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Effect of Network Centrality on the Relationship between Trust and Collaborative Decision-Making in Supply Chain

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Abstract

Purpose: The current research aims to explain the significance of power in the supply chain, with a particular emphasis on the buyer's perspective. In doing so, this research investigates the influence of network centrality on trust and collaborative decision-making in supply chain. Power, in this research, is measured with two structural dimension of network centrality: degree centrality and betweenness centrality. **Research design, data and methodology:** The empirical analysis is performed with the survey answered by supply chain managers from various industries in Korean corporations. The survey encompasses constructs, including trust, power, and collaborative decision-making. This study performs several statistical tests to analyze the direct effect model, the mediation effect model, the moderation effect model, and the moderated moderation effect model. **Results:** The indirect effect of trust on collaborative decision-making through degree centrality is significant whereas the mediation effect of betweenness centrality is not. The moderation test results indicate that the relationship between trust and collaborative decision-making is not influenced by the levels of degree centrality and betweenness centrality. **Conclusions:** This study discloses managerial implications such that even in the presence of coercive or opportunistic behaviors stemming from high level of network centrality, trust-based collaboration may not be significantly influenced.

Keywords : Trust, Collaborative Decision-Making, Degree Centrality, Betweenness Centrality, Supply Chain, Mediation Effect, Moderation Effect, Distribution Science

JEL Classification Code: C83, M10, M11

1. Introduction

Supply chain integration plays a pivotal role in enhancing supply chain performance and generating value across the entire supply chain (Frohlich & Westbrook, 2001; Li et al., 2022). Researchers have developed various measures for supply chain integration, including collaborative decision-making through trust and information

sharing between buyers and suppliers (Cagliano et al., 2006; Ramanathan & Gunasekaran, 2014).

Recent studies indicate that power and dependency are closely related to trust and supply chain integration. For instance, previous research suggests that power is a significant obstacle (Handfield & Bechtel, 2002), while asymmetric dependency negatively impacts trust among supply chain partners (Brinkhoff et al., 2015). Moreover,

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trust and power coexist in supply chain relationships, influencing supply chain integration differently (Krause et al., 2007). However, limited evidence exists regarding the importance of power, dependency (Huo et al., 2019), and trust as key factors affecting integration (Laaksonen et al., 2008). Reimann and Ketchen (2017) highlight the often-overlooked role of power between suppliers and buyers, despite its correlation with supply chain integration. Relational capitals and assets, such as trust, power, and relational commitment, are critical in achieving supply chain integration and gaining a competitive advantage. Ireland and Webb (2007) argue that balancing trust and power can mitigate uncertainties and risks in the supply chain. Yeung et al. (2009) state that trust and power, individually and interactively, affect supplier integration. Other studies reveal that dependency controls the effectiveness of supplier cooperation (McCarthy-Byrne & Mentzer, 2011), and both dependency and trust significantly impact supply chain collaboration (Laaksonen et al., 2008). Additionally, Petersen et al. (2008) assert that while dependency may not directly affect supplier integration, it influences the socialization process, ultimately impacting integration.

In business, entities like buyers and suppliers are interdependent, requiring a dyadic transaction to create mutual benefits in a social exchange (Cropanzano & Mitchell, 2005). However, empirical examination on the relationship between power and trust is limited (Yeung et al., 2009). Studying power dynamics within the entire supply network, rather than solely focusing on dyadic relationships, is essential. A network perspective considers the interconnectedness and interdependencies among multiple actors in the supply chain, providing a comprehensive understanding of power dynamics (Dyer & Singh, 1998; Chen & Paulraj, 2004; Lavassani & Movahedi, 2021). Despite recent insights and the expansion of the supply chain perspective into a network perspective, there is still a lack of thorough investigation into the impact of power on trust building and collaborative decision-making in supply networks. To address this research gap, the current study aims to provide empirical evidence on the role of power in the relationship between trust and collaborative decision-making within the entire supply network. Power may serve as a hidden variable influencing the dynamics between trust and collaborative decision-making. Adopting an intrinsic network perspective, the current study explores power's mediating and moderating effects by measuring power within the supply network using two network centrality (NC) concepts: degree centrality (DC) and betweenness centrality (BC).

NC in this study refers to the strategic position and influence of a firm or entity within the network. Therefore, centrality measures like degree and betweenness in network

theory, help assess the importance of a node (e.g., a company, supplier, or facility) in terms of connections, control over information flow, and proximity to other supply network nodes. In this regard, a firm with high centrality is expected to benefit from improved access to information, resources, and relationships. In addition, collaborative decision-making is a process of doing decisions together and achieving same agreement from collaborated parties. It involves process of identifying and choosing alternative courses of action in a manner appropriate to the demand of the situations. This concept in supply chains involves a team of partners working together to make choices about various aspects of the supply chain, including planning, sourcing, production, distribution, and returns. This approach allows for better resource allocation, improved visibility, and greater efficiency in responding to changes. The DC and BC measures focus on understanding how the structural positions of actors in the supply network influence power dynamics. This approach aligns with Granovetter's (1985) embeddedness concept, emphasizing the importance of social relationships and network structures in shaping individual behavior and outcomes. Therefore, power is not solely derived from resource dependence, as suggested by the resource dependency perspective of Pfeffer and Salancik (1978).

To achieve the research objectives, this study collects cross-sectional survey data from supply chain managers in Korea. The survey encompasses various constructs, including trust, power, and collaborative decision-making. Following Hayes' (2018) recommendation, the study adopts a process model to simultaneously analyze mediating and moderating effects. Specifically, it focuses on understanding the impact of power based on the buyer's structural position from a supply network perspective. By utilizing the process model, the study aims at elucidating the significance of power dynamics in supply chains, with a particular emphasis on the buyer's perspective. Recognizing the importance of understanding and managing power dynamics within supply chains, this study contributes to both scholarly research and managerial practice.

2. Literature Review

2.1. Collaborative Decision-making and Trust in the Supply Chain

Supply chain integration is a process by which a firm strategically collaborates with supply chain partners to achieve the effective and efficient flow of products, services, information, funds, and decisions to provide maximum value to customers. Relevant economic activities include system alignment, information sharing, and joint

investments, and ongoing inter-organizational social relationships among business partners (Zhao et al., 2011). Supply chain integration begins with internal cooperation, leading to external cooperation with suppliers and customers (Flynn et al., 2010).

