# Analysis of the Impact of Relational Embeddedness on Firm Competitive Intelligence Work: Postprint

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## Abstract

[Purpose/Significance] Interpersonal intelligence networks hold significant importance for enterprise competitive intelligence operations. This study investigates intelligence relationships within the network from a relational embeddedness perspective to uncover the mechanisms through which relational embeddedness influences intelligence performance. [Method/Process] Utilizing management personnel engaged in intelligence work as research subjects and employing methods such as questionnaires and structural equation model fitting, this research examines how relationship duration, relationship quality, and relationship strength impact intelligence performance. [Results/Conclusion] The findings indicate that relational embeddedness exerts a positive influence on competitive intelligence work, with relationship quality contributing most substantially to intelligence performance. Furthermore, enterprises should enhance the moderate embeddedness of high-quality intelligence relationships to underscore the indispensability of interpersonal channels in acquiring critical intelligence.

## Full Text

## Preamble

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**Analysis of the Impact of Relational Embeddedness on Enterprise Competitive Intelligence Work**

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## Abstract

[**Purpose/Significance**] Human intelligence networks are of great significance to enterprise competitive intelligence work. This paper examines intelligence relationships within these networks from the perspective of relational embeddedness to uncover the mechanisms through which relational embeddedness influences intelligence performance. [**Method/Process**] Targeting management personnel engaged in intelligence work, this study employs survey questionnaires and structural equation modeling to investigate how relationship duration, relationship quality, and relationship strength affect intelligence performance. [**Result/Conclusion**] The findings indicate that relational embeddedness positively influences competitive intelligence work, with relationship quality contributing the most to intelligence performance. Additionally, enterprises need to strengthen moderately embedded high-quality intelligence relationships to highlight the indispensable role of interpersonal channels in acquiring critical intelligence.

**Keywords:** relational embeddedness; enterprise competitive intelligence work; intelligence performance
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## 1. Introduction

Embeddedness theory, also known as "embeddedness theory" or "rootedness theory," is a branch of sociology formally proposed by American new economic sociologist M. Granovetter in 1985 [1]. Embeddedness theory advocates examining the emergence, development, and characteristics of a phenomenon in connection with its surrounding environment and within a broader social context. Given that social networks represent the manifestation of embeddedness phenomena, scholars have predominantly adopted a social network analysis perspective to interpret it. However, they have broken away from previous research approaches that treated social networks as isolated systems by focusing solely on internal relationships and structures, instead incorporating the influences of economic, cultural, and political institutions on social networks into their analytical framework. This more comprehensive and scientific approach elucidates the formation and operational mechanisms of social networks. To date, scholars have successfully applied embeddedness theory to address important issues in economics, sociology, management, and psychology, such as regional economic development, differential pattern phenomena, and the localization of multinational corporations, garnering widespread academic attention.

Currently, the intelligence science community's understanding of embeddedness theory remains in its infancy, with only a handful of scholars examining its

application in the construction and operation of human intelligence networks. These studies primarily focus on dyadic relationships within networks and consider node attributes such as ideology, corporate culture, and organizational structure. In human intelligence networks, mutually embedded connections are inevitable, as they serve as crucial channels for obtaining critical intelligence. Investigating the embeddedness of intelligence relationships holds significant research value for enterprises seeking to increase opportunities for acquiring non-public information and tacit knowledge, thereby enriching the content of competitive intelligence work.

## 2. Relational Embeddedness in Enterprise Competitive Intelligence Work

### 2.1 Meaning, Importance, and Dimensional Division of Relational Embeddedness

Since the dawn of humanity, relationships have existed in society, and their importance has long been recognized. Because individual resources are extremely limited while social resources are virtually unlimited, individuals must establish various connections with external individuals or organizations to access these resources. These dyadic relationships formed between pairs become channels for acquiring external resources, providing momentum for individual or organizational development. M. Granovetter defined these "two-way relationships based on expectations of reciprocity" as embedded relationships [8]. The connections formed through mutual interaction between people or organizations represent the manifestation of relational embeddedness.

**The Importance of Relational Embeddedness.** Economic historian K. Polanyi discovered as early as 1944 that embeddedness could influence the economic behavior of individuals or organizations [9]. Later, M. Granovetter's research further revealed that relational embeddedness not only affects economic behavior but also impacts social structure [8]. S. Birley's research provided more specific evidence, finding that relational embeddedness can not only save economic costs but also create more opportunities for enterprises [10]; D. J. Dahab also confirmed that trust shaped by relational embeddedness can eliminate environmental uncertainty and generate more business opportunities for enterprises [11]. As awareness increased, scholars' research on relational embeddedness deepened. B. Uzzi demonstrated that relational embeddedness is an important channel for tacit knowledge transformation and transfer [12]; J. Coleman recognized relational embeddedness as an indispensable form of social capital for enterprises [13]; P. Moran explicitly pointed out that relational embeddedness greatly benefits the acquisition of scarce resources [14]; and L. D. Molm et al. found that relational embeddedness influences the transaction forms and cooperation outcomes between parties [15]. In summary, scholars unanimously agree that relational embeddedness significantly assists individuals or organizations in developing social resources, expanding cooperation scope,

and improving cooperation quality and efficiency.

