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Big-Data-Enabled Confucian-Merchant Spirit for High-Quality Enterprise Development: Theoretical Framework and Practical Paths

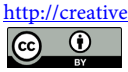
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Abstract

Against the backdrop of the digital economy, the modern transformation of the Confucian-merchant spirit, a core carrier of fine Chinese commercial ethics, is confronted with practical dilemmas such as predominant qualitative research, difficulty in effect quantification and insufficient implementation models. This paper introduces big-data technology into research on how the Confucian-merchant spirit empowers enterprise development. Rooted in practical scenarios of enterprises in Shandong Province, it integrates organizational behavior science, business ethics and data science, and constructs a mediating-effect theoretical model of "Confucian-merchant spirit-organizational capability-enterprise performance". It analyzes the internal mechanism through which the Confucian-merchant spirit empowers enterprises from the ethical-technological-governance three-dimensional perspective. Adopting research methods including bibliometrics, multi-source data collection, text sentiment analysis and mediating-effect testing, this study attempts to quantify the abstract Confucian-merchant spirit and break the bottleneck of quantification in traditional ethical research. The findings indicate that the Confucian-merchant spirit does not exert direct influence on enterprise performance; instead, it generates indirect empowering effects by improving organizational capability, and such effects present heterogeneous characteristics across industry types and enterprise development stages. Accordingly, this paper proposes hierarchical and classified digital practical paths and develops a lightweight digital diagnostic tool for the Confucian-merchant spirit, providing new research paradigms and practical references for traditional culture empowering modern enterprise governance.

Subject Areas

Business Analysis

Keywords

Confucian-Merchant Spirit, Big Data, Organizational Capability, High-Quality Enterprise Development, Business Ethics, Cultural Digitalization

1. Introduction

The digital wave has driven big-data technology to penetrate the whole process of enterprise operation, offering brand-new technical tools for the creative transformation and innovative development of fine traditional Chinese culture. Rooted in Confucian views on righteousness and profit, the Confucian-merchant spirit takes integrity-oriented operation, pursuing profit under morality, benefiting the society, harmonious co-existence and self-cultivation as its core connotations. As a valuable heritage of China's traditional commercial civilization, it is highly intrinsically consistent with modern corporate social responsibility, ESG governance and corporate culture construction. Under the orientation of high-quality enterprise development, numerous domestic enterprises have begun to draw on Confucian-merchant wisdom for business management. In particular, as the birthplace of the Confucian-merchant culture, Shandong Province boasts a cultural soil for local enterprises to inherit the Confucian-merchant spirit. Nevertheless, three practical challenges prevail in practice. First, as an ethical-value category, the Confucian-merchant spirit is mostly implemented at the level of cultural publicity, lacking implementation systems adapted to business procedures. Second, its implementation effect is evaluated subjectively and qualitatively, without objective quantifiable assessment instruments. Third, small- and medium-sized enterprises (SMEs) are constrained by resources and lack replicable, low-cost implementation models.

Existing studies on the Confucian-merchant spirit mostly focus on connotation interpretation and case-based speculative analysis, dominated by qualitative research. Empirical studies on transmission mechanisms through which the Confucian-merchant spirit affects enterprise operating performance remain insufficient. Within enterprise scenarios, big-data applications mainly concentrate on market forecasting and financial risk control, while research on empowering enterprise governance with traditional commercial ethics remains in its initial stage. How digital technology can bridge the transformation of the Confucian-merchant spirit from cultural ideas to corporate practice and quantitatively identify its empowering effect has become an important theoretical and practical proposition. Accordingly, combining humanistic ethics and big-data analytical tools, this paper constructs a theoretical model for the Confucian-merchant spirit to empower enterprise development, explores its internal mechanism, and investigates digital implementation paths, so as to provide theoretical support and practical schemes for traditional culture to facilitate high-quality enterprise development.

2. Literature Review and Research Gaps

2.1. Research on Confucian-Merchant Spirit and Enterprise Development

Research on the Confucian-merchant spirit falls into three major directions: connotation interpretation, value adaptability analysis and enterprise case studies. In terms of connotation definition, scholars generally regard the balance between righteousness and profit as its core, emphasizing moral self-discipline, social-responsibility fulfillment and benefit pursuit in commercial operations. Cheng Fang generalized the modern Confucian-merchant spirit into dimensions including unity of righteousness and profit, integrity-oriented operation and societal benefaction, pointing out that the Confucian-merchant spirit serves as an important ideological resource for traditional commercial ethics to adapt to the contemporary market economy [1]. Luo Tingting proposed a five-dimensional model of "gentleman-style Confucian merchants", taking benevolence, righteousness, credibility, self-cultivation and moderation as critical references for the construction of modern corporate ethics, and stressed that the Confucian-merchant spirit unites personal moral cultivation and commercial practice [2].