Collaborative decision-making, characterized by information sharing and cooperation among supply chain partners, is a key to achieving supply chain integration and improving sustainability. Effective collaboration in decision-making processes enables members to reduce uncertainty and make more informed and coordinated decisions. By sharing information and cooperating, supply chain partners can collectively address challenges, identify opportunities, and develop strategies that benefit the entire supply chain. Consequently, this can lead to enhanced performance and sustainable outcomes (Frohlich & Westbrook, 2001). Meanwhile, trust refers to a firm's belief regarding its exchange partners' honesty, openness, and benevolence. Trust is crucial in facilitating collaborative activities among partners (Yeung et al., 2009; Freitas et al., 2024). Firms are more likely to engage in collaborative efforts, share information, coordinate activities, and make joint decisions when they trust their partners (Yang et al., 2025; Holgado et al., 2024). Trust, as an important form of relational capital, reduces exchange risks and fosters cooperation among partners because it prevents uncertainty and opportunistic behaviors (Wang et al., 2011).

An atmosphere where supply chain members willingly go beyond the minimum requirements of their relationship nurtures trust in supply chain (Ireland & Webb, 2007). Accordingly, building trust becomes a key to maintaining collaborative decision-making through long-term partnerships between supply chain partners. Trust is an alternative to traditional cost control and coordination mechanisms, and it facilitates knowledge transfer, joint learning, and sharing risks and costs among partners. Consequently, trust is indeed a critical component for successful supply chain management (Delbufalo, 2012).

2.2. Dyadic Power in the Supply Chain Collaboration

Power and dependency are intertwined and mutually dependent concepts (Emerson, 1964). Power might emerge from one's degree of dependency on others, whereas dependency, in turn, creates the opportunity for the exercise of power (Zhuang & Zhou, 2004). Some firms may manage their dependency over other firms by controlling resources (Pfeffer & Salancik, 1978). One organization's net dependency over another determines relative power in inter-organizational relationships, such that when one organization is more dependent on another, the latter holds more power. A high level of total inter-dependency indicates a strong, cooperative, and long-term relationship between

two parties.

Cox (2001) proposes a power matrix and analyzes buyer-supplier power levels based on the dimensions of relative utility and scarcity of resources. This matrix categorizes buyer-supplier relationships into four positions: buyer dominance, inter-dependency, independency, and supplier dominance, which reflect the power dynamics generated by the level of resource dependency. Power is a multi-dimensional concept at various levels, including organizational, individual, and relationship, and power dynamics can manifest differently across these levels.

Based on the source of power, power can be classified into two dimensions: coercive and non-coercive (Hunt & Nevin, 1974). Coercive power involves one party exerting control over another through adverse actions, such as punishment, threats, or penalties (Yeung et al., 2009). In contrast, non-coercive power involves one party promoting the partner's desired behavior through positive actions, encompassing various power sources like expert, reference, legitimate, and reward. Firms often establish long-term and strong relationships with their supply chain partners to secure competitive advantages, which, in turn, strengthen inter-dependency among themselves (Narasimhan et al., 2009). Power imbalances and asymmetrical relationships are more realistic than completely symmetric relationships. When one party has significantly more power than the other in a buyer-supplier relationship, it creates an asymmetric dependency or a power imbalance, and sometimes even worsens corporate governance performance (Gu et al., 2024; Hingley et al., 2015; Rindt & Mouzas, 2015; Vesalainen & Kohtamäki, 2015). This imbalance can result in opportunistic behaviors, while powerful organizations may be reluctant to build long-term cooperative relationships due to concerns regarding increased dependency and potential power loss.

2.3. Network Centrality and Power

Recognizing the limitations of traditional dyadic frameworks (Choi et al., 2001), researchers have increasingly adopted a network perspective to understand the complex interdependencies underlying modern supply chains. A firm's relative position within this interconnected web of multiple entities and interactions shapes its business strategies and ability to build competitive advantages by managing material and information flows (Kim et al., 2011). Social network analysis offers valuable insights into the performance of individual firms and the supply network as a whole (Han et al., 2020), outlining how a firm's network position can confer informational and competitive advantages by influencing its competitive priorities (Yang et al., 2024). Other studies have suggested the need to deal with supply networks from the perspective of social network

analysis (Borgatti & Li, 2009; Galaskiewicz, 2011; Bellamy & Basole, 2013; Han et al., 2020) as the analysis helps firms better understand how a position in the network affect the performance of individual companies and the entire supply network. Understanding the structural dimensions of supply networks, including the informational and power dynamics associated with different positions, is crucial for organizations seeking to leverage their network-based resources and navigate supply chain complexities.

The theoretical framework in the current study is grounded on network theory. The theory helps analyze and understand the intricate relationships and flow of information, resources, and insights within supply chain networks. It provides a framework to identify critical players, understand structural and relational dynamics, and separate signal from noise to make more informed decisions. Rooted in the theoretical perspectives, this study goes through the relationship among trust, network centralities (i.e., DC and BC), and collaborative decision making in the context of supply chain.

This study introduces the concept of centrality to discuss the role of power in the situation between trust and collaborative decision-making in supply chain. It attempts to enrich the literature by empirically extending the understanding of how the influence of power appears under the expanded perspective of supply network by measuring power using more diverse concepts (i.e., DC and BC).

A firm with higher centrality over others has high relative power, which leads to more opportunities to control opportunism that causes the bullwhip effect (e.g., information asymmetry, breach of contract, exploitation of asset specificity). For instance, firms with high DC can leverage their numerous connections to foster open communication and information sharing, reducing misunderstandings and enhancing trust. Meanwhile, firms with high BC can facilitate cooperation by acting as intermediaries, ensuring that diverse perspectives are integrated into decision-making processes. As a result, by reducing opportunism, the actors in the supply chain will engage in higher trust and cooperative decision-making, ultimately leading to improved efficiency and stronger relationships.