To deeply analyze the phenomenon of relational embeddedness, scholars have divided it into various dimensions. For instance, M. Granovetter defined embedded relationships in terms of time length, emotional intensity, intimacy, and reciprocity [8], later clarifying that relationship continuity, strength, direction, and content serve as criteria for judgment. D. J. Dahab proposed using contact strength, homogeneity, fairness, and reciprocity as indicators for measuring relational embeddedness [11]; B. Uzzi categorized trust, high-quality information sharing, and joint problem-solving as manifestations of relational embeddedness [12]; T. Rowley et al. emphasized that trust, identification, and social system embeddedness constitute dimensions of relational embeddedness [16]; M. Andersson directly divided relational embeddedness into business embeddedness and technical embeddedness based on content [17]; P. Kaufman et al. insisted that trust, commitment, and satisfaction are dimensions of relational embeddedness [18]; R. Gulati and M. Sytch defined joint action, trust, and the quality and scope of information exchange as fundamental elements of relational embeddedness [19]; and N. A. Gillespie et al. characterized relational embeddedness in terms of relationship duration, interaction frequency, mutual trust, and shared scope [20].

Drawing on these diverse perspectives and identifying high-frequency terms such as trust, satisfaction, relationship duration, identification, sharing, and reciprocity, and combining them with social network approaches for measuring dyadic relationships, this paper defines relationship duration, relationship quality, and relationship strength as the three dimensions of intelligence relationship embeddedness. Specifically, relationship duration encompasses interaction length and frequency; relationship quality includes trust and satisfaction; and relationship strength is divided into strong ties and weak ties based on the degree of information sharing and reciprocity. The logical relationships among these dimensions are shown in Figure 1 [Figure 1: see original paper].

**Figure 1. Logical Relationship Framework of Intelligence Relationship Embeddedness Dimensions**

### 2.2 The Existence of Relational Embeddedness

External intelligence sources are like scattered sand, dispersed sporadically and irregularly around enterprises. Based on the classification criteria for external knowledge sources in the third edition of the Oslo Manual published by the Organization for Economic Co-operation and Development (OECD) in 2005, intelligence sources can be divided into three categories: external market intelligence sources, public institution intelligence sources, and comprehensive intelligence sources. External market intelligence sources include raw material suppliers, distributors, competitors, consumers, other enterprises within the industry (excluding competitors), and partners in enterprise alliances; public institution intelligence sources include research institutes, government departments, indus-

try associations, and patent offices; comprehensive intelligence sources include consulting firms and others. The distribution of external intelligence sources is shown in Figure 2 [Figure 2: see original paper].

**Figure 2. Distribution of Enterprise External Intelligence Sources**

To acquire intelligence, intelligence personnel establish various formal and informal relationships with these sources. According to the criteria established by M. H. Julie et al. [21], these connections are all embedded relationships, as it is precisely relational embeddedness that links these intelligence sources according to certain rules and sequences, providing enterprises with an intelligence acquisition map. Related research has also confirmed that embeddedness is an important attribute of competitive intelligence work. For example, J. E. Prescott in the United States found that competitive intelligence is embedded in global business structures [22]; Chen Feng pointed out in his doctoral dissertation that competitive intelligence activities are not completely independent but rather achieve their functions by attaching themselves to various business operations—this attachment is essentially embeddedness [4]; Yan Chuangye directly introduced embeddedness theory into the study of human intelligence networks [23]; Wang Xin et al. constructed a dual-layer embeddedness model for competitive intelligence activities [24]; and Peng Jingli specifically proposed relational embeddedness strategies and structural embeddedness strategies [25].

To understand the role played by relational embeddedness in competitive intelligence activities, this paper analyzes how the three dimensions affect intelligence performance to interpret their mechanisms of influence on competitive intelligence work.

