The impact of supply chain relationship configurations on supplier performance: Investigating buyer-supplier relations in the aerospace industry

Keywords:
Buyer-Supplier Relationship Configurations, Supply Relationships, Agency Theory, Operational Efficiency, Aerospace Industry

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Abstract

Purpose

A supplier may sell not only to one buyer (sole relationship configuration) but also to the buyer's competitors (shared relationship configuration) for a specific product category. This study examines the performance implications when suppliers establish shared relationships with the buyer's competitors.

Design/methodology/approach

Secondary data is used to test hypotheses relating a supplier's relationship configurations to its operational performance. A seemingly unrelated regression approach (SUR) is applied to analyze the data, followed by endogeneity checks of the empirical findings.

Findings

The study shows that suppliers with less-shared ties with buying firms' competitors exhibit superior inventory efficiency and asset turnover. Thus, suppliers can improve operational efficiency by creating relatively exclusive, deep, and trust-based relations instead of more extensively shared and shallower relationships.

Research limitations/implications

Based on agency theory as a theoretical lens and aerospace industry data, this research contributes by addressing the supplier's perspective and linking its operational efficiency performance with its chosen supply relationship configuration.

Practical implications

Suppliers need to understand the performance implications of choosing relatively exclusive relationships versus shared relationships with buying firms. The research provides new insights for managers and can guide their supply chain decision-making.

Originality/value

Little is known about how a supplier's relationship configurations can elevate, or impair, its operational efficiency. While conventional wisdom holds that suppliers should focus on multiple avenues of revenue growth by selling to buyers' competitors, this study demonstrates that more sales to a buying firm's rivals might, in fact, reduce a supplier's efficiency.

Keywords

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Introduction

To remain competitive, organizations constantly strive to improve their operational performance. Prior research has indicated that supply chain relationship configurations play an essential role in improving an organization's success (Leuschner *et al*., 2013). This study extends the buyer-supplier relationship literature by investigating the link between a supplier's relationship configurations and its operational performance. A supplier's relationship configuration is defined as a set of ties that a supplier establishes with the buying firm and its competitors for a specific product or service category. The supplier's relational ties with buying firms can typically range from sole (exclusive) to extensively shared, multi-incumbent relations (Yan *et al*., 2020). A supplier's sole relationship configuration reflects a setting where a supplier provides goods or services to only one (exclusive) buyer. Accordingly, a supplier's shared relationship configuration refers to a setting in which the supplier establishes ties with the buying firm plus one or more of the buying firm's competitors (multi-incumbent).

Researchers have investigated how supply chain relations can impact operational efficiency, resource utilization, and overall operating performance of supply chain network members (Karatzas *et al*., 2016; Parmigiani *et al*., 2011). However, prior research has mainly examined the impact of supply network configurations on the buying firms' performance. Scholars have rarely taken the perspective of supplying firms (Kim, 2017). As relatively little is known about the performance implications of relationship configurations from a supplier's perspective, this study extends previous research by investigating how specific configurations can impact a supplier's operational performance.

Relationship configurations are relevant in many industrial contexts, but the entire spectrum of various configurations might not be observable in some sectors. To better understand

the specific performance impacts of supplier relationship configurations, this research examines a capital and knowledge-intensive industry so that a continuum of buyer-supplier relationships (ranging from extensively shared to exclusive) can be observed. More importantly, the study findings needed to be generalizable to other contexts where suppliers play an essential role in product development. Therefore, the aerospace context is suitable for this study for several reasons.

First, the aerospace industry is characterized by large suppliers deeply involved in product development with manufacturers. Furthermore, suppliers in the aerospace industry engage in various relationship configurations, ranging from sole (exclusive) to vastly shared relations with manufacturers (buying firms). Some suppliers opt for sole ties to establish deep partnerships with their customers, especially in the aerospace component aftermarket business (Chou *et al.*, 2012). For instance, TMX Aerospace exclusively supplies raw materials like aluminum and titanium to Boeing (Wallace and Hill, 2011). In contrast, other suppliers leverage their competitiveness and share their aerospace parts and systems with many buying firms. For example, Dynamic Gunver Technologies LLC supplies aircraft engine components to two large aircraft engine manufacturers, Pratt and Whitney and Rolls Royce (Spekman and Gibbons, 2008; Agrawal *et al*., 2016).

Second, due to extensive bills of materials and diverse technological capability requirements, the global aerospace industry is characterized by many buyer-supplier relationships (Williams *et al.*, 2002). Prior research has described increasing tensions between buyers and suppliers in the aerospace sector, indicating that concerned suppliers review their requirements to determine the optimal relationship configuration(s) (Rosetti and Choi, 2008). Due to the lengthy supplier certification process, aerospace companies are motivated to share suppliers. Once a supplier is certified to supply "flying parts," it becomes a valuable target for other OEMs trying to

save the time and efforts of certifying new suppliers. However, they risk losing intellectual property (I.P.). Finally, the aerospace industry is known for requiring collaboration, knowledge-sharing, and long-term relationship-building among buyers and suppliers (Rossetti and Choi, 2008). Hence, the aerospace industry is an important locus of dynamic inter-organizational relations.