Network theory links power-dependency to network positions, where centrality becomes a secondary source of inter-organizational power - the ability to create dependency through resource exchange (Astley & Sachdeva, 1984). Entities with central network positions can access more information and control more resources, and both resource dependency theory and network theory elucidate how power imbalances and network positions can influence strategic resource control (Granovetter, 1985; Liu et al., 2022). Asymmetric dependency in exchange relationships leads to asymmetry in network structure, with power differentials

determining the central positions held by actors. Those with higher power tend to occupy stronger central positions and have greater control over critical resources, while those with lower power face weaker network positions and limited control. It highlights how the network position of buyers or suppliers determines the extent of their power.

Network theory and social network analysis define centrality as the level of impact an actor has within a network, where highly central actors have a large number of connections or occupy strategically significant positions. The position indicates their popularity or prominence among network partners, i.e., a measure of an organization's performance based on its social and transactional connections and interactions (Burt, 1992). Firms with high NC in a supply chain hold advantages in accessing markets, ideas, information, advice, and business opportunities, as centrality is linked to power from a network perspective, as noted by Hakansson and Ford (2002) and Batista et al. (2023).

To measure the level of centrality in the supply network, this study utilizes DC and BC. First, DC, defined as a node's frequency of connections in a network, determines a firm's visibility and accessibility to information and knowledge sources within the supply chain (Luo et al., 2024). Firms with higher DC can spread information and ideas more effectively (Wang et al., 2015), positioning them as essential channels of relational information and granting them better access to and control over resources (Coleman, 1990). However, excessive centrality can also lead to drawbacks, such as knowledge redundancy and free-riding behavior by partners, potentially causing resource problems and a lack of mutual benefits. Balancing the advantages and disadvantages of NC is crucial for firms seeking to leverage their strategic position and optimize performance within the supply chain ecosystem.

Second, BC quantifies the importance of an entity within a network based on its position as a bridge or intermediary between other entities, indicating the extent to which it lies on the shortest paths among all pairs of others. It indicates the level to which a subject can bridge structural gaps by connecting two or more subjects that lack direct connections (Burt, 1992). Firms with high BC serve as gatekeepers, mediating interactions, conveying influence, and controlling the access and flow of information (Behara et al., 2014). They provide unique advantages in facilitating knowledge spillovers and enhancing knowledge transfer and absorptive capacity, contributing to increased innovation. However, this centrality measure also carries potential drawbacks, such as resource overuse and relationship failure due to inadequate coordination of linked connections, as well as a loss of control when individual partners become fully interconnected, resulting in decreased trust among network members. Firms can mitigate the challenges associated with

their role as bridges within the network by balancing the benefits and risks of BC.

3. Hypothesis Development

3.1. Trust and Collaborative Decision-Making

Trust has been widely recognized as a meaningful predictor of positive outcomes in inter-organizational relationships (Tsanos & Zografos, 2016). Based on inter-organizational relations theory, Morgan and Hunt (1994) empirically verify the hypothesis that trust fosters collaboration. Trust not only directly influences information integration but also mediates the relationship between institutional forces and information integration (Cai et al., 2010). As a critical enabler of supply chain integration, trust contributes to the long-term stability of the relationship (Handfield & Bechtel, 2002).

According to social capital theory, trust provides manufacturers with access to a broader range of information sources, improves information quality, relevance, and timeliness, and reduces the costs and obstacles to information acquisition (Adler & Kwon, 2002). High-trust partnerships among entities involved are characterized by open information sharing, mutual skill enhancement, collaborative strategy development, and joint problem solving (Fawcett et al., 2012), all of which result in benefits in terms of reduced cycle times, low transaction cost, and increased supply chain resilience (Collier & Sarkis, 2021). Establishing long-term relationships between suppliers and buyers based on shared values, goals, and dependency is crucial for improving supply chain performance (Krause et al., 2007). Trust also significantly enhances the effectiveness of joint decision-making processes (Revilla & Knoppen, 2015).

Meanwhile, transaction cost theory proposes that developing trust and collaborative relationships between suppliers and buyers can reduce transaction costs and secure a competitive advantage (Ireland & Webb, 2007; Yeung et al., 2009). When a firm trusts the goodwill of its partners, it leads to greater collaboration and dependency between partners (Wang et al., 2011). Trust creates an environment of cooperation and reduces potential uncertainties and opportunistic behaviors in transactions. Besides, trust motivates buyers and suppliers to align their best interests and activities. Trust, therefore, becomes a prerequisite for preventing uncertainty and opportunistic behavior and fostering an environment that is conducive to collaborative decision-making. (Nurhayati et al., 2023).

Trust among organizations catalyzes open information sharing, joint discussion of alternatives, and collaborative working processes based on mutual understanding.

Organizations are more inclined to engage in these collaborative behaviors when there is a high level of trust. However, the formation of trust is neither easy nor automatic. It requires exchanging information, interacting, and building a foundation of shared experiences and understanding between partners. Valid knowledge creation for decision-making relies on this collaborative exchange. Because trust creates an environment where collaboration can thrive, it facilitates joint planning and problem solving, and nurtures collaborative behaviors among partners (Yeung et al., 2009). Therefore, the research proposes the hypothesis.

H1: Trust has a positive influence on collaborative decision-making.

3.2. Relationship between Trust and Power

Trust and power are two distinct means by which firms seek to promote desirable behavior from their partners. Trust and power are complementary yet contrasting constructs of social behavior. Generally, a high level of trust reduces transaction costs associated with negotiation, monitoring, and coercion. Power, buyer power in particular, positively influences collaborative decision-making when combined with trust between the two parties. When a supplier trusts a buyer, they are more likely to see the relationship as reliable. This stability encourages the supplier to allocate more resources, leading to higher transaction volume. Carefully controlled utilization of power can promote supply chain integration and thus positively impact performance (Maloni & Benton, 2000).

Some scholars argue that an open social structure's favorable position can lead to certain detrimental effects such as increased opportunism, information overload, conflict, and obstruction of collaboration with new partners (Wang et al., 2015). Even in scenarios where good levels of trust exist among parties, the presence of opportunistic behavior can undermine effective supply chain integration. Trust alone may not be sufficient to ensure smooth collaboration and coordination throughout the supply chain if opportunism occurs. While a firm has high trust with a partner, it can pursue stronger collaborative decision-making, but at the same time the partner may expand the level of opportunistic behavior.