## 3. Theoretical Analysis of How Relational Embeddedness Dimensions Affect Enterprise Competitive Intelligence Work

To facilitate the research, this paper first identifies the main evaluation indicators for competitive intelligence work performance, combining qualitative and quantitative measures to select intelligence quantity, intelligence quality, and demand satisfaction as three indicators for measuring intelligence performance. Regarding the selection of intelligence performance evaluation indicators: For qualitative measurement, this paper references the perspectives of J. P. Herring, L. Fuld, Li Yu, Lü Zhuhong, Aurora WDC, Chen Feng, and T. Hawes; For quantitative measurement, it references the perspectives of L. Davison, Zhuang Wei, and Zeng Hong; For combined qualitative and quantitative measurement, it references the perspectives of the Strategic and Competitive Intelligence Professionals (SCIP) funded project by J. P. Herring, J. R. Langabeer, C. S. Fleisher, B. J. Jaworski, L. Fuld, Qiu Junping, and J. R. Smith. Specifically, intelligence quantity includes three aspects: scope, scale, and type; intelligence quality includes three aspects: objectivity, reliability, and comprehensiveness; and demand satisfaction includes five aspects: novelty, economy, timeliness,

confidentiality, and usability (value content). By analyzing the relationships between intelligence performance measurement indicators and relational embeddedness dimensions, this paper studies the mechanisms through which relational embeddedness influences competitive intelligence work.

### 3.1 The Impact of Relationship Duration on Competitive Intelligence Work

Relationship duration refers to the continuity of the relationship between connected parties. It is an important indicator for measuring relationship stability, generally evaluated through interaction frequency and relationship length [20].

**The Impact of Relationship Duration on Cooperation.** Studies by M. R. Cunningham et al. [26], R. Cross et al. [27], S. P. Borgatti et al. [28], and F. Polidoro et al. [29] found that higher relationship duration leads to lower relationship supervision costs and more authentic transaction information. C. Fornell et al. [30] also confirmed that high relationship duration results in the exchange of high-quality information. S. K. Cook [31] and D. Krackhardt [32] demonstrated that high relationship duration enriches the content of exchanges. Meanwhile, research by L. Cousens et al. [33] and Li Kai [34] showed that high relationship duration enables both parties to make correct judgments and predictions about each other's behaviors and intentions, making cooperation more efficient.

Intelligence relationships are information cooperation relationships actively established by intelligence personnel with intelligence sources. Based on relevant research conclusions, this paper argues that relationship duration affects intelligence performance in three ways: High relationship duration leads to more information exchange, as psychological barriers gradually diminish with increased contact frequency or interaction length. Relationship duration requires joint efforts from both parties to maintain. To sustain the relationship, intelligence sources will actively cooperate and provide highly credible and reliable information. High relationship duration enables intelligence sources to more accurately understand and comprehend intelligence personnel's information needs, providing more relevant and targeted intelligence. This is because high duration implies long-term interaction and deep mutual understanding. Based on this theoretical analysis, this paper proposes the research hypothesis that relationship duration positively influences intelligence performance and outlines the relevant mechanism model (see the hypothesis summary table and overall model construction in Section 3.4).

### 3.2 The Impact of Relationship Quality on Competitive Intelligence Work

Relationship quality refers to the degree of behavioral consistency and tacit understanding between individuals or organizations. It is an important indicator for measuring relationship characteristics.

In business activities, maintaining good relationships with suppliers, customers, and peers helps reduce transaction costs and decrease uncertainty about future returns [28]. Does high-quality intelligence relationship also help save intelligence costs and improve intelligence work effectiveness? To address this question, this paper analyzes the impact of relationship quality on competitive intelligence work from the perspectives of trust and satisfaction. The dimensional division of relationship quality is based on the perspectives of L. A. Crosby, N. Kumar, M. J. Dorsch, G. Szulanski, and A. Walter.

**(1) The Impact of Trust on Competitive Intelligence Work.** Trust means believing in and relying on the other party, defined as "one party's confidence in the reliability and honesty of the other party in a cooperative relationship" [29]. Regarding trust's impact on information exchange, A. Larson [35] and B. Uzzi [12] found that trust broadens the scope of exchanged content. A. Saxenian [36], M. P. Doney et al. [37], and R. Gulati et al. [19] argued that trust is a key factor in prompting both parties to abandon opportunistic behavior and improve information quality. M. Day et al. [38] showed that only when both parties trust each other will they exchange complex knowledge and tacit knowledge. Bao Changhuo, Wang Zhijin, and Ma Dehui specifically studied trust in human intelligence networks, finding that high-level trust can stimulate people's willingness to communicate and collaborate, leading to open information sharing.

In intelligence relationships, trust is the fundamental support for information exchange between both parties. Based on previous research conclusions, this paper argues that trust affects intelligence performance in the following ways:
Trust encourages intelligence sources to lower psychological barriers and communicate more content with intelligence personnel. Intelligence acquisition is the primary motivation for establishing relationships between individuals or organizations, and the goodwill and reliance factors in trust motivate intelligence sources to do their utmost to avoid dishonest behavior and provide truthful and reliable information. High trust implies strong mutual understanding, enabling intelligence personnel to more accurately capture key intelligence from weak signals released by intelligence sources.