The sole vs. shared relations conceptualization differs from the concept of single sourcing vs. multiple sourcing because the latter is based solely on the buyer's perspective. In the single or multiple sourcing setting, it is the buying firm that decides to source goods or services from either a supplier pool (multiple sourcing) or a single supplier (single sourcing) (Costantino and Pellegrino, 2010). Since the phenomenon under study is relatively unexplored compared to single vs. multiple sourcing, the first objective of this paper is to clearly articulate the critical facets of sole and shared relationship configurations. The study's second objective is to investigate how a supplier's relations influence its operational performance. In so doing, this research seeks to explore critical factors that explain why some suppliers select a sole relationship configuration while others do not. Hence, this research is motivated by the following research question:

> **How does a supplier's chosen relationship configuration with buying firms influence its operational performance?**

Sole and Shared Relationship Configurations

Suppliers will experience different pros and cons when structuring their supply chain relationship configurations (Leuschner *et al*., 2013). Thus, they need to find the optimal balance between sole and shared relations and determine whether or not it is advantageous to develop additional ties with the buying firm's competitors. For instance, on the one hand, creating a *sole* bond enables the supplier to better align with the exclusive customer, achieve effective operational

integration, develop shared objectives, and benefit from higher efficiency through streamlined, coordinated supply chain operations (Leuschner *et al*., 2013; Schmelzle and Tate, 2022). On the other hand, the *shared* relationship configuration can substantially enhance a supplier's revenue growth opportunities with additional potential buyers. However, at the same time, a supplier structuring shared relationship configurations faces a potential conflict of interest with the buying firms, possibly weakening its operational performance.

Suppliers often engage solely with one manufacturer to gain exclusive access to a customer's essential resources, ultimately looking for a competitive advantage. Exclusive ties enable both parties to temporarily preclude competitors from accessing the relationship-specific resources. For example, one supplier exclusively delivers specific arm-rests to Herman Miller (as a sole supplier), enabling it to receive preferential treatment from a prestigious customer (Agrawal and Lee, 2019). This exclusive bond precludes competitors from imitating similar quality products. Of course, this setting requires both the supplier and the buying firm to develop a bond beyond merely transactional exchanges. The two parties shape a unique tie to sustain a long-term relationship (Schwieterman *et al*., 2020). Both parties ensure that their goals are aligned in such settings, minimizing opportunistic behaviors.

The sole configuration described above is contrasted by shared relations. One executive in the aerospace industry remarked that 'Some of our very close suppliers are spending a lot of time developing stuff for other competitors. They are spending resources on others, not on us... we'd prefer that they work with us, and … share and invest in technology for our advantage' (Gates, 2011). Thus, researchers have argued that sole suppliers are often preferred over shared suppliers when the goal is primarily to minimize the risk of knowledge leakage to the competition (Yan *et al*., 2020). Suppliers with significant shared relations may face a conflict of interest regarding

critical knowledge dissemination among supply chain members (Rebolledo and Nollet, 2011). The potential I.P. loss and confidential technology leakage to competitors are concerns in the aerospace industry (Farris *et al*., 2005).

Supply chain scholars have demonstrated that sole relationships foster trustful and effective collaboration. Consequently, deep ties and a long-term focus are beneficial to achieving goal congruence among both parties involved (Kim and Choi, 2015; Swanson *et al*., 2017). Owing to frequent and deep information exchange, suppliers and buying firms grow mutual trust (Rebolledo and Nollet, 2011), establish a shared understanding of critical objectives (goal congruence), strategies, and tactics (Kim and Choi, 2015; Zaheer and Trkman, 2017), and develop a perceived psychological bond enhancing fairness in the buyer-supplier relations (Blessley *et al*., 2018). As a result of more frequent coordination and better collaboration, the supplier and the buyer can cooperate as a team and respond faster to market changes with coordinated actions (Swanson *et al*., 2017), thereby enhancing the resilience and agility of both organizations (Datta, 2017; Gligor *et al*., 2019). Deep, trustful relations are particularly effective for new product development, as the best people are allocated to the joint efforts (Yan *et al*., 2017). The long-term focus has been an essential driver of such relationship configuration. In terms of efficient production resource utilization, more depth and breadth in the communication of sole relations leads to more effective information exchange, extended process harmonization and integration, and enhanced status transparency about supply chain operations (Swanson *et al*., 2017; Zhu *et al*., 2017; Schmelzle and Tate, 2022).

Nonetheless, some organizations appear to prefer the shared relationship configuration. Supply chain scholars noted that shared ties are beneficial because the suppliers can leverage their investment across larger sales volumes with several vital customers (Zacharia *et al*., 2019) and

better cope with annual cost reduction targets (Williams *et al*., 2002). In the aerospace industry, especially smaller suppliers frequently face hurdles in securing financing for lengthy and high-cost new product development projects (Williams *et al*., 2002) and consequently prefer a shared supplier configuration to spread the risks and costs. One additional benefit of shared relationship configuration is the potential source of vicarious inter-firm learning (Rebolledo and Nollet, 2011). In particular, buying firms could learn about their rivals through shared suppliers (Agrawal *et al*., 2016; Zacharia *et al*., 2019). Muthulingam and Agrawal (2016) highlight that a buying firm's efforts to improve shared suppliers' quality performance would also benefit its competitors. Such actions can have spillover effects on other buying firms who also source from the same supplier (Agrawal *et al*., 2016).

The scholarly debate about the pros and cons of relationship configurations has been inconclusive so far; studies on performance implications of supply chain relationship configurations led to inconsistent findings. While some researchers argue that shared relations can enhance organizational performance, others claim the opposite. In the literature, *shared* relationship configurations have been associated with lower product cost (Zacharia *et al*., 2019), higher organizational learning (Agrawal *et al*., 2016; Zacharia *et al*., 2019), lower risk exposure (Williams *et al*., 2002), and higher responsiveness (Davis-Sramek *et al.*, 2019), for example. In contrast, research on *sole* relationship configurations has indicated performance improvements in terms of quality (Agrawal and Lee, 2019), resilience and agility (Datta, 2017; Gligor *et al*., 2019), new product development speed (Yan *et al*., 2017), intellectual property protection (against knowledge leakage) (Yan *et al*., 2020), strategic alignment between buying firm and supplier (Kim and Choi, 2015; Zaheer and Trkman, 2017), and operational process efficiency (Swanson *et al*., 2017; Zhu *et al*., 2017). Scant attention has been paid to date to investigate how and to what extent

suppliers configuring their (downstream) supply chain relations can elevate or impair their operational efficiency. Hence, the prior literature appears incomplete, providing little and inconclusive theoretical guidance on this phenomenon.