Studies on modern adaptability suggest that the Confucian-merchant spirit can enrich corporate culture, elevate corporate social-responsibility performance, improve stakeholder relationships and provide references for modern corporate governance [3]. Some regions in China have launched pilot projects introducing Confucian-merchant culture into enterprises and formed benchmark cases. However, most existing studies adopt descriptive cases and theoretical speculation; large-sample empirical tests are rare, and no consistent conclusion has been reached on transmission paths whereby the Confucian-merchant spirit influences enterprise performance [4].

2.2. Big Data, Corporate Culture and Business Ethics Research

Big-data technology enables mining of unstructured text and behavioral data, and has been widely applied in enterprise customer analysis, public-opinion monitoring and human-resource management. Liu Changan argued that text mining and lexicon-modeling techniques can convert enterprise reputation, employee behaviors and media reports into computable indicators to dynamically observe the construction effects of corporate culture and business ethics [5]. Some scholars have adopted machine-learning text-analysis methods to extract signals of corporate ethical culture from annual reports and online texts and test its influences on business operations [6]. On the whole, nevertheless, big-data tools are mostly used for economic-indicator measurement, rather than the quantitative measurement of traditional Chinese commercial ethics.

2.3. Research Commentary

Distinct research gaps can be identified from existing literature. First, research paradigms for the Confucian-merchant spirit are dominated by qualitative spec-

ulation, lacking operable quantitative-indicator systems for abstract ethical traits [7]. Second, integrated analytical frameworks combining "Confucian-merchant spirit-digital technology-enterprise development" are insufficient, and mediating transmission mechanisms of the Confucian-merchant spirit on enterprise performance call for empirical tests. Third, replicable digital implementation paths suitable for enterprises of varied scales are deficient, and theoretical achievements are poorly translated into corporate practice. This paper addresses the above-mentioned gaps.

3. Theoretical Analysis and Research Framework

3.1. Definition of Core Concepts

Modern-version Confucian-merchant spirit: A set of modern commercial values derived from the creative transformation of traditional Confucian-merchant culture, covering five dimensions: integrity-oriented operation, pursuing profit under morality, benefiting the society, harmonious co-existence, and self-cultivation. Integrity-oriented operation refers to commercial contracts and customer credit; pursuing profit under morality means abiding by moral bottom lines and balancing righteousness and profit; benefiting the society corresponds to corporate social responsibility; harmonious co-existence denotes supply-chain collaboration and win-win outcomes for stakeholders; self-cultivation represents moral cultivation of managers and employees [1] [2].

Big-data empowerment: It refers to identification, indicator quantification, effect evaluation and risk early-warning of practices of the Confucian-merchant spirit via multi-source data collection, text mining, sentiment analysis and statistical modeling, providing data support for corporate cultural governance [5].

Organizational-capability mediating variable: It consists of four sub-dimensions: corporate-cultural cohesion, employee organizational behavior, supply-chain collaboration and corporate social reputation, acting as an intermediate transmission carrier for the Confucian-merchant spirit to affect enterprise performance [8].

3.2. Mechanism Analysis

The Confucian-merchant spirit cannot directly boost enterprise revenue. Instead, it enhances comprehensive organizational capability by reshaping internal corporate culture, standardizing employee behaviors and improving external stakeholder relationships, and further exerts positive impacts on enterprise operating performance [8]. First, internally, values of self-cultivation and the unity of righteousness and profit are embedded into management systems to strengthen employee identity and organizational cohesion and mitigate internal management frictions. Second, in the supply-chain dimension, harmonious co-existence guides enterprises to build reciprocal upstream-downstream partnerships and stabilize supply chains. Third, externally, integrity-oriented operation and societal benefaction improve corporate social reputation and customer word-of-mouth and optimize access to market resources [3].