Trust is linked to power in the supply chain. Without desired inter-organizational relational elements such as trust, commitment, shared vision, firms may be reluctant to share information with their partners because of concerns regarding information leakage and a potential loss of power. Yeung et al. (2009) contend that suppliers should establish trust as a foundation before using coercive power. However, their empirical research results reveal that buyer's coercive power improves supplier integration in Chinese supply chains, even in the absence of trust. The nature of trust and

power may have negative implications, particularly when one construct fails to achieve desirable outcomes. These dynamics highlight the complexity of the relationship between trust and power. Various factors, including the nature of the relationship, the industry dynamics, and the broad socio-cultural and economic context, influence the interplay between trust and power. With these issues in mind, the hypotheses can be set up as follows.

H2: Trust has a positive influence on degree centrality.

H3: Trust has a positive influence on betweenness centrality.

3.3. Relationship between Power and Collaborative Decision-Making

Power dynamics can affect the ability to integrate knowledge effectively, while the effectiveness of knowledge integration can also influence power dynamics within the supply chain. Asymmetrical power between buyer and supplier has an impact on knowledge sharing such as exchange and transfer of technological knowledge (Cai et al., 2010). Power positively impacts accelerated decision-making and several power dimensions impact decision-making and knowledge integration in innovation projects within the supply chains (Ireland & Webb, 2007).

This study defines power in terms of centrality from the perspective of a supply network. In a buyer-supplier relationship characterized by power imbalances, dominant organizations exert their power to maintain control, whereas weaker organizations tend to follow their lead in order to continuously access resources (Gulati & Sytch, 2007). Higher centrality reflects a higher level of power because it makes it easier for a firm to impose its thinking on other partners within the network and achieve its own goals (Hakansson & Ford, 2002). Occupying a central position can provide advantages in accessing both explicit and tacit knowledge, as well as other valuable resources. However, excessive centrality can also adversely affect knowledge exploration and exploitation. Excessive centrality can result in a reliance on existing knowledge and established practices, limiting the ability of firms to fully benefit from the novelty and productivity associated with new knowledge. Ferriani et al. (2009) mention the possibility of diminishing returns to centrality because of monitoring an increasingly extensive network.

Many researchers have provided evidence that interfirm network closure characterized by solid ties can enhance trust and collaboration among cooperating firms, alleviating opportunism concerns (Gulati & Sytch, 2007). There are other claims that network closure may have adverse effects. A closed network structure hinders individual firms from connecting with external actors and restricts access to

resources and information beyond the network (Burt, 1992). Additionally, an excessively dense network structure can limit knowledge and information sharing with external firms, thereby impeding the acquisition of creative knowledge and ideas for new product development and innovation. Based on earlier studies' discussion of power, centrality, network disclosure, supply chain return, and collaboration, this research presumes that power, as measured by centrality, is inherently linked to trust and collaborative decision-making. Trust and power are distinct concepts with complementary and opposing characteristics in the context of collaborative decision-making. Thus, hypotheses are proposed as:

H4: Degree centrality has an influence on collaborative decision-making.

H5: Betweenness centrality has an influence on collaborative decision-making.

3.4. Mediation Effect and Moderation Effect of Centrality Relationship

Firms with a higher DC in a supply network have an impact on competitiveness and bargaining power (Chen & Paulraj, 2004). Power can play a positive role in the relationship between trust and collaborative decision-making unless it is excessive. Excessive or abusive use of power can rather undermine trust and hinder collaborative decision-making. When power becomes disproportionate or is exercised in a manner that disregards the input and concerns of others, it can negatively affect trust and open communication. Therefore, balancing power, trust, and collaborative decision-making is crucial for creating a productive collaborative environment. The study proposes two hypotheses to investigate the role of NC in the relationship between trust and collaborative decision-making:

H6: Degree centrality has a mediation effect on the relationship between trust and collaborative decision-making.

H7: Betweenness centrality has a mediation effect on the relationship between trust and collaborative decision-making.

The two power variables adopted have conceptually distinct attributes in the supply network. To better understand the relationship among these variables, the study explores whether a moderation effect or a moderated moderation effect exists. Examining how the two centrality variables influence the overall model can contribute to a more robust and nuanced understanding of network dynamics. Centrality measures are utilized to assess the

importance or prominence of entities within a network. By considering different centrality measures and their impact on the overall model, the study can gain a deeper understanding of network dynamics and draw more reliable conclusions. The study proposes the following hypotheses to test the moderation effects.

H8: Degree centrality has a moderation effect on the relationship between trust and collaborative decision-making.

H9: Betweenness centrality has a moderation effect on the relationship between trust and collaborative decision-making.

Additionally, for testing the moderated moderation effects, a hypothesis is proposed as follows:

H10: Betweenness centrality moderates the moderated influence of DC on the relationship between trust and collaborative decision-making.

4. Research Methodology

4.1. Sample Characteristics

This study employs a cross-sectional research design to test the hypotheses. An online survey service company assists in collecting the data, and 300 responses are used for analysis. The evaluation measures are based on a 5-point Likert scale. The industries are classified according to the 9th edition of the Korean Standard Industrial Classification as follows: electronic components, computers, audiovisual equipment, and communication equipment: 45 (15.00%); primary metals: 7 (2.33%); metal processing products: 37 (12.33%); food products: 25 (8.33%); beverages: 5 (1.67%); clothing, accessories, and fur products: 12 (4.00%); wigs and shoes: 2 (0.67%); textile products: 18 (6.00%); wood and wood products: 4 (1.33%); pulp, paper, and paper products: 2 (0.67%); printing and record media reproduction: 8 (2.67%); cork, charcoal, and petroleum refining products: 2 (0.67%); chemicals and chemical products: 20 (6.67%); medical materials and pharmaceuticals: 11 (3.67%); rubber, vehicle, and plastic products: 7 (2.33%); non-metallic mineral products: 3 (1.00%); medical precision optical instruments and watches: 2 (0.67%); electrical equipment: 13 (4.33%); other machinery and equipment manufacturing: 41 (13.67%); automobiles and trailers: 26 (8.67%); other transportation equipment: 4 (1.33%); furniture: 6 (2.00%).