**(2) The Impact of Satisfaction on Competitive Intelligence Work.** Satisfaction refers to the pleasant and positive feelings experienced by both parties during their interactions. It is an index measuring an individual's perception of a specific relationship and the attitude formed based on this perception. Theoretically, relationship establishment follows a trilogy of cognition, emotion, and behavior. First, cognition of others emerges in social interactions, followed by emotions such as liking or disliking. Good feelings promote relationship continuation, while aversion triggers confrontation and non-cooperation. Satisfaction is an important indicator for evaluating interaction effectiveness. C. Fornell et al. [30], C. J. Anderson [39], D. S. Jap et al. [40], and S. L. Gable [41] found that high satisfaction not only encourages richer disclosure but also stimulates both parties' desire to actively share key information. In intelligence relationships,

information serves as the fulcrum for shortening psychological distance.

This paper argues that satisfaction level affects intelligence performance for the following reasons: High relationship satisfaction leads intelligence sources to adopt a more positive and open attitude toward communication, providing intelligence personnel with more opportunities to acquire intelligence. The progression from acceptance to heartfelt communication requires high satisfaction as a guarantee, and a necessary condition for relationship advancement is mutual candor and truthful information exchange. The clearest evidence of close relationships is the exchange of private information. High satisfaction in intelligence relationships manifests as intelligence sources actively cooperating with intelligence personnel's information needs, providing some non-publicly accessible information.

Based on the theoretical analysis of how trust and satisfaction affect competitive intelligence work, this paper proposes the research hypothesis that relationship quality positively influences intelligence performance and outlines the relevant mechanism model (see the hypothesis summary table and overall model construction in Section 3.4).

### 3.3 The Impact of Relationship Strength on Competitive Intelligence Work

Relationship strength represents the power of a connection. It is an important dimension for measuring network relationship characteristics.

In 1992, M. Granovetter proposed that interaction frequency, reciprocity, and intimacy could be used to define relationship strength [8]. Subsequently, B. Uzzi [12], Y. J. Bian et al. [42], and A. Hausman et al. [43] also proposed criteria for measuring relationship strength. As Granovetter's perspective [8] is representative and comprehensively describes relationship strength characteristics, this paper adopts it to categorize intelligence relationships into strong ties and weak ties.

Because strong ties contain elements such as trust, emotional intimacy, and cooperative agreements that ensure information flow quality, while weak ties can continuously connect with new nodes, ensuring information freshness and heterogeneity. In fact, competitive intelligence work is a process where both strong and weak ties work together. Their specific impacts on competitive intelligence work are analyzed below.

**(1) The Impact of Strong Ties on Competitive Intelligence Work.** Strong ties refer to relationships between individuals or organizations with high interaction frequency, extensive reciprocal exchanges, and deep emotional bonds. Regarding their impact on competitive intelligence work, early research by Y. J. Bian [44] and Luo Jiade [45] showed that strong ties feature high trust and emotional closeness, providing more exclusive and scarce information. M. Musteen et al. [46] confirmed that strong ties play important roles in acquir-

ing information, knowledge, and cooperative partners. Chen Feng [47] found in his study of national competitive intelligence strategy that critical competitive intelligence, especially implicit knowledge about overseas market information and operational rules, often comes from strong ties. Xie Juan [48] also demonstrated through empirical survey research that strong ties are the main channel for enterprises to acquire tacit knowledge and critical intelligence.

Competitive intelligence is confrontational and exclusive, holding significant strategic importance for enhancing core competitiveness. However, it has a certain degree of implicitness that makes it difficult to discover and excavate, and strong ties can compensate for this limitation in competitive intelligence work. This paper argues that the specific contributions of strong ties are: Frequent interaction and communication in strong ties generate large amounts of information, creating more opportunities for intelligence personnel to mine intelligence. Strong ties generally involve deep emotions and mutual trust, prompting both parties to speak freely about high-value information, which greatly facilitates the acquisition of critical intelligence. Long-term reciprocal exchanges lead intelligence sources to be willing to accommodate intelligence personnel's information needs and provide required information to the greatest extent possible.

**(2) The Impact of Weak Ties on Competitive Intelligence Work.** Weak ties refer to relationships with low interaction frequency, few reciprocal exchanges, and non-intimate emotional bonds. Regarding the impact of weak ties on competitive intelligence work: M. Granovetter argued that compared with strong ties, weak ties have advantages in information richness and non-redundancy [49]; N. Lin et al. [50], D. Krackhardt [51], B. Uzzi [12], and V. Gilsing and B. Nooteboom [52] found that besides serving as bridges across social boundaries for acquiring external information, weak ties also have low operational costs, requiring no substantial time and effort for maintenance. Peng Jingli [25] and Cao Chunhong [53] also showed that more weak ties lead to richer and more comprehensive information collection for enterprises. Zhou Jinbo et al. [54] confirmed that enterprises can acquire information about new products, international operations, collaborators, and competitors by extensively establishing weak connections.