This research addresses two main gaps in the literature. First, as the above discussion outlined, the current literature appears to neglect the phenomenon of suppliers' sole and shared relationship configurations with buying firms from a supplier's point of view. Additionally, prior studies have not explored how such relationship configurations may impact suppliers' performance. Second, there is a lack of understanding of why some suppliers would select sole relations while others opt for a shared relationship configuration with the buying firm's competition. Therefore, this study draws on agency theory to better understand the divergent interests of buyers and suppliers. To the best of our knowledge, this is the first study to empirically examine the direct impact of a supplier's relationship configuration on its operational performance.

Agency Concerns in the Buyer-Supplier Relations

This research applies agency theory (AT) as a relevant theoretical lens for this phenomenon. AT focuses on business relations in which actor P (the principal) authorizes actor A (the agent) to make decisions on its behalf (Eisenhardt, 1989). This delegation requires a certain level of cooperation among both actors, and there are inherent agency problems due to information asymmetry and divergent interests (goal conflict) between them. To minimize harmful agency issues, the principal might implement measures to reduce a) goal conflict and b) information asymmetry. The literature suggests that aligning goals and achieving congruence would discourage agents from engaging in opportunistic behaviors (Whipple and Roh, 2010; Mukandwal *et al.*,

2020). Additionally, the principal may increase monitoring and control efforts to reduce information asymmetry and ensure that agents behave appropriately (Wowak *et al.*, 2016).

In supply chain research, AT has been utilized to analyze the dynamics of buyer-supplier relationships and predict the behaviors of supply chain entities (actors) engaged in inter-firm exchange relationships (Fayezi *et al.*, 2012). Researchers have applied the AT lens to investigate various supply relationship phenomena such as setting performance objectives, ensuring goal congruence, aligning incentives, integrating supply chain processes, and maintaining long-term supply relations (Delbufalo and Bastl, 2018; Robinson *et al.*, 2018; Tate *et al.*, 2010). The theory prescribes that buyers and suppliers employ specific measures to align their divergent interests and minimize agency issues. Specifically, supply chain parties take various actions, ranging from enhanced information sharing to establishing specific structural relationships to reduce conflicts of interest. For instance, in the Tesla–Panasonic collaboration, Panasonic is the exclusive electric battery supplier to Tesla for its Model S (Higgins and Mochizuki, 2019). Tesla and Panasonic invested jointly in a Gigafactory to produce battery cells. The two parties' mutual interests converged to cater to the growing electric vehicle market segment (Ramsey, 2016). Therefore, the exclusive relations structure allows both parties to eliminate the burden of high-cost monitoring and reporting efforts (Wowak *et al.*, 2016). Based on AT logic, both supplier and buying firms may collectively view relationship configurations as a means to achieve a genuine 'win-win type' of relations, whereby both parties perform superior to their competition (Germain *et al.*, 2008). Thus, AT is a valuable theoretical lens to understand the potentially detrimental impact of agency issues when analyzing a supplier's relationship configuration.

Hypotheses Development

Suppliers' Shared Relations and Inventory Efficiency

This section discusses how a supplier's shared relationships can impact its inventory efficiency. A supplier's inventory efficiency refers to its inventory-related practices and processes that effectively enable the supplier to minimize inventory-related costs (Mitra and Singhal, 2008; Elking *et al*., 2017; Yang *et al*., 2018). Thus, the inventory efficiency measure represents how well a supplier utilizes its inventory-related resources (Defee and Fugate, 2010). For example, in the aerospace industry, manufacturers rely on suppliers for on-time deliveries of components required during the production process and time-critical spare parts needed for after-sales service (Chou *et al*., 2012; Rosetti and Choi, 2008). As a result, aerospace suppliers working with multiple manufacturers have to effectively ensure time-based service levels with sufficient inventory volumes while avoiding overstocking parts (Saidy *et al*., 2017). Hence, a supplier's relationship configuration (i.e., being exclusive vs. more shared) can help achieve greater operational efficiency. The following two theoretical perspectives are instrumental in understanding the phenomenon in depth.

First, this study posits that a supplier's shared relationships could elevate agency issues with the buying firm. Such configuration may result in low levels of trust among supply chain parties (Whipple and Roh, 2010) and fear of opportunism (Rebolledo and Nollet, 2011). Suppliers using shared relationship configurations may encounter difficulty aligning goals with the focal buying firm since they must align with several clients simultaneously. Generally, shared suppliers may experience more pressure from buying firms to hold greater buffer stocks than sole suppliers. This is because buying firms cannot entirely rely on a shared supplier's available inventory, which might be dedicated to other buyers. Hence, the buying firm may cascade the risk of disruption to

their shared suppliers by requiring higher inventory levels (Chatfield *et al*., 2013). For example, the 2020-2021 global semiconductor shortage situation indicates that buying firms were particularly affected when shared suppliers spread too thin across many customers (Burkacky *et al*., 2021).

Researchers demonstrated that quickly switching to new suppliers to cope with unexpected supply disruptions is often difficult for organizations (Ellis *et al*., 2010). Therefore, reliance on current suppliers profoundly affects a buying firms' stance toward its suppliers' inventory management practices (Chen and Thomas, 2018). Buying firms may be quite reluctant to rely on the multi-incumbent shared suppliers' safety stock volumes because such suppliers maintain extensive relationships with the buying firms' competitors. The buyers are concerned that their rivals could (theoretically) obtain preferential treatment (precedent shipments from said inventory) from the multi-incumbent shared suppliers in the case of future supply chain disruptions. This scenario implies a potential agency conflict due to goal misalignment. As a result, an incumbent shared supplier might be required to hold larger inventories than a sole supplier. In contrast, a supplier with a sole relationship configuration can dedicate its corresponding inventory to its exclusive supplier, decreasing stockout risks and reducing safety stock levels and contingency measures resulting in higher inventory efficiency.