In this study, big-data technology serves as the measurement infrastructure rather than a causal mediating variable. It quantifies the otherwise unobservable Confucian-merchant-spirit practices via collecting employee behavioral data, online reviews, media texts and supply-chain records, and supports model estimation for examining the relationship between organizational capability and enterprise performance. Accordingly, this paper constructs a three-dimensional ethical-technological-governance theoretical framework and proposes the mediating-effect logical chain: Confucian-merchant spirit → organizational capability → enterprise development performance. Big-data technology runs through indicator construction, effect testing and dynamic monitoring for model measurement, but it is not included as a causal variable in the mediating-effect empirical model.

4. Research Design

4.1. Research Methods

Prior to sentiment scoring, raw Chinese text materials (customer online reviews, media reports and stakeholder comment texts) went through multi-step preprocessing: HTML tag removal, elimination of special symbols and stop-words, Chinese word segmentation, and vocabulary filtering for low-frequency terms.

For model construction, the training dataset consisted of publicly available Chinese sentiment corpus combined with manually annotated in-domain texts sampled from our collected enterprise-related corpus. Two independent researchers completed text labeling following the self-built Confucian-merchant-spirit keyword lexicon; inconsistent labels were reconciled via group discussion. Standard classification performance metrics including precision, recall and F1-score were computed to evaluate model predictive performance. After model training, predicted sentiment outputs from the LSTM model were further validated against manually reviewed hold-out text records. Model-generated sentiment scores were adjusted when systematic deviation was detected between algorithm outputs and human manual coding results, reducing algorithm noise before generating final text-based indicator values.

1) Bibliometric analysis: Using “Confucian-merchant spirit”, “business ethics”, “big data + enterprise governance” as search terms, this study retrieves literature from CSSCI and CNKI databases. CiteSpace is adopted to draw keyword co-occurrence maps, sort out research evolution and identify research gaps [7].

2) Multi-source data collection: Ten anonymized pilot enterprises in Shandong Province covering manufacturing, commercial service and other industries were selected, consisting of large-sized enterprises and small- and medium-sized enterprises. The observation period ranges from [5/2025] to [5/2026]. Multi-source datasets include enterprise ERP financial records, OA system employee behavioral logs, web-scraped public customer reviews and media texts, supply-chain cooperation records, and stratified-sampled employee questionnaires (with reliability and validity tests). In terms of questionnaire implementation, a total of 286 employee questionnaires were distributed, and 241 valid questionnaires were finally

obtained, yielding a valid response rate of 84.27%. Non-disclosure agreements were strictly signed to prevent the leakage of corporate confidential information.

3) Big-data text mining: A special keyword lexicon for the Confucian-merchant spirit is built. The LSTM neural network is used for sentiment analysis of review texts; Pandas is applied for cleaning and normalization of heterogeneous data [5].

4) Quantitative statistics and model testing: SPSS and Stata are employed for descriptive statistics, correlation analysis and mediating-effect tests. Tableau is utilized to build visual dynamic dashboards; external validation samples are set to check model prediction deviations [8].

5) Multiple-case comparative study: Digital empowerment paths of the Confucian-merchant spirit across enterprises in different industries are compared horizontally, and common patterns and differentiated strategies are summarized [4].

Before multi-source indicators were treated as measurements of Confucian-merchant ethical practice, systematic reliability, validity inspection and manual calibration were performed for questionnaire, unstructured text, and enterprise administrative data respectively.

For questionnaire indicators: Cronbach's α coefficient was calculated to test internal-consistency reliability. The Cronbach's α of each dimension was above 0.8, satisfying the acceptable reliability threshold. Confirmatory factor analysis (CFA) was conducted to assess convergent validity and discriminant validity. Average variance extracted (AVE) and composite reliability (CR) met the standard criteria for good construct validity. Items with poor loading were eliminated before subsequent statistical analysis.

For text-mining indicators (customer reviews, media reports and other unstructured texts): After sentiment analysis via the LSTM model based on the self-built Confucian-merchant-spirit lexicon, manual calibration and inter-rater reliability testing were implemented. Two independent coders coded randomly sampled text subsets (15% of total text corpus) against the established coding rules. Krippendorff's Alpha/Cohen's Kappa reached 0.75, indicating acceptable inter-coder agreement. Cases with inconsistent coding results were discussed and adjudicated by a third researcher to revise the lexicon and adjust model output scores, reducing algorithm noise before generating text-based indicator values.