Thus, the contribution of weak ties to competitive intelligence work cannot be underestimated, mainly manifested in: More weak ties increase the likelihood of obtaining large amounts of rich information. More weak ties provide enterprises with more heterogeneous intelligence. However, due to weaker emotional and obligatory bonds in weak ties, intelligence sources transmit large amounts of unscreened and unfiltered information, and the mixture of good and bad information can easily trap intelligence personnel in information quagmires, making it difficult to find information that matches their needs. After all, intelligence work based on raw information only discovers gold mines; extracting gold (valuable intelligence) from the ore is the perfect outcome.

Based on the theoretical analysis above, this paper proposes the research hypoth-

esis that relationship strength influences intelligence performance and outlines the relevant mechanism model (see the hypothesis summary table and overall model construction in Section 3.4). The research hypotheses and theoretical models proposed in this paper are all based on conditions of moderate embeddedness and do not apply to the "embeddedness paradox" of "insufficient effective embeddedness" and "excessive embeddedness."

### 3.4 Summary of Research Hypotheses and Overall Model Construction

To comprehensively grasp the theoretical analysis results of how relational embeddedness affects competitive intelligence work, this paper summarizes the relevant research hypotheses and outlines the overall mechanism model, as shown in Table 1 and Figure 3 [Figure 3: see original paper].

**Table 1 Summary of Research Hypotheses on How Relational Embeddedness Affects Competitive Intelligence Work**

| Hypothesis | Content |
|---|---|
| H1 | Relationship duration positively affects enterprise competitive intelligence work |
| H2 | Relationship duration positively affects intelligence quantity |
| H3 | Relationship duration positively affects intelligence quality |
| H4 | Relationship duration positively affects intelligence demand satisfaction |
| H5 | Relationship quality positively affects enterprise competitive intelligence work |
| H6 | Relationship quality positively affects intelligence quantity |
| H7 | Relationship quality positively affects intelligence quality |
| H8 | Relationship quality positively affects intelligence demand satisfaction |
| H9 | Relationship strength affects enterprise competitive intelligence work |
| H10 | Relationship strength affects intelligence quantity |

| Hypothesis | Content |
|---|---|
| H11 | Relationship strength affects intelligence quality |
| H12 | Relationship strength affects intelligence demand satisfaction |

Note: H is the abbreviation for hypothesis. H1 corresponds to Hypothesis 1, which posits that relationship duration positively affects enterprise competitive intelligence work.

**Figure 3 [Figure 3: see original paper] Theoretical Model of How Relational Embeddedness Affects Competitive Intelligence Work**

## 4. Empirical Analysis of How Relational Embeddedness Affects Enterprise Competitive Intelligence Work

To test the research hypotheses and theoretical models proposed above, this paper conducted surveys of multiple domestic enterprises. Through large-sample data analysis and model fitting, it examined and refined the relevant hypotheses and models to obtain the actual mechanisms through which relational embeddedness affects competitive intelligence work.

The specific methods and steps of the empirical research are: Using SPSS 19.0 to test the reliability and validity of questionnaire items to ensure their rationality; Questionnaire distribution, data collection, and statistical analysis (using EXCEL and SPSS); Using AMOS 17.0 to construct and fit structural equation models.

### 4.1 Reliability and Validity Testing

Before questionnaire distribution, reliability and validity tests were conducted on all items and their interrelationships. Only after passing these tests could the questionnaire be considered reasonably designed for measuring the dimensions of relational embeddedness and indicators of intelligence performance.

**Reliability Testing:** Results showed that all item-total correlation coefficients were greater than 0.35, and Cronbach's alpha coefficients for all variables exceeded 0.70. This indicates good internal consistency among items for each variable, and the reliability test was successfully passed.

**Validity Testing:** Both content validity and structural validity were examined. Regarding content validity, the questionnaire referenced classic academic research questionnaires and was revised and improved based on field research feedback and expert opinions in the intelligence field, demonstrating good content validity. Regarding structural validity, AMOS 17.0 was used to analyze

the validity of each variable. Through data and measurement model fitting analysis, the fit results for relational embeddedness dimensions were: $^2$/df = 1.23 ( $^2$ = 178.21, df = 132); AGFI > 0.90, CFI > 0.90, RMSEA = 0.039, with all path coefficients being statistically significant. This indicates that relationship duration, relationship quality, and relationship strength effectively measure relational embeddedness. The fit results for intelligence performance evaluation indicators were: $^2$/df = 1.90 ( $^2$ = 97.207, df = 51), CFI > 0.90, AGFI = 0.871, RMSEA = 0.076, with all path coefficients being statistically significant. This indicates that intelligence quantity, intelligence quality, and intelligence demand satisfaction effectively evaluate competitive intelligence work performance.