Second, shared suppliers may face more challenges (pushback) from buying firms to collaborate due to greater agency issues. The underlying logic is that the buying firms may view multi-incumbent shared suppliers as more opportunistic because of their inherent ties with the buying firm's rivals (Yan *et al*., 2020). The supplier's substantially shared relationships could limit how a shared supplier might access critical operational information from the buying firm. It is well established that effective supply chain collaboration can enhance transparency and reduce

bullwhip effects, improving inventory performance (Cannella and Ciancimino, 2010; Chan and Prakash, 2012; Hofer *et al*., 2012). If buying firms intentionally restrict information sharing, multi-incumbent shared suppliers might suffer from insufficient transparency, leading to significantly over-reaction or under-reaction when facing unforeseen demand changes (Autry and Griffis, 2008; Kim, 2017).

Furthermore, an extensively shared (multi-incumbent) supplier might face substantial hurdles when requesting joint investment in collaboration technology (e.g., electronic data interchange [EDI]) from buying firms because such relationship-specific investments are perceived as not safeguarded (Rungtusanatham *et al*., 2007). In such cases, shared suppliers may be precluded from timely and frequent information exchange, resulting in demand distortion effects (Swanson *et al*., 2017). Conversely, a supplier engaging in less shared relationships may benefit from the buying firm's stronger collaborative efforts or higher motivation to fund relationship-specific investments (e.g., harmonized processes and technology infrastructure, technology integration, and data exchange standardization) (Autry and Griffis, 2008). Consequently, suppliers will achieve higher inventory efficiency performance when engaged in trust-based collaborations with buying firms derived from exclusive relationships (Jain *et al*., 2017). Therefore, a supplier selecting a less-shared configuration could achieve better operational synchronization with the buying firm and higher inventory efficiency. In conclusion, it is hypothesized:

> *H_1: A supplier's less-shared relationship configuration is associated with higher inventory efficiency.*

Suppliers' Shared Relations and Production Resource Efficiency

This section focuses on the performance consequences of a supplier's relationship configuration on its production resource efficiency. Production resource efficiency is defined as the "capability to produce outputs with minimum resource requirements" (Pettit *et al*., 2010, p. 12). It is an essential organizational capability measure that captures how a firm optimizes resource consumption to achieve the desired level of outputs (Defee and Fugate, 2010). Supply chain relationships play a crucial role in attaining production efficiency, including suppliers' relationship configuration decisions (Leuschner *et al.*, 2013).

This research posits that a supplier's relationship configuration with a buying firm can be a critical strategic choice to impact its production efficiency. Researchers established those supply relationships with close and deep ties could facilitate rich collaborations especially regarding joint new product development (NPD) projects (Fixson, 2005; Mikkelsen and Johnsen, 2019; Namdar *et al*., 2018; Schmelzle and Tate, 2017). Based on a long-term focus, both supplier and buying firm develop a shared understanding of values, objectives, and necessary activities over time (Robinson *et al*., 2018). In an exclusive type of supply relationship, both parties share similar agendas. Thus, they are more likely to contribute an appropriate level of resources to the production processes (Kim, 2017), as demonstrated by Toyota, for example (Clark and Fujimoto, 1991; Narasimhan and Narayanan, 2013). Scholars have noted that such deep, trustful relationships enable frequent and rich information exchange (Rebolledo and Nollet, 2011; Schoenherr *et al*., 2015) based on harmonized data-exchange protocols (Autry and Griffis, 2008), which increases the motivation toward technology integration between supplier and buying firm and other relationship-specific investments (Krolikowski and Yuan, 2017; Ralston *et al*., 2015; Yan *et al*., 2017). Such enhanced

coordination among the partners increases the utilization of production-related assets (Leuschner *et al*., 2013).

In addition, the improved information sharing and coordination of production schedules can help reduce setup times and increase flexibility, especially in a batch process environment. This could result in higher production efficiency (Zaheer and Trkman, 2017). However, sharing resource inputs in production processes is noticeably easier in exclusive buyer-supplier relationships than in shared relationships. Thus, a supplier establishing more shared relationship configurations with multiple competing buyers may not be able to easily tap the focal buying firm's resources for production process cost savings.

Finally, a supplier with less-shared relationships could leverage the (relatively) exclusive relationships by deploying implants to the buying organization to provide additional expertise early on in the new product design processes. This co-location will enhance knowledge exchange and continuous improvement activities and lead, ultimately, to higher production resource efficiency based on deeper collaboration and holistic problem solving (Krolikowski and Yuan, 2017). However, due to resource constraints, the same level of collaboration of a sole relationship cannot realistically be achieved with multiple buying firms. To conclude, it is advantageous for a supplier to emphasize a sole relationship configuration (i.e., less-shared relationships with buyers), as the goals and interests among two parties are kept aligned. This focus enables the supplier to achieve higher production efficiency. Accordingly:

> *H_2: A supplier's less-shared relationship configuration is associated with higher production resource efficiency.*

Supplier's Shared Relations and Asset Turnover

Asset turnover measures a firm's ability to yield revenue from its assets (Brown and Bukovinsky, 2001; Fairfield and Yohn, 2001). This measure reflects how efficiently a firm utilizes the available resources. It is hypothesized that a supplier's fewer ties with a buyer's competitors (less-shared relations) may positively impact the supplier's asset turnover. On the one hand, suppliers can strive for a high asset turnover by diversifying their sales to multiple customers and achieving higher sales volumes (Stapleton *et al*., 2002). To achieve higher sales, a supplier might even engage with potentially all buyer's rivals in need of similar parts or systems. In so doing, a shared supplier might benefit by increasing sales volumes.