The scale of companies is measured based on their annual sales and the number of employees. Over the past three years, the average annual sales are distributed as follows: 114 companies (38.91%) annual sales of 50 billion

Korean won or less; 34 companies (11.6%) annual sales between 50 billion and 100 billion Korean won; 76 companies (25.94%) annual sales between 100 billion and 500 billion Korean won; 18 companies (6.14%) annual sales between 500 billion and 1 trillion Korean won; 51 companies (17.41%) annual sales exceeding 1 trillion Korean won. Regarding the average number of permanent employees over the past three years, the distribution is as follows: 154 companies (52.20%) 50 employees or fewer; 40 companies (13.56%) between 50 and 100 employees; 66 companies (22.37%) between 100 and 500 employees; 10 companies (3.39%) between 500 and 1,000 employees; 25 companies (8.47%) more than 1,000 employees.

4.2. Scale Development and Measurement Methodology

The latent items for each construct are developed through a literature review. The initial items are validated through multiple discussions and then revised. To assess the structural position characteristics of an organization from a network perspective, DC is measured by referring to Fang et al.'s study (2015). For BC, items are developed by applying the measures of structural holes in social network analysis such as redundancy, constraint, and efficiency indicators. Appendix 2 contains the survey items.

The constructs are established by averaging the items within each construct. Because the intercorrelations among the items within a construct are not considerably high from the content validity perspective, regression analysis is performed using single-item indicators. Multiple-item constructs are used to test the hypotheses. The data comprises surveyed responses based on the subjective judgment of corporate managers, which reflect insights and opinions from individuals with expertise in a particular domain. A potential common method bias by subjective measurements is assessed by using Harman's single-factor method (Podsakoff & Organ, 1986). The results indicate that one factor accounts for 40.68% of the total variance, which satisfies the commonly accepted criterion of less than 50%.

The internal consistency is checked by the Cronbach's alpha coefficient, which ranges from 0.829 to 0.896, surpassing the common acceptance criterion of 0.7. In particular, the Cronbach's alpha is 0.896 for trust, 0.844 for collaborative decision-making, 0.888 for DC, and 0.829 for BC, respectively. Appendix 1 shows the confirmatory factor analysis result, with the following fit indices: $\chi^2 = 523.241$, $d-f = 200$, $\chi^2/d-f = 2.616$, $p\text{-value} < .0001$, $RMR = 0.074$, $GFI = 0.856$, $NFI = 0.870$, $TLI = 0.902$, $CFI = 0.915$, and $RMSEA = 0.074$. Although GFI and NFI are slightly below 0.90, they are close to the acceptable level of 0.90. The values of RMR and RMSEA are below 0.08, indicating a good fit (Hu & Bentler, 1999).

Bagozzi and Yi (1988) propose that the criteria be a composite reliability (CR) of 0.7 or higher and an average variance extracted (AVE) of 0.5 or higher. As displayed in Table 1, the AVE values are 0.483 for trust and 0.478 for collaborative decision-making, both of which slightly lower than the criteria. However, the CR values are 0.893 and 0.845 respectively, surpassing the threshold (Fornell & Larcker, 1981). Furthermore, the ratio of χ^2 to the degrees of freedom is below 3.0, indicating an acceptable model fit.

4.3. Data Analysis

All statistical analyses are conducted using SPSS version 23.0. The mediation and moderation effects are analyzed by SPSS PROCESS macro, adhering to Hayes' (2018) guidelines. PROCESS macro supports researchers to verify the significance of indirect effects by utilizing the bootstrapping technique, and to set up various models as desired, despite of limited prior knowledge on the relationship between constructs. Another reason for using this method is the relaxation of some assumptions. For example, it has the limitation of being based on indirect inference without directly testing the significance of the size of the mediating effect like Baron & Kenny's method, and it does not require a normal distribution like the Sobel test.

The estimation of these two effects is done by a bootstrapping procedure. Three direct effects and the total effect are calculated – the direct effect of the independent variable on the mediator, the direct effect of the independent variable on the dependent variable, the direct effect of the mediator on the dependent variable, and the total effect of the independent variable on the dependent variable. The determination of complete or partial mediation depends on whether the effect of the independent variable on the dependent variable remains significant or not, assuming that the mediation effect is significant. To conclude moderation, all three tests must be significant – the effect of the independent variable on the dependent variable, the moderator's effect on the dependent variable, and the interaction effects on the dependent variable. Significance level is set, as usual, at 0.05.

Statistical significance is greatly influenced by the size of the sample, no matter how small the effect truly is in the real world. Thus, practical significance representing the magnitude of the difference (or effect size) should also be considered when making decisions. As shown in Table 1, the correlation coefficients are 0.5 or greater with one exception 0.473 so that it indicates the practical significance of research outcome due to a large effect size. There is no similar previous study applying NC in supply chains. Thus, comparisons are impossible.

Table 1: AVE, Correlations Coefficient, and Correlation Coefficient Squared

	trust	collaborative decision-making	degree centrality	between-ness centrality
trust	0.483	0.721	0.473	0.506
collaborative decision-making	0.520	0.478	0.560	0.542
degree centrality (DC)	0.224	0.314	0.669	0.729
between-ness centrality (BC)	0.256	0.294	0.531	0.626

Note: The diagonal values (in bold) represent the AVE (Average Variance Extracted); the values above the diagonal for correlation coefficient; and the values below the diagonal for correlation coefficient squared.

VIF (Variance Inflation Factor) has a range of 1.037 ~ 2.234 and tolerance has a range of 0.437 ~ 0.965. To reduce methodological bias and increase the reliability of the results, this study conducted a literature review meeting on the research topic for six months and a questionnaire meeting for three months. In the meeting the researcher carefully prepared and completed the questionnaire so that it could be easily and accurately answered from the respondents' perspective. Additionally, the result suggested appropriate constructs and items and considered statistical methods for analyzing them in advance. Various analyses such as factor analysis, regression analysis, structural equation analysis, and PROCESS macro were attempted as preliminary steps, and among them, PROCESS macro is applied considering the difficulty of setting factor structures and mitigation of strict assumptions. Nonetheless, the risk of methodological bias might still exist.