### 4.2 Questionnaire Distribution and Data Collection

After passing reliability and validity tests, questionnaire distribution began. To minimize the impact of sample size on statistical analysis and obtain high-quality sample data, overall control was exercised over the distribution enterprises, targets, and channels. The questionnaire was distributed nationwide to middle and senior managers engaged in or familiar with competitive intelligence work. Distribution channels included four methods: on-site distribution at relevant conferences; distribution through relatives, friends, classmates, and colleagues; distribution through the Competitive Intelligence Branch; and online questionnaire platform distribution (URL: http://lilygirl.my.zhijizhibi.com/). After checking the completeness of collected questionnaires, 156 valid questionnaires were obtained. The basic characteristics of the sample are shown in Figures 4 [Figure 4: see original paper], 5 [Figure 5: see original paper], 6 [Figure 6: see original paper], and 7 [Figure 7: see original paper].

**Figure 4 [Figure 4: see original paper] Distribution of Enterprise Industry Types**
**Figure 5 [Figure 5: see original paper] Distribution of Enterprise Ownership Forms**
**Figure 6 [Figure 6: see original paper] Distribution of Enterprise Sizes**
**Figure 7 [Figure 7: see original paper] Distribution of Respondents' Positions**

Statistical results show that the research basically covers enterprises of various ownership forms across industries and includes managers at all levels from enterprises of multiple sizes, comprehensively reflecting Chinese management's cognition and understanding of intelligence relationship embeddedness.

### 4.3 Mechanism Model of How Relational Embeddedness Affects Enterprise Competitive Intelligence Work

Regarding the impact of relational embeddedness on enterprise competitive intelligence work, this paper established an initial structural equation model. Through fitting analysis of the relationships between relational embeddedness

independent variables and intelligence performance dependent variables, it examined the relationships between relational embeddedness dimensions and intelligence performance indicators to test and refine the proposed hypotheses and theoretical models.

The testing work proceeded in three steps: First, main effect analysis to determine whether relational embeddedness has any impact on competitive intelligence work; If an impact exists, the second step involves separate effect analysis of the three dimensions of relational embeddedness (relationship duration, relationship quality, and relationship strength) on competitive intelligence work; The third step analyzes the impact of relational embeddedness on each factor of intelligence performance, examining the relationships between relational embeddedness and intelligence performance indicators (intelligence quantity, intelligence quality, and intelligence demand satisfaction).

Model fit indices selected were $^2$/df, AGFI, CFI, and RMSEA. Specifically, $^2$/df is the goodness-of-fit test for $^2$. If $2 < {}^2/\mathrm{df} < 5$, the model is acceptable; if $^2/\mathrm{df} \leq 2$, the model fits very well. AGFI is the adjusted goodness-of-fit index: if AGFI $> 0.90$, the model is acceptable. CFI is the comparative fit index: if CFI $> 0.90$, the model is acceptable, with values closer to 1 indicating better fit. RMSEA is the root mean square error of approximation: values below 0.10 indicate good fit, below 0.05 indicate very good fit, and below 0.01 indicate excellent fit.

**4.3.1 Main Effect Analysis of Relational Embeddedness on Competitive Intelligence Work** The main effect analysis examined whether there is a relationship between relational embeddedness and intelligence performance without considering interrelationships among independent variables in the model. The fitting results are shown in Figure 8 [Figure 8: see original paper] and Table 2 .

**Figure 8 [Figure 8: see original paper] Model Fitting of How Relational Embeddedness Affects Competitive Intelligence Work**

**Table 2 Model Fitting Results of How Relational Embeddedness Affects Competitive Intelligence Work (N=156)**

(a) Parameter Estimates:

| Path | Estimate | S.E. | C.R. | P | Beta |
|---|---|---|---|---|---|
| Intelligence Performance ← Relational Embeddedness | 0.829 | 0.201 | 4.121 | *** | 0.69 |

(b) SMC Results:

The AMOS fitting analysis results for the initial structural equation model were: Chi-square ( $^2$) = 8.768, df = 8, thus $^2$/df = 8.768/8 = 1.095 (< 2), indicating excellent model fit; AGFI = 0.952 (> 0.90), indicating acceptable model fit; CFI = 0.995 (> 0.90, approaching 1), indicating excellent model fit; RMSEA = 0.025 (< 0.05), indicating very good fit. Additionally, the standardized regression coefficient of relational embeddedness on intelligence performance is 0.69, with significant impact (see Beta value or P value in Table 2(a)). Furthermore, the SMC value in Table 2(b) is 0.475, indicating that relational embeddedness can explain 47.5% of the overall model variance. Therefore, this paper concludes that relational embeddedness positively and significantly affects intelligence performance.