On the other hand, the supplier might not necessarily realize the desired resource utilization because the potential business expansion has detrimental side effects. The aerospace industry, for example, is characterized by a tremendous variety of different stock-keeping units (SKU) due to the idiosyncratic requirements of various buying firms for each aircraft system (Williams *et al*., 2002). Hence, the shared supplier might need to invest in (new) idiosyncratic assets to cope with the high part count and ever-changing requirements of multiple customers (buying firms), which could result in a substantially lower asset turnover ratio (Skowronski *et al*., 2020). A supplier would achieve a higher asset turnover by focusing on fewer (exclusive) customers rather than multiple customers.

Besides, a supplier with fewer ties to a buyer's competitors (less-shared relations) faces fewer hurdles with sharing relevant assets (including its R&D experts) with a buying firm if needed. For instance, such a need for sharing critical assets could be triggered when a supplier addresses the problem of underutilized assets. To deal with this challenge, a buying firm is more likely to absorb the incumbent supplier's risk if the supplier engages exclusively with the former.

A buying firm could allow the sole supplier to redeploy its nonutilized assets in such a situation. In the aerospace industry, Boeing supported its exclusive suppliers accordingly during a crisis (Cameron, 2020). Such support from the buying firm is feasible because exclusive supply relations are characterized by mutual trust and reciprocal long-term commitments. Accordingly, it is hypothesized:

> *H_3: A supplier's less-shared relationship configuration is associated with higher asset turnover.*

Methodology

Methodology Overview

To test the hypotheses, secondary data were collected and analyzed from two sources, Mergent Online and COMPUSTAT. Mergent Online is a comprehensive source for identifying buyer-supplier relations and is used in prior supply chain management research (Lu and Shang, 2017). As described before, the context of the aerospace manufacturing industry is appropriate for testing the study hypotheses. This section provides a more detailed overview of the aerospace industry. Aerospace manufacturers outsource up to 70% of a typical aircraft platform (Williams *et al*., 2002). Hence, buyer-supplier relationships are crucial in this setting (Rebolledo and Nollet, 2011).

Unlike other industrial sectors, the existing buyer-supplier relations in the aerospace industry encompass both sole and shared relationship configurations, with the former particularly present in the aftermarket support service (Chou *et al*., 2012; Farris *et al*., 2005). The buyer-supplier relations are relatively stable in the aerospace sector compared with other industry sectors (Roehrich *et al*., 2017). The aerospace regulatory environment appears to induce, at least partially, relatively stable buyer-supplier relations in this industry (Rossetti and Choi, 2005). Before

establishing formal contractual relationships with aerospace manufacturers, suppliers must undergo a thorough assessment and rigorous qualification procedures. The regulation requires substantial effort due to the lengthy qualification processes of aerospace components and manufacturing processes (Rossetti and Choi, 2005). Consequently, the relatively high upfront hurdles lead to high barriers to entry and substantial switching costs, resulting in more stable and relatively long-term buyer-supplier relations; this specific industry characteristic enables robust data collection and analysis for the phenomenon under investigation.

The data set was compiled as follows. The first step was to identify relevant original equipment manufacturers in the aerospace industry, i.e., publicly traded firms in 2018. Second, data on buyer-supplier dyadic relationships for the sample aerospace manufacturers was obtained from the Mergent Online database. The year 2018 was chosen as the reference year, as it was the most recent year for which the complete set of buyer-supplier relations was available. As a third step, COMPUSTAT financial data was supplemented for the identified suppliers. After removing missing observations and merging all variables, the final sample consisted of 184 unique suppliers associated with the aerospace manufacturers (buying firms) for 2018. About 26% of these supplying firms were related to equipment and systems (e.g., electrical and mechanical systems), 35% were materials and structure suppliers (e.g., fabricated metals, airframe structure, standard parts, etc.), and 39% were suppliers of misc. services. The distribution of the suppliers encompassed spatially continuous values of exclusive (sole) and shared types of relationship configurations. About half of the suppliers had established exclusive relations, whereas the other half held different levels of shared relationships configurations. Specifically, 10% of all suppliers were exclusive suppliers providing equipment and systems; 16% of the total were exclusive

suppliers for materials and structure, and 23% of the total were exclusive suppliers for misc. services.

Measures

Dependent Variables

This study has three dependent variables. The first dependent variable is *Suppliers' Inventory Efficiency.* This measure is operationalized as the ratio of annual sales to average inventory value and then standardized at the three-digit NAICS level. Note that the average inventory is computed by dividing the sum of inventory for the years 2017 and 2018 by two. The second dependent variable is *Suppliers' Production Resource Efficiency*, operationalized as dividing total sales by plant, property, and equipment and standardized at a three-digit NAICS level. The operationalization of the first two dependent variables is adopted from the approach used by Mishra *et al*. (2013). The final dependent variable is *Suppliers' Asset Turnover Ratio,* operationalized by dividing net sales by total assets. This measure is commonly used in supply chain and operations management research to capture a firm's efficiency in generating sales revenue (Kim and Henderson, 2015). All three dependent variables capture the effects of inputs on value generation (Chuang *et al*., 2019).

Independent Variables

The primary independent variable is *Suppliers' Shared Relationship Configuration.* This variable reflects the ratio of an individual supplier holding shared relations with a buying firm's competitors from the same industry to the total number of buying firms in the same industry. The possible values of this variable range from 0.125 to 1 (with 0.125 indicating the most exclusive

(sole) supplier, i.e., a supplier only works with one buying firm), and 1 specifying the most significant level of sharedness of a supplying firm (i.e., a shared supplier that holds active relations with all buying firms).