For enterprise administrative data (ERP financial records, OA behavioral logs, contract performance, compliance and supply-chain cooperation records): Raw administrative records underwent manual cross-checking. We eliminated duplicate entries, missing-value records and obvious outlier samples by cross-referencing internal enterprise documents and field interview notes. Suspicious abnormal records were verified through communication with enterprise administrators to guarantee data accuracy prior to indicator construction.

4.2. Construction of the Indicator System

The abstract Confucian-merchant spirit is decomposed into observable indicators covering five dimensions: integrity-oriented operation, pursuing profit under mo-

rality, benefiting the society, harmonious co-existence, and self-cultivation.

Integrity-oriented operation: integrity-related keywords in customer reviews, consumer-complaint data, contract-performance records; Pursuing profit under morality: operation-compliance records, response texts for stakeholder appeals; Benefiting the society: public-welfare investment records, social-responsibility disclosure texts; Harmonious co-existence: supply-chain cooperation stability, evaluation from upstream and downstream partners; Self-cultivation: participation in employee ethical training, internal-management behavioral records, employee-satisfaction questionnaires.

For indicator scoring: Text-based indicators (e.g., customer reviews, media texts) adopt sentiment analysis output scores ranging from 0 to 1; objective business records (contract performance, compliance records, welfare investment and supply-chain cooperation records) are converted into original scores according to event frequency, completion rate and input scale; questionnaire items are averaged to obtain the original score for corresponding sub-indicators.

For normalization: Min-max normalization is applied to all sub-indicators to unify all original scores into the interval [0, 1], eliminating dimensional differences among multi-source heterogeneous data.

For weight determination: Equal weight is adopted to assign weights to the five first-level dimensions of the Confucian-merchant spirit. For composite score calculation: The final comprehensive score of Confucian-merchant-spirit implementation (core independent variable) is computed via weighted summation: Score CMS = $\sum_{i=1}^{5} w_i S_i$, where ScoreCMS denotes the composite Confucian-merchant-spirit score; w_i stands for the weight of dimension i; S_i represents the normalized score of dimension i.

This composite score serves as the core independent variable. Organizational capability serves as the mediating variable; enterprise financial performance and reputation indicators are taken as dependent variables [6].

5. Empirical Analysis and Research Findings

Based on multi-source-data processing, questionnaire tests and mediating-effect regression for pilot enterprises, major conclusions are drawn as follows.

First, the total effect of the Confucian-merchant spirit on enterprise performance is positive yet indirect, and organizational capability exerts full or partial mediating effects. The Confucian-merchant spirit cannot directly improve business outcomes. Its value is realized through mediating paths including enhanced organizational cohesion, optimized supply-chain collaboration and elevated social reputation [8]. Mere slogan advocacy without implementation in organizational systems cannot generate practical empowering effects [3].

Second, significant heterogeneity exists in empowering effects. For commercial-service enterprises, dimensions of integrity and customer reputation of the Confucian-merchant spirit contribute more; for manufacturing enterprises, har-

monious co-existence (supply-chain collaboration) and social-responsibility dimensions play stronger roles. Large-scale enterprises with sound data infrastructure can realize full-dimensional monitoring, whereas SMEs should focus on core scenarios instead of copying complex indicator systems [4].

Third, big data enables quantitative assessment of Confucian-merchant-spirit implementation yet has limitations. Noise exists in online texts, so algorithm outputs must be manually calibrated combined with internal corporate documents and field investigations. Big data acts only as a tool and cannot replace internal institutional construction of enterprises [5].

Fourth, practical dilemmas for Shandong-based enterprises are identified: most enterprises recognize the value of Confucian-merchant culture but lack complete closed-loop mechanisms covering ideas, institutions and monitoring evaluation. Restricted by manpower costs, SMEs struggle to construct complex cultural-evaluation systems, so lightweight digital tools possess practical application value [1].

To assess industry- and scale-based heterogeneity, subsample mediation analysis was conducted. Enterprises were grouped into manufacturing and commercial-service categories according to core business scope; firm size was classified into large-sized enterprises and SMEs following Shandong's official SME classification criteria. We performed Bootstrap-based mediation estimation with 1000 replications for each subgroup and adopted Bootstrap group-coefficient comparison to examine statistical differences across groups. Heterogeneity evidence shows that commercial-service firms obtain larger indirect effects from the integrity- and reputation-related dimensions of the Confucian-merchant spirit, while manufacturing firms are more strongly influenced by harmonious co-existence (supply-chain collaboration) and social-responsibility dimensions. Large-sized enterprises realize significant effects across multiple dimensions, whereas SMEs only gain significant effects from core integrity-oriented dimensions. Given the limited number of pilot firms in this study, formal statistical significance tests for cross-group coefficient differences are under-powered. The observed heterogeneity mainly reflects systematic pattern differences across subgroups from subsample Bootstrap mediation results, rather than relying solely on group-comparison p-values.