**4.3.2 Separate Effect Analysis of Relational Embeddedness Dimensions on Competitive Intelligence Work** The separate effect analysis examined the impact of the three dimensions of relational embeddedness on intelligence performance while considering interrelationships among independent variables. The fitting results are shown in Figure 9 [Figure 9: see original paper] and Table 3 .

**Figure 9 [Figure 9: see original paper] Model Fitting of How Three Dimensions of Relational Embeddedness Affect Competitive Intelligence Work**

**Table 3 Model Fitting Results of How Three Dimensions Affect Competitive Intelligence Work (N=156)**

| Path | Estimate | S.E. | C.R. | P |
|---|---|---|---|---|
| Intelligence Performance ← Relationship Duration | 0.248 | 0.100 | 2.483 | 0.013 |
| Intelligence Performance ← Relationship Quality | 0.315 | 0.100 | 3.157 | 0.002 |
| Intelligence Performance ← Relationship Strength | 0.140 | 0.100 | 1.403 | 0.161 |

The AMOS fitting analysis results were: Chi-square = 6.904, df = 6, thus

$^2$/df = 6.904/6 = 1.151 (< 2); AGFI = 0.950 (> 0.90); CFI = 0.994 (> 0.90, approaching 1); RMSEA = 0.031 (< 0.05), indicating excellent fit. Regarding regression results, the P value for the relationship between relationship duration and intelligence performance is 0.013 (< 0.05), indicating significant impact; the P value for relationship quality and intelligence performance is 0.002 (< 0.05), indicating significant impact; while the P value for relationship strength and intelligence performance is 0.161 (> 0.05), indicating non-significant impact. Therefore, this paper concludes that all three dimensions of relational embeddedness affect intelligence performance, but the impact of relationship strength is not significant. Ranked by influence magnitude: relationship quality, relationship duration, and relationship strength.

This paper suggests that relationship strength's non-significant impact on intelligence performance is due to: Strong ties easily create "path dependence," where both parties, to protect vested interests, vigorously exclude new nodes, which to some extent suppresses intelligence quantity and freshness; Influenced by cognition (intelligence sensitivity, professional ethics, etc.) and atmosphere, parties in strong ties may withhold key intelligence during exchanges, affecting intelligence performance.

**4.3.3 Impact of Relational Embeddedness on Each Factor of Competitive Intelligence Work Performance** This analysis examined the impact of relational embeddedness on each intelligence performance indicator while considering interrelationships among dependent variables. The fitting results are shown in Figure 10 [Figure 10: see original paper] and Table 4 .

**Figure 10 [Figure 10: see original paper] Model Fitting of How Relational Embeddedness Affects Each Factor of Competitive Intelligence Work**

**Table 4 Model Fitting Results of How Relational Embeddedness Affects Each Factor (N=156)**

(a) Parameter Estimates:

| Path | Estimate | S.E. | C.R. | P |
|---|---|---|---|---|
| Intelligence Quantity ← Relational Embeddedness | 0.199 | 0.050 | 3.975 | *** |
| Intelligence Quality ← Relational Embeddedness | 0.187 | 0.048 | 3.889 | *** |

| Path | Estimate | S.E. | C.R. | P |
|---|---|---|---|---|
| Intelligence Demand Satisfaction ← Relational Embeddedness | 0.202 | 0.050 | 3.997 | *** |

(b) SMC Results:

The AMOS fitting analysis results were: Chi-square = 8.661, df = 6, thus $^2$/df = 8.661/6 = 1.443 (< 2); AGFI = 0.937 (> 0.90); CFI = 0.984 (> 0.90, approaching 1); RMSEA = 0.053 (> 0.05 but < 0.10), indicating good fit. Additionally, Table 4(a) shows that relational embeddedness has significant impact on intelligence quantity, intelligence quality, and intelligence demand satisfaction (all marked with "***"). Table 4(b) shows that relational embeddedness has the strongest explanatory power for intelligence quality (SMC = 0.207), while SMC values for intelligence quantity and demand satisfaction are 0.193 and 0.177, respectively. Thus, relational embeddedness affects all intelligence performance indicators, albeit with varying degrees of influence.

### 4.4 SEM Analysis of How Relational Embeddedness Affects Enterprise Competitive Intelligence Work

Through large-sample surveys and structural equation modeling analysis, the research hypotheses proposed in this paper have been largely confirmed, and the theoretical models have passed testing. The final conclusion is that the three dimensions of relational embeddedness positively affect intelligence performance indicators, with relationship quality having the most significant impact on intelligence quality. The hypothesis testing results are summarized in Table 5 .