Control Variables

This study identifies several buyer- and supplier-related control variables that prior literature has considered important factors influencing a supplier's relationship configuration and operational efficiency performance. First, a supplier's size can be a critical determinant of a supplier's operating bandwidth to engage with multiple buying firms. Likewise, a buying firm's size can also influence a supplier's decision on the tenure (length of the working relations) with the former (Zolkiewski *et al*., 2006). To account for the firm size of buyers and suppliers, *Supplier's Total Assets* and *Buyer's Total Assets* were employed as control variables (Dang *et al*., 2018). Second, prior studies suggested that a firm's profitability captures a significant tangible value of a firm, a pre-condition that accounts for the firm's continued success (Mishra *et al*., 2013). Therefore, *Supplier's ROA* (return-on-assets) and *Buyer's ROA* were included as control variables in the model. *Supplier's* and *Buyer's Debt-to-Equity Ratios*, which measure the supplier and buying firm's financial leverage, respectively, were included as control variables because these variables may affect a supplier's operational performance (Stapleton *et al*., 2002). Next, *Suppliers' Cost of Goods Sold*, which reflects the direct cost associated with producing goods and services, is included in the analysis. Finally, due to supplier firms' heterogeneity across industry sectors, industry effects are controlled by having dummy variables based on the three-digit NAICS industry code.

Estimation

The seemingly unrelated regression (SUR) method was used for modeling supplier-specific factors (i.e., supplier-only model) to estimate the effects of the supplier's relationship configuration on its operational efficiency measures. This research utilizes SUR due to the three dependent variables regressed on the same set of covariates. A similar structure of three simultaneous equations is needed to specify the model. There is potential simultaneity bias stemming from regressing the same set of dependent variables on the same set of independent variables. The simultaneity bias can lead to correlation across error terms in a multiple equation system. The SUR method can provide unbiased and consistent parameter estimates to account for correlations of the errors across multiple equations (Autry and Golicic, 2010; Griffis *et al*., 2012; Zellner, 1962). A Breusch–Pagan test was conducted to validate whether the SUR technique produces more efficient parameter estimates than separate ordinary-least-squares (OLS) models (Breusch and Pagan, 1979). The results (chi-squared = 18.97; $p = .0003$) from the Breusch–Pagan test indicate that the correlation coefficients were jointly significant, clearly indicating that the SUR estimation approach is more efficient than separate OLS equations.

Results (Suppliers' Only Model)

Table I depicts the descriptive statistics and correlation coefficients for all of the measures used in this study. In addition, results from the simultaneous system of equations for testing Hypotheses H_1 to H_3 are reported in Table II. Also noted in Table II, the coefficient of suppliers' inventory efficiency is negative and statistically significant (-0.632; $p < .05$), which supports Hypothesis H_1 in that suppliers' less-shared relationship configuration is associated with the higher level of suppliers' inventory efficiency.

Table I.
Descriptive statistics and correlations

	Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10
1	Supplier's Inventory Efficiency	-0.14	1.03	1									
2	Supplier's Production Efficiency	-0.01	0.97	0.10	1								
3	Supplier's Asset Turnover	0.89	0.68	0.11	0.18	1							
4	Supplier's Shared-Relationship Configuration	0.30	0.24	-0.05	0.01	-0.10	1						
5	Supplier's ROA	-0.01	0.19	0.16	0.13	0.01	0.13	1					
6	Supplier's Total Assets	24.71	154.25	0.03	-0.06	-0.15	-0.01	0.01	1				
7	Supplier's Debt-to-Equity Ratio	1.79	7.06	-0.09	-0.17	-0.04	-0.05	-0.14	0.10	1			
8	Supplier's Cost of Goods Sold	6.47	24.44	0.17	-0.05	-0.06	0.03	0.03	0.59	0.11	1		
9	Buyer's ROA	0.10	0.13	0.01	0.03	0.01	0.07	0.02	-0.01	-0.02	-0.03	1	
10	Buyer's Total Assets	64.18	45.69	-0.01	-0.03	0.04	-0.12	0.04	0.03	0.03	0.01	-0.31	1
11	Buyer's Debt-to-Equity Ratio	49.07	120.05	0.01	-0.01	0.04	-0.10	0.01	0.05	0.05	-0.03	-0.04	0.55

Hypothesis H_2 was not supported, as the result of the association between suppliers' shared relationship configuration and suppliers' higher levels of production resource efficiency was not significant. However, the suppliers' asset turnover coefficient is negative and significant (-0.457; $p < .01$), meaning that Hypothesis H_3 is supported.

Table II.
Seemingly Unrelated Regression Results (Supplier Only Model)

Variables	**Supplier's Inventory Efficiency**	**Supplier's Prod. Resource Efficiency**	**Supplier's Asset Turnover**
Intercept	-0.031	-0.075	0.802**
	(0.472)	(0.497)	(0.296)
Supplier's Shared-Relationship Configuration	-0.632*	0.070	-0.457**
	(0.309)	(0.326)	(0.194)
Supplier's ROA	0.276	0.557	0.066
	(0.425)	(0.449)	(0.267)
Supplier's Total Assets	-0.002	-0.003	-0.001**
	(0.000)	(0.005)	(0.003)
Supplier's Debt-to-Equity Ratio	-0.008	-0.007	-0.003
	(0.007)	(0.011)	(0.007)
Supplier's Cost of Goods Sold	0.007*	-0.001	0.001
	(0.003)	(0.003)	(0.002)
Industry Fixed Effects	Yes	Yes	Yes
R^2	0.12	0.04	0.26

N=184, Notes: † $p < .10$; * $p < .05$; ** $p < .01$

Figure 1 plots the predicted values of both significant operational efficiency measures on the y-axis (using the standardized scale) against the supplier's relationship configuration. The values of the x-axis span the entire range of the potential supplier's relations (i.e., from sole to extensively shared). As shown in the figure, the negative effect of a supplier's shared configuration on inventory efficiency is noticeably more extensive than the effect on asset turnover. Nonetheless, the data suggest that a supplier's less-shared relationship configuration will lead to better operational efficiency for both inventory efficiency and asset turnover.