6. Practical Paths: Big-Data-Driven Confucian-Merchant-Spirit Empowerment for High-Quality Enterprise Development

On the basis of the theoretical framework and empirical conclusions, practical paths are proposed from three levels: enterprises, digital-tool development, and government-industry-association support.

6.1. Enterprise Level: Constructing Hierarchical and Classified Implementation Modes

Large-scale enterprises: Build complete digital-monitoring modules for the Confucian-merchant spirit embedded in ERP and OA business systems. Establish a

trinity closed-loop of "cultural ideas-management institutions-data monitoring". Regularly output diagnostic reports on Confucian-merchant-spirit implementation and identify righteousness-profit imbalance risks in business decision-making [2].

SMEs: Reject all-in-one schemes and adopt lightweight solutions. Concentrate on core scenarios such as integrity-oriented operation, customer service and employee care. Apply simplified digital diagnostic tools and prioritize practical outcomes over formalistic cultural construction [4].

6.2. Digital-Tool Development: Lightweight Decision-Support Tool for the Confucian-Merchant Spirit

Develop lightweight digital auxiliary tools based on the indicator system in this study with three major functions: 1) rapid diagnosis of Confucian-merchant-spirit implementation to identify corporate construction weaknesses; 2) risk early-warning for righteousness-profit imbalance and ethical alerts for business decisions; 3) case-base matching to push adaptive practical cases according to enterprise industry and scale. The tool lowers technical thresholds and is trialed and promoted among SMEs [5].

6.3. Support from Government and Industry Associations

Leveraging Shandong's Confucian-merchant-culture resources, federations of industry and commerce and industry associations can carry out enterprise training with research outcomes of this paper, set benchmarks for digital Confucian-merchant governance, encourage digital-transformation projects for traditional culture, and guide enterprises to integrate traditional commercial ethics into digital transformation processes [1].

7. Conclusions, Limitations and Prospects

7.1. Conclusions

This paper introduces big-data technology into studies on the Confucian-merchant spirit, constructs the mediating-effect model of "Confucian-merchant spirit-organizational capability-enterprise performance", and establishes a multi-dimensional quantitative-indicator system for the Confucian-merchant spirit. The study concludes that the high-quality-development empowerment of the Confucian-merchant spirit relies on the mediating transmission of organizational capability rather than direct effects on business performance. Empowering effects are heterogeneous across industries and enterprise scales. Big-data technology breaks the quantification bottleneck of traditional business-ethics research but must coordinate with corporate institutional construction. Hierarchical and classified digital implementation paths should be adopted for enterprises of different sizes, and lightweight tools shall be popularized to expand practical coverage. This research realizes paradigm innovation combining qualitative deconstruction and quantitative verification and offers new insights for the creative transformation of fine tra-

ditional Chinese culture [7].

7.2. Limitations

The empirical sample of this study consists of ten anonymized pilot enterprises in Shandong Province with limited sample size. Although sample metadata including industry distribution, firm size, observation period and questionnaire response rate have been supplemented, the universality of the theoretical model still needs further verification based on larger-sample cross-regional data. Constrained by corporate data-access conditions, some internal non-public indicators cannot be fully obtained. Besides, the lightweight digital diagnostic tool developed in this research only realizes the functions of diagnosis and risk early-warning and has not been put into large-scale commercial deployment [8].

7.3. Prospects

Future research can expand cross-regional and cross-industry samples and further optimize measurement indicators for the Confucian-merchant spirit. Long-term panel-data tracking research can be conducted to examine long-term sustainable-development impacts of the Confucian-merchant spirit. Functions of digital tools shall be iterated to promote wider application of digital achievements of Confucian-merchant culture. Technology application is not intended to eliminate the humanistic essence of the Confucian-merchant spirit, but to revitalize contemporary practical value of traditional commercial wisdom, facilitate deep integration of fine traditional Chinese commercial culture into the market economy, and support high-quality development of Chinese enterprises [3].

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Conflicts of Interest

The authors declare no conflicts of interest.

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