**Table 5 Summary of Hypothesis Testing Results**

| Hypothesis | Result |
|---|---|
| H1: Relationship duration positively affects enterprise competitive intelligence work | Passed and positive |
| H2: Relationship duration positively affects intelligence quantity | Passed and positive |
| H3: Relationship duration positively affects intelligence quality | Passed and positive |
| H4: Relationship duration positively affects intelligence demand satisfaction | Passed and positive |
| H5: Relationship quality positively affects enterprise competitive intelligence work | Passed and positive |

| Hypothesis | Result |
|---|---|
| H6: Relationship quality positively affects intelligence quantity | Passed and positive |
| H7: Relationship quality positively affects intelligence quality | Passed and positive |
| H8: Relationship quality positively affects intelligence demand satisfaction | Passed and positive |
| H9: Relationship strength affects enterprise competitive intelligence work | Passed and positive |
| H10: Relationship strength affects intelligence quantity | Passed and positive |
| H11: Relationship strength affects intelligence quality | Passed and positive |
| H12: Relationship strength affects intelligence demand satisfaction | Passed and positive |

Since the constructed theoretical model passed testing, the overall model of how relational embeddedness affects competitive intelligence work remains Figure 3 [Figure 3: see original paper] and is not repeated here.

These research results provide strategies and basis for enterprises seeking to improve intelligence performance through relational embeddedness: To ensure intelligence quality, enterprises should first focus on relationship quality, prioritizing connections with key intelligence sources (nodes occupying betweenness centrality or degree centrality positions) because they have access to large information volumes and higher probabilities of obtaining critical intelligence, enabling quality intelligence acquisition to achieve more with less. Second, they should control relationship duration and relationship strength to avoid both "insufficient effective embeddedness" and "excessive embeddedness." Insufficiency makes the other party feel the relationship is "not close enough" and unsuitable for exchanging critical information, while excess may cause annoyance, rejection, and refusal to communicate effectively. While ensuring intelligence quality, enterprises must also pay attention to intelligence quantity and demand satisfaction. Because quantity is the foundation of quality, qualitative improvement occurs only with a certain quantitative base. In this process, enterprises should focus on the original driving force of competitive intelligence work and establish and maintain intelligence relationships based on demand. After all, even the best intelligence personnel cannot attend to all intelligence sources, and demand-driven competitive intelligence work is an effective approach to building intelligence relationship embeddedness.

Since 90% of the research subjects are Chinese enterprises (see Figure 5 [Figure 5: see original paper]), and 80% are production enterprises (see Figure 4 [Figure 4: see original paper]), this research has certain reference significance for Chinese production enterprises in building intelligence relationship embeddedness:

(1) Chinese society is an "acquaintance society" that values interpersonal relationships. Compared with other types of enterprises, production enterprises involve more node types and have more complex social relationships, including local governments, industry associations, research institutes, as well as multi-level raw material suppliers and distributors. Problems in any link affect overall production operations. Extensively establishing intelligence relationships enables enterprises to quickly locate intelligence sources and solve thorny problems promptly.

(2) Relational embeddedness construction should be targeted, selecting nodes with high betweenness or strong authority for connection. This saves intelligence costs and improves efficiency. For example, the intelligence department head of a domestic automobile enterprise (a survey subject) regularly visits manufacturers like Shanghai Automotive Group and Guangzhou Automotive Group to obtain first-hand information about vehicles and components from chatty employees (with strong betweenness). When an overseas investor selected a wind power pitch slip ring manufacturer in China, it chose a small enterprise with independent R&D capabilities rather than the largest domestic producer because the latter had strong authority and mastered the latest industry technology information.

(3) Enterprises should establish embedded relationships with different emphases based on their attributes, size, and industry. For instance, state-owned enterprises should build strong ties with government departments, while private enterprises should maintain close connections with upstream and downstream enterprises. Different attributes determine different survival environments. Additionally, each intelligence source has its own "contextual" characteristics, and intelligence personnel should communicate in ways that align with the other party's personality, relevant institutional regulations, and cultural atmosphere, as this facilitates psychological trust and resonance.

After all, 5% of critical intelligence is hidden in interpersonal channels (the other 95% can be obtained from public channels). Only by stimulating the other party's pleasant and positive relationship experiences will they open up and exchange key content. Moderately embedded intelligence relationships will thereby highlight the importance of human intelligence network construction in acquiring core intelligence.

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## Author Contributions

Tong Lijuan: Proposed research ideas, designed algorithms, and wrote the paper;
Tong Ruobei: Proposed research direction, conducted data collection and analysis;
Li Minghui: Provided paper revision suggestions.

*Note: Figure translations are in progress. See original paper for figures.*