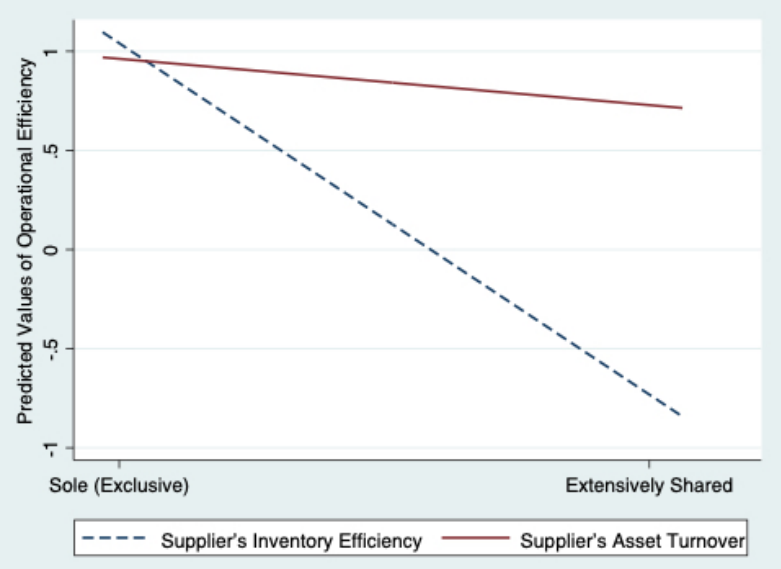

Figure 1:Operational Efficiency

Endogeneity Checks

This study addresses the possible endogeneity of the supplier's shared-relationship configuration and suggests using the instrumental variable approach to account for potential bias. Supply chain management scholars have increasingly recognized the firm's performance is influenced by relational factors (i.e., inter-firm interactions) (Yan *et al.*, 2015). This implies that

suppliers' performance may differ depending upon which buying firms are associated with them. Thus, concern remains that a supplier's shared relations may be potentially endogenous. Moreover, a supplier's decision to have sole versus shared supply relationship configurations with buying firms may not be exclusively made by supplier firms. Hence, buying firms could also play a role in influencing the type of buyer-supplier relations. Without controlling for buyer-level variables, omitted variable bias may exist, leading to potential endogeneity issues. Thus, this study estimates additional models using a dyadic dataset that enables to control for a buying firm's variables. Nevertheless, the control variables related to the buying firm (through dyadic data) may not resolve the endogeneity problems completely. Thus, an instrument variable approach was employed to ensure the robustness of the study findings.

Suppliers' invested capital was identified as a potential instrument that is likely to impact a supplier's choice of relationship configuration. Furthermore, it is also not expected to correlate with any omitted variables that affect a supplier's operational efficiency. As argued in the prior section, in multiple-supply relations, suppliers need to consider the individual requirements of several buying firms. Thus, they would require more production capacity and capital investments (Padgett *et al*., 2020). To account for endogeneity correction, this study follows a typical approach by conducting a two-stage generalized method of moments (GMM) estimation procedure using "ivreg2" in Stata (Shi *et al*., 2016). Specifically, in the first stage, an instrumental variable is regressed on a speculated endogenous variable with other covariates in the model; in the second stage, the same set of covariates from the SUR models are included. The instrument's effect on the supplier's shared-relationship configuration was significant ($p < .01$). To validate whether the instrument deployed in all models passes the under- and over-identification tests, Anderson's canonical correlations statistics (p=0.01) and Cragg-Donald Wald F statistics confirm the rejection

of the null hypothesis that the instrumental variable is under-identified and weak, respectively. Furthermore, the Sargan statistic (p=0.000) for all models supports the exogeneity of the instrument variable. The results with instrumental variable (IV) estimations (with additional buyer-level controls) were consistent with SUR models and are presented in Table III.

Table III.
Instrumental Variable Regression with GMM Estimation

Variables	**Supplier's Inventory Efficiency**	**Supplier's Prod. Resource Efficiency**	**Supplier's Asset Turnover**
Intercept	0.709	0.286	1.275*
	(0.683)	(0.612)	(0.604)
Supplier's Shared-Relationship Configuration	-3.853*	-1.989	-4.218**
	(1.906)	(1.605)	(1.688)
Supplier's ROA	1.410**	1.137*	0.554
	(0.550)	(0.505)	(0.465)
Supplier's Total Assets	-0.003	-0.001	-0.001
	(0.007)	(0.001)	(0.001)
Supplier's Debt-to-Equity Ratio	-0.081†	-0.027**	-0.008
	(0.01)	(0.008)	(0.009)
Supplier's Cost of Goods Sold	0.015**	0.001	0.005
	(0.004)	(0.004)	(0.004)
Buyer's ROA	0.462	0.316	0.479
	(0.685)	(0.580)	(0.596)
Buyer's Total Assets	-0.002	-0.001	-0.001
	(0.002)	(0.001)	(0.001)
Buyer's Debt-to-Equity Ratio	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)
Industry Fixed Effects	Yes	Yes	Yes
Anderson Canon. Corr	5.870	6.528	6.321
	(p<0.01)	(p<0.01)	(p<0.01)
Cragg-Donald Wald F statistic	5.768	6.412	6.210