5. Analysis Results

The explanatory power (R square) of the model consisted of trust and two network centralities is 0.5827 and its F-value is 99.4842 (p-value < 0.0000). In addition, the explanatory power of total effect model (M4) is 0.5187 and the F-value is 154.6687 (p < 0.0000).

The Pearson correlation analysis for pairs of variables shows that all variables are positively associated with each other. In the regression analysis for collaborative decision-making, trust and two centralities do not exhibit multicollinearity. To explore paths among variables, parallel mediation tests are conducted using Model 4 of the PROCESS macro version 3.4 (Hayes, 2018). A 95% confidence interval for each coefficient that does not include zero indicates the effect to be significant. For the single mediation models, indirect effects are tested by using the Sobel test and a bootstrapping procedure with 5,000 samples, confirming the conditional indirect effects.

Table 2: Direct Effect (M1)

Hypothesis	R ²	β	p-value
1	0.5827	0.2996	0.0000*
2	0.2468	0.3037	0.0000*
3	0.2642	0.3081	0.0000*
4	0.5827	0.1930	0.0000*
5	0.5827	0.0740	0.1397

Note: Significant at α = 0.05

Table 2 depicts the test result of direct effect between variables. Positive correlations are identified between trust and collaborative decision-making, between trust and DC, between trust and BC, between DC and collaborative decision-making, and between BC and collaborative decision-making.

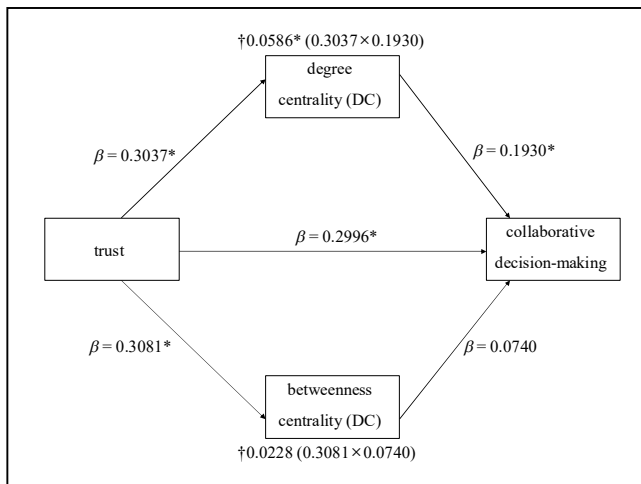


Figure 1: Research Model M1 (Significant at α = 0.05; † effect size)

Figure 1 displays the basic research model M1, including the mediation effect, while Table 3 summarizes the test result of the mediation effect. In the analysis, firm size is controlled, the unit of which is the natural logarithm of the number of employees, because it is correlated with the dependent variable.

This study selects the number of employees (firm size) as a control variable. Firm size serves as a comprehensive control variable in supply chain and network-related studies due to its significant impact on various dynamics. Larger firms often possess more resources, which can enhance their capacity for effective communication and collaboration within the supply chain. Additionally, larger firms tend to have established reputations, which can foster higher levels of trust among supply chain partners. This trust is crucial for mitigating risks associated with opportunism and for facilitating cooperative decision-making. Furthermore, firm size can influence a company's degree of centrality in the

network; larger firms are often more connected and can play pivotal roles as hubs in the supply chain, enhancing their ability to coordinate activities and share information effectively.

Next, the research investigates the interaction between trust and two centrality measures in relation to collaborative decision-making to test research models M2 (as in Figure 2) and M3 (as in Figure 3). The fact that the 95% confidence intervals constructed include zero suggests that there is no evidence of a significant moderating effect.

Table 3: Mediation Effect (M1)

Variable	Effect	β	95% confidence interval	p-value
trust	total effect	0.3811	(0.3384~0.4238)	0.0000*
	direct effect	0.2996	(0.2525~0.3468)	0.0000*
Degree centrality (DC)	indirect effect	0.0586	(0.0261~0.0952)*	-
betweenness centrality (BC)	indirect effect	0.0228	(-0.0150~0.0597)	-

Note: *Significant at α = 0.05

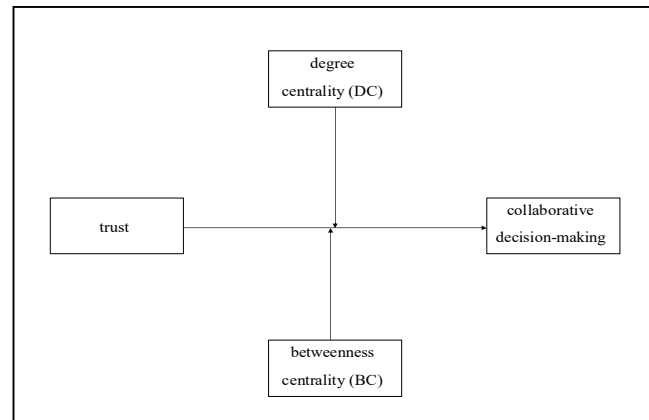


Figure 2: Research Model M2

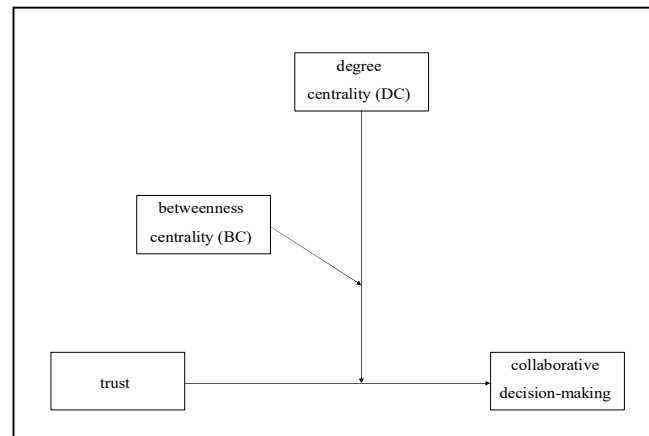


Figure 3: Research Model M3

The results, as summarized in Table 4, indicate that neither the interaction between trust and DC nor the interaction between trust and BC is found to be significant. Hypotheses 8 and 9 are not supported. Therefore, the study concludes that neither DC nor BC moderates the relationship between trust and collaborative decision-making.

