	0.000	Established

5 Conclusions, Implications, Limitations, and Prospects

5.1 Conclusions

Based on the Stimulus-Organism-Response (SOR) theoretical framework, this study constructed research hypotheses and a model, where brand symbols, industrial maturity, and incentives from brand management subjects were regarded as external stimuli, perceived brand value as buyers' internal psychological activities, and brand quality as buyers' final evaluative responses. A series of analytical conclusions were obtained through the Partial Least Squares Structural Equation Modeling (PLS-SEM) method.

The direct impact coefficient of perceived brand value on brand quality reached 0.706 ($p<0.001$), indicating that the improvement of labor service brand quality highly depends on the demand side's subjective perception of brand value. To enable buyers to form a favorable brand evaluation, it is necessary to make buyers fully perceive the value brought by the brand. This is consistent with previous research conclusions [34, 35]. Building on previous studies, this research further obtained more in-depth and detailed findings.

Brand symbols, industrial maturity, and incentives from management subjects all indirectly affect brand quality through perceived brand value, with indirect effects of 0.284, 0.244, and 0.118, respectively (all $p<0.05$), verifying the complete transmission path of "stimulus-psychological processing-response". Among them, brand symbols contributed the most to the mediating effect, followed by industrial maturity, and incentives from brand management subjects contributed the least. This fully indicates that the core value of labor service brands should be symbolized to facilitate buyers' cognition of labor service brands. Differences in industrial maturity also affect buyers' cognition and emotions towards labor service brands. Appropriate incentives from brand managers can encourage buyers to form cognitive and emotional trust. In addition, this study proposed a big data three-dimensional precision governance framework.

5.2 Implications

5.2.1 Brand Symbols

The tangible display of a brand ' s core value and service philosophy is key to improving brand quality, which can b e achieved by creating brand symbols. The creation of brand symbols includes the development of tangible and intangib le elements. Tangible elements include the brand ' s name, logo, packaging (e.g., work clothes of labor service personnel) , slogans, music, and stories—all tangible contents. Intangible elements are the foundation of tangible elements, and tang ible contents serve to express intangible elements. Intangible elements mainly refer to the brand ' s core value, which in cludes functional value, emotional value, and symbolic value. Functional value mainly refers to the skills, qualities, and e thics of labor service personnel. Emotional value is mainly reflected in the emotional influence of labor service personne l on buyers. Symbolic value is the self-concept reflected when buyers use labor services. Emotional value and symbolic v alue can be expressed through brand personality and brand culture.

Therefore, brand managers need to standardize functional value as much as possible, conduct skill certification, and identify elements within functional value that can be symbolized.

Brand personality can be derived and refined from the personalities of excellent labor service personnel, then made tangible and symbolic. Brand culture is also extracted from excellent labor service personnel or the local culture of labor service personnel, and is designed to be tangible and symbolic.

5.2.2 Industrial Maturity

Industrial maturity is an important factor affecting buyers ' perception of labor service brand value. In mature industrie s, labor service personnel tend to be highly specialized, making it easier for buyers to develop cognitive and emotional tr ust.

Differences in industrial maturity across regions form an important foundation for the development of labor service brands. Workers in regions with mature industries have relatively more advantages and competitiveness due to better skills.

Market demand for certain types of labor services is limited within a specific period. For labor services with an excess supply, no matter how well their skills develop, it is difficult to achieve exchanges, thus making it hard to improve brand quality.

Therefore, brand managers need to plan which labor service brands to develop. They should focus on labor service brands with relative regional advantages, relatively mature industries, and sufficient market demand, as these brands have more room for quality improvement.

5.2.3 Brand Management Subjects

Brand managers include governments, industry associations, and leading enterprises. They need to conduct planning and design, guidance and training, supervision, certification, and improvement, and integrated marketing communication for labor service brands.

The planning and design of labor service brands involve identifying and designing elements that can build the brand, elements that reflect the brand ' s value, are crucial to buyers, solve buyers ' problems, and have advantages over compe titors. These advantages are preferably inherent. Such elements generally include core values, personality, and cultural s ymbols.

Brand elements can be found in labor service personnel themselves, their local culture, or inspired by buyers and competitors.

Brand design includes the design of intangible and tangible elements. The design of intangible elements focuses on core value and personality, highlighting core value to better solve buyers ' problems, and shaping personality to facilitat e the establishment of purchase, satisfaction, and loyalty relationships with customers. The design of tangible elements s ymbolizes core value and brand personality, aiming to attract buyers ' attention, arouse interest, stimulate purchase desi re, promote transactions, and facilitate integrated marketing communication.

Guidance includes government guidance on the types and directions of labor service brand development. Training is conducted by training organizations for labor service personnel. In this process, the government should provide incentives and support, and supervise the quality of labor service brand building.

Brand managers also need to carry out certification, including certification of training organizations and certification of labor service personnel by training organizations. They should continuously standardize and hierarchize skills, enabling labor service personnel to continuously improve and obtain corresponding qualifications.

5.2.4 A Three-Dimensional Precision Governance Framework for Big Data

The process of big data management encompasses data acquisition, storage, analysis, and decision-making. Against the backdrop of advancing big data technologies, leveraging such technologies can drive the high-quality development of labor service brands. This paper proposes a three-dimensional precision governance framework for big data, comprising three dimensions: data acquisition, data analysis, and decision-making.