Table 4: Multiple Moderation Effect (M2)

Interaction term	β	95% confidence interval
trust and degree centrality (DC)	-0.0513	(-0.1180~0.0163)
trust and betweenness centrality (BC)	0.0525	(-0.0332~0.1345)

Table 5 presents the test results of the moderated moderation model M3, which explores the interaction of trust, DC, and BC in relation to collaborative decision-making. The results indicate that neither DC nor BC individually moderates the relationship between trust and collaborative decision-making. This finding is consistent with the previous results mentioned in Table 4. Additionally, the interaction between DC and BC is found to be non-significant. This suggests that the combined effect of these centrality measures does not significantly influence the relationship between trust and collaborative decision-making. Furthermore, the interaction of trust, DC, and BC was also found to be non-significant. This indicates that the combined effect of these three factors does not significantly moderate the relationship between trust and collaborative decision-making. Based on these results, Hypothesis 10 is not supported.

This study concludes that neither the moderation effect (individual centrality measures) nor the moderated moderation effect (combined centrality measures) is significant in the relationship between trust and collaborative decision-making.

Table 5: Moderated Moderation Effect (M3)

Interaction term	β	95% confidence interval
trust and degree centrality (DC)	-0.0522	(-0.1226~0.0296)
trust and betweenness centrality (BC)	0.0498	(-0.0308~0.1252)
degree centrality (DC) and betweenness centrality (BC)	0.0013	(-0.0905~0.0736)
Trust, degree centrality (DC), and betweenness centrality (BC)	-0.0108	(-0.0291~0.0423)

6. Concluding Remark

Numerous studies have emphasized the significance of

collaborative decision-making in supply chain management, highlighting its positive impact on various aspects of supply chain performance. Empirical evidence supports the notion that collaborative efforts lead to both financial and non-financial improvements in the supply chain (Frohlich & Westbrook, 2001; Krause et al., 2007). In parallel, trust has emerged as a vital precursor to supply chain integration. It acts as a catalyst, fostering sustainable relationships between suppliers and buyers. Understanding the power dynamics within the network, in conjunction with trust and collaboration, is essential for comprehending the supply chain from a strategic standpoint (Cox, 2001). Accordingly, this study aims to investigate the role of power in the relationship between trust and collaborative decision-making among buyers and suppliers within the supply network. Power, in this context, is aligned with the structural dimension of the supply network and operationalized using DC and BC. This study's findings are as follows.

First, collaborative decision-making is influenced by trust, which plays a crucial role in the supply chain. Trust serves as a key factor shaping collaboration among companies. Lack of trust, hidden information, or questionable behaviors can significantly hinder collaboration between organizations (Narayanan & Raman, 2004). Trust is the bedrock upon which successful, long-lasting partnerships can be established and maintained. Without trust, cooperation and synergy become challenging to achieve. The prevailing consensus suggests a positive relationship between trust and collaboration, where higher levels of trust foster increased collaboration. Explaining how trust promotes collaboration is relatively straightforward, but understanding the reverse scenario can be more complex.

Power imbalances can impact the dynamics of buyer-supplier relationships. When a supplier perceives a power imbalance, with the buyer wielding power and the supplier's goal being to sustain sales with that specific buyer, it can lead to a distorted perception of trust. The supplier may feel compelled to maintain the relationship despite lacking genuine trust, driven by the fear of losing a substantial portion of their business or struggling to find alternative buyers. In such cases, the supplier's perception of the buyer's power can cloud their judgment regarding trust. By taking the power perspective into account when discussing trust and collaboration, the current research can provide a more comprehensive understanding of the underlying dynamics at play.

Second, the power structure within the supply chain plays a significant role in driving integration (van Donk & van der Vaart, 2005), and this study examines the mediating effects of two centrality measures from a supply network perspective to explore this influence. Empirical findings demonstrate that DC has a positive indirect effect.

Specifically, trust directly impacts collaborative decision-making and also indirectly influences it through DC. However, BC does not exhibit such a mediating effect. This distinction can be attributed to the different perspectives emphasized by these two centrality measures (Kim et al., 2011).

7. Discussion

A higher DC provides a firm with greater control over information and resources. Firms that are highly connected have access to a wider range of information and potential collaboration opportunities by establishing relationships with numerous parties in the network. This heightened connectivity enables them to exert direct influence on the parties they interact with, while also indirectly influencing transactions and interactions among other entities in the network. Firms with high centrality, due to their extensive connections and influence, contribute to strengthening collaborative decision-making processes. Their involvement brings diverse perspectives, information, and resources to the table, thereby enhancing the overall quality of decision-making within the network.

By emphasizing common norms and regulations, these central companies can balance the interests and behaviors of network participants, fostering cooperation and effective decision-making. Even if companies with high centrality demonstrate opportunistic tendencies, the presence of alternative companies in the network can help mitigate potential adverse effects. Identifying second- or third-tier suppliers that were previously overlooked becomes crucial for future contingencies (Kim et al., 2011). The availability of alternative options provides other network participants with the opportunity to switch partners or seek alternative sources of supply, reducing their dependence on a single firm. This flexibility acts as a safeguard against opportunistic behavior and helps maintain ongoing collaborative relationships.

Conversely, when a firm possesses high BC, it assumes a crucial role in mediating connections among other firms within the network. Disrupting or removing such a firm may leave only a limited number of alternative companies capable of filling that position. Power arises from its ability to mediate connections between other companies. The analysis findings reveal that power based on BC does not serve as a mediating factor in the influence of trust on decision-making. Specifically, trust may increase BC, but BC itself does not directly impact collaborative decision-making.

From a supply chain manager's perspective, the finding suggests that while having a high degree of connectivity within the network enhances access to information and

collaboration opportunities, it does not automatically translate into direct influence on decision-making processes. Instead, the benefits of DC are realized through its indirect effects, such as fostering trust and enabling the sharing of diverse perspectives. In practice, this could involve actively engaging with network partners, sharing relevant information, and promoting collaborative initiatives that enhance overall decision quality. Understanding that the impact of DC is mediated by trust and collaboration emphasizes the need for managers to cultivate a supportive environment that encourages open dialogue among partners. This approach can ultimately lead to more effective decision-making and stronger collaborative relationships within the supply chain.