The first dimension-data acquisition-involves establishing a data acquisition platform, which serves as the cornerstone of big data empowerment. It requires building an end-to-end data system tailored to the characteristics of both immature and mature industries. For immature industries, the focus is on: (1) developing digital profiles for labor service personnel, encompassing information such as skill levels, work experience, and training certifications to accurately track individual growth; (2) refining training and certification data to standardize training criteria and certification processes, providing clear guidance for skill enhancement; and (3) granularizing skill classification data to define skill gradients, facilitating industry-specific human resource matching. For mature industries, efforts include: (1) establishing an early warning mechanism for labor surplus, utilizing real-time big data monitoring of labor supply and demand dynamics to forecast surplus risks and support industrial scale adjustments; and (2) synchronously optimizing training upgrade data, with a focus on high-end and emerging skill training to continuously inject innovative momentum into brand quality. This forms a closed loop from data collection and governance to application, enabling high-quality data to drive improvements in labor service brand quality. Essentially, the first dimension involves constructing digital personas for labor service personnel across both mature and immature industries.

Key nodes of the first dimension include: (1) creating digital labels for labor service personnel; (2) conducting training certification for labor service personnel; (3) classifying skills according to the skill levels of different labor service personnel; and establishing an early warning mechanism for labor surplus for labor service personnel in mature industries.

The second dimension—analysis layer—involves data analysis. Relying on big data, this dimension conducts in-depth mining from two perspectives: labor supply-demand and personnel development. On one hand, it analyzes labor source s to clarify the characteristics of labor output from different regions and groups; combined with labor supply and deman d analysis, it accurately identifies market gaps and surplus links, providing a basis for labor mobility and industrial layo ut optimization, helping immature industries fill supply gaps and mature industries balance supply and demand. On the other hand, it focuses on analyzing labor service personnel transformation and training upgrades, using big data to map personnel skill profiles and career development trajectories, identify transformation pain points and training needs, cus tomize growth paths for labor service personnel, promote their skills to adapt to industrial upgrading, and thereby enha nce the human support for labor service brand quality.

Key nodes in the second dimension include, for immature industries: (1) analyzing labor sources; (2) analyzing labor supply and demand; for mature industries: (1) analyzing the direction of labor service personnel output, upgrading, and transformation; (2) analyzing the direction of training upgrades.

The third dimension—decision-making—involves formulating differentiated incentive policies based on data analysis . Targeting different industrial maturity levels (immature and mature industries) and types of labor service personnel, it develops precise support plans. For immature industries, it focuses on nurturing incentives, such as providing skill train ing subsidies and special funds for brand cultivation, promoting the transformation from “extensive labor supply” to “ quality-oriented development”. For mature industries, it strengthens upgrading incentives, such as tax incentives and in dustrial collaboration rewards, to consolidate brand quality advantages. Meanwhile, based on the transformation needs of labor service personnel and the direction of training upgrades, it matches personalized incentives for groups with diff erent skill levels and occupational types, stimulating the enthusiasm of labor service personnel to improve skills and ma intain brand quality.

The big data three-dimensional precision governance framework is shown in the figure below:

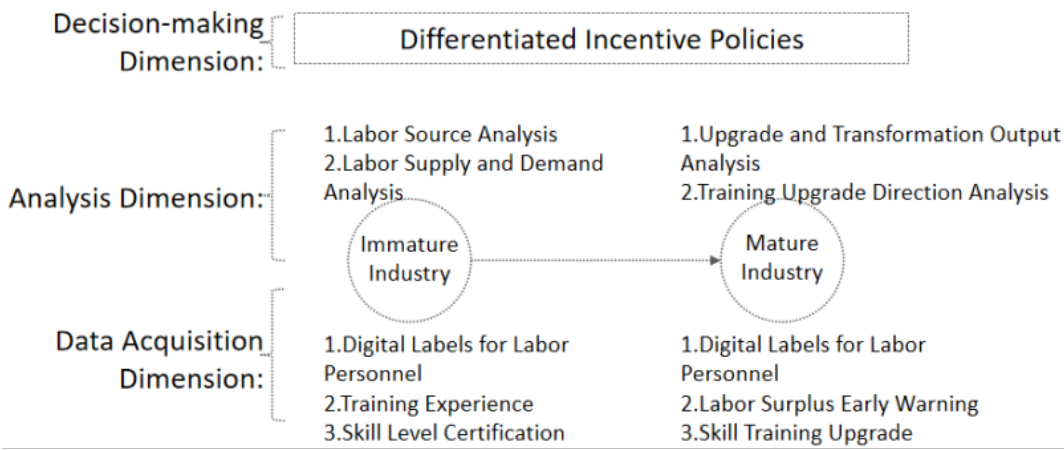


Figure 3: Diagram of the Three-Dimensional Precision Governance Framework for Big Data

5.3 Limitations and Prospects

Although this study reveals the core mechanism of labor service brand building quality, it still has the following limitations:

The symbolization of labor service brands can be divided into different depths and perspectives. Not all labor service brands are suitable for a high degree of symbolization. Due to resource constraints, this study did not deeply analyze which brands are suitable for symbolization to what extent.

In addition, in general brand research, the core value provided by the brand to buyers and brand symbols are studied separately. For the sake of convenience, this study unified the connotation of brand symbols into tangible symbols and the core value represented by the symbols.

The conclusions of this study are more applicable to the Chinese region. All the selected samples are Chinese. Chinese consumers are dominated by a collective culture, value face culture, and trust the sharing of acquaintances more. When decomposing the latent variables of this study into measurement items, measurement items for emotional value and symbolic value were set. In countries that value individualistic culture, consumers pay more attention to the functional value of labor service brands.

Facing these limitations, future research needs to be further deepened and improved: (1) Hierarchically classify brand symbols into symbols of different depths. (2) Precisely connect the digitalization of brand symbols with big data management technology. (3) Through big data management technology, realize the specific strategies for the coordinated development of brand quality building and industrial development.

CRediT authorship contribution statement

First author: Writing-original draft, Supervision, Investigation. **Second author:** review & editing, Data curation, Conceptualization. **Third author:** Validation, Supervision.**Fourth Author:** Validation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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