Companies with high BC often possess unique information and resources, allowing them to monopolize ties within the supply chain, including communication, connections, transportation, or transactions. Consequently, they can control or limit the flow of crucial resources, such as essential information, among other organizations, impeding their interactions (Fox et al., 2013). In other words, firms with high BC possess significant capacity to constrain interactions among other partners (Kim et al., 2011). If the supply chain experiences disruptions, it may be challenging for partners to find alternative companies to substitute critical components and materials. As a result, other companies may hesitate to engage in ongoing and close collaborative decision-making and may instead conform to the firm with high BC.

The moderation tests for hypotheses 8 and 9 reveal that the relationship between trust and collaborative decision-making is unaffected by the levels of the two types of network centralities. While there is a complementarity between coercive power and goodwill trust, non-coercive forms of power can coexist with trust (Ireland & Webb, 2007). Yeung et al. (2009) highlight the importance of establishing a trusting environment among partners before leveraging power. They argue that without a solid foundation of trust, employing power—especially coercive power—to influence internal integration among buyers may prove difficult or ineffective.

For example, a central position in a network is more visible, which means that opportunistic behaviors can damage existing alliances and hinder opportunities for future partnerships. Consequently, a firm with high DC is likely to promote trust and reciprocity among its network partners, thereby enhancing cooperation and interfirm learning. Even in situations where coercive or opportunistic behaviors arise from high levels of degree or BC, trust-based collaboration and the strong relationships formed among network partners may remain largely unaffected.

This study employs DC and BC as proxies for network power, relying on subjective judgments for measurement.

While quantitative metrics derived from social network analysis could offer more reliable indicators for centrality measurement, their use necessitates the availability of suitable data for social network analysis. Additionally, collaborative decision-making is commonly employed as a representative measure of supply chain performance. However, it would provide more valuable and insightful results if the study has assessed performance across various dimensions, such as financial performance, non-financial performance, supplier or buyer integration, and/or internal integration. In future studies, further exploration of trust could involve subdividing it into affective trust and trust in competency within the research model, potentially revealing additional insights into the relationship between trust and collaboration.

Follow-up studies and longitudinal studies need to be conducted to reduce the risk of methodological bias in the research results. In addition, it seems necessary to expand the meaning of power by considering closeness centrality and eigenvector centrality as NC. Future research could explore the relationship between trust and collaborative decision-making in more diverse industries or with a focus on other types of supply chain networks (e.g., global vs. regional). Also, possibly by suggesting actions supply chain managers can take to mitigate potential issues arising from NC.

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Appendix 1: Confirmatory Fctory Analysis Result

Constructs	Item	stand. factor loading	factor loading	S.E.	t	p-value	AVE	CR
trust	t1	0.600	0.754	0.075	10.092	0.000	0.483	0.893
	t2	0.755	1.024	0.080	12.805	0.000		
	t3	0.768	1.018	0.078	13.048	0.000		
	t4	0.638	0.917	0.085	10.761	0.000		
	t5	0.743	1.000	-	-	-		
	t6	0.730	0.854	0.069	12.407	0.000		
	t7	0.707	0.868	0.073	11.953	0.000		
	t8	0.654	0.830	0.075	11.032	0.000		
	t9	0.639	0.845	0.078	10.784	0.000		
collaborative decision-making	c1	0.747	1.172	0.123	9.498	0.000	0.478	0.845
	c2	0.752	1.311	0.137	9.534	0.000		
	c3	0.693	1.128	0.124	9.072	0.000		
	c4	0.709	1.241	0.135	9.196	0.000		
	c5	0.661	1.119	0.127	8.790	0.000		
	c6	0.569	1.000	-	-	-		
degree centrality (DC)	d1	0.715	0.810	0.058	13.972	0.000	0.669	0.890
	d2	0.869	1.073	0.058	18.605	0.000		
	d3	0.833	1.009	0.058	17.459	0.000		
	d4	0.847	1.000	-	-	-		
betweenness centrality (BC)	b1	0.732	0.842	0.062	13.664	0.000	0.626	0.833
	b2	0.840	1.000	-	-	-		
	b3	0.797	0.994	0.065	15.215	0.000		

Appendix 2: Survey Questions

1. Trust

: Between our firm and major suppliers,

- (t1) There are no hidden intentions in their actions.
- (t2) I believe they are honest.
- (t3) I tend to interpret their actions positively.
- (t4) I do not attempt to exert influence over their behavior.
- (t5) I respect and accept their perspectives and arguments.
- (t6) I trust their job performance abilities.
- (t7) I am satisfied with their knowledge and expertise.
- (t8) I accept their expertise.
- (t9) I believe they have unique knowledge/skills.

2. Collaborative Decision-making

: Our firm's suppliers . . .

- (c1) Display a high level of cooperation in business decision-making.
- (c2) Seek mutually beneficial compromises when issues arise in transactions.
- (c3) Engage in discussions and collaborate to enhance the operational efficiency of the partner firm.
- (c4) Actively propose ideas to improve the relationship between the parties.
- (c5) Demonstrate flexibility in scheduling and business matters.
- (c6) Believe that resolving transactional issues through

contractual mechanisms (lawsuits, arbitration) is beneficial for both parties.

3. Degree Centrality

: Our firm . . .

- (d1) Establishes many direct transactional relationships with other companies in the supply network to obtain a central (core) position.
- (d2) Possesses a high level of influence and power within the network due to its extensive connections with many other companies in the supply network.
- (d4) Secures a relatively more sales channels compared to other companies in the supply network.
- (d5) Secures a relatively more purchasing sources compared to other companies in the supply network.

4. Betweenness Centrality

: Our firm . . .

- (b1) Plays the role of an intermediary for essential components that must be present in the finished product within the supply network.
- (b2) Acts as a bridge connecting other companies within the supply network that are not directly connected.
- (b3) Occupies a central position in the supply network, being located on the shortest path connecting other companies to each other.