N=440, Notes: † $p < .10$; * $p < .05$; ** $p < .01$

Discussion

The primary objective of this study is to investigate whether suppliers' shared-relationship configurations impact their operational performance. The study draws upon agency theory to examine whether a less-shared relationship configuration offers performance benefits to suppliers in terms of their operational efficiency. The study theorized that suppliers holding less-shared ties might face lesser agency problems with their principals (buying firms). In this regard, both suppliers and buyers are subject to fewer agency problems, incur lower agency costs, achieve easier goal alignment, and benefit from building transparent and trust-based relations with each other (Rebolledo and Nollet, 2011). Consequently, the tendency toward relatively open and transparent communication between a (rather exclusive) supplier and the buying firm helps to reduce information asymmetry within the buyer-supplier dyad. This, in turn, positively influences a supplier's operational efficiency. Many examples from the aerospace industry illustrate that buying firms often incentivize their suppliers to engage in exclusive relations. For instance, Boeing typically supports their dependent suppliers by ordering more parts than it needs to keep its future production plans, reflecting the mechanism of how Boeing aligns its goals with those of suppliers by helping them increase their production capacities (Cameron, 2020). This example of incentive alignment supports the AT-based theoretical arguments that a less-shared supplier firm could yield higher incentives from a buying firm than a more extensively shared supplier.

Indeed, this study shows that two suppliers' operational efficiency outcomes, i.e., inventory efficiency and asset turnover, are significantly associated with a supplier's less-shared relationship configuration. Consequently, suppliers gain from building fewer, albeit selective, relations (instead of extensive ties with multiple buying firms' rivals) and enhance inventory efficiency and asset turnover. These findings provide fresh insights into the debate over how suppliers can reap benefits

from their exclusive relations with buying firms. This research demonstrates the need to understand buyer-supplier relationship strategies better. The study results also imply that buying firms should recognize and respond to their partners' goals to have sustained relations.

Interestingly, the results do not support the hypothesis that a supplier's shared relationship configuration influences its production resource efficiency. The prediction was not upheld. One possible explanation might be that suppliers are engaging with multiple buying firms' rivals because this allows them to diversify production-related risks by securing various sources of revenue, thereby potentially compensating for the advantages outlined before when transacting with fewer customers.

Theoretical Implications

This paper applies the lens of agency theory to a supply chain phenomenon and thereby broadens the theory's scope within the supply management literature. This research takes the supplier's perspective to investigate how a specific supply relationship configuration (sole vs. shared) affects the suppliers' operational performance. Specifically, this study analyzes the configuration's implications on operational efficiency performance regarding inventory efficiency, production efficiency, and asset turnover measures. Thereby, this research highlights how organizations can enhance their competitiveness by establishing appropriate relations with buying firms to become more efficient (Parmigiani *et al.*, 2011; Leuschner *et al*., 2013).

This study contributes to the literature by linking a supplier's operational efficiency performance to its selected supply relationship configurations with buying firms. While much of the prior literature has focused on examining how a focal firm's performance is influenced by its strategic sourcing practices, scant attention has been paid to the link between specific supply

relationship configuration strategies and the corresponding operational performance of a supplier (Arora *et al*., 2016; Saeed *et al*., 2005). Even though prior research has established that trust and deep ties influence buyer-supplier relations quality (Magnan *et al*., 2017), surprisingly little is known about how relational ties of suppliers with buying firms can affect their operational performance (Kim, 2017). This study contributes new insights based on the suppliers' perspectives and is an initial step toward addressing the theoretical gap. A new, interesting viewpoint is offered by drawing upon agency theory to demonstrate that suppliers could enhance operational efficiency by developing sole (exclusive) relational ties with buying firms. The findings indicate that emphasizing relatively exclusive relations improves a supplier's operational efficiency in several dimensions. In particular, this research enhances the understanding of how shared relations with buying firms impact the suppliers' inventory efficiency and asset turnover.

Managerial Implications

This research addresses a relevant supply trade-off decision and offers several managerial implications concerning the benefits of specific buyer-supplier relations. The study provides new insights into the performance implications of supply chain relationship configurations from the supplier's perspective. Specifically, it informs managers about the potential efficiency advantages of determining the optimal supply network structure. Several research findings appear to be counterintuitive.

In many markets, for example, managers would strive to create contractual relations with multiple buying firms (i.e., extensively shared relationship configuration) to increase revenue and reduce risks (lowering the dependency on specific customers) (Zhu *et al*., 2017). However, this research demonstrates that focusing on sole (exclusive) ties offers many operational benefits to be

exploited. Following the study's results, managers can enhance their operational performance by establishing less shared relationship configurations and focusing on more exclusive relations with buying firms. This is an exciting finding and offers a new guiding perspective for managers as a crucial managerial contribution. Thus, managers should carefully scrutinize their operations and assess the potential for efficiency gains by adapting their supply relationship configuration. By sharing goals and aligning strategies, managers may be able to make better decisions and create a global operational optimum (e.g., regarding lot-sizing decisions involving both buyers and suppliers), instead of just a local one, and respond to market changes in a coordinated way.

Furthermore, this research indicates that the emphasis on exclusive ties may help overcome agency issues, especially regarding information asymmetry and potential goal conflicts or moral hazard risks. However, the performance improvement potential might depend on the ability and willingness of the involved buying firms to share relevant knowledge with the suppliers and invest resources in the necessary integration (Zaheer and Trkman, 2017; Schmelzle and Tate, 2022). This research guides managers to achieve significant gains with their inventory by collaborating across organizational boundaries. Likewise, they could significantly enhance the asset turnover ratio of their organizations should they decide to adopt a focus strategy by linking exclusive relations with fewer buying firms. Thereby, managers can improve their operational performance and enhance their organization's responsiveness, which is a decisive competitive factor in many market environments.

Limitations and Future Research

This study acknowledges several limitations, which present new opportunities for future research. First, while this study has focused on operational efficiency measures, future research

could expand into other performance measures, such as financial, innovation, agility, resilience, sustainability, or quality performance measures. Second, this study is focused on the aerospace manufacturing sector because the phenomenon appears to be particularly relevant in such an environment. In this regard, a potential limitation in terms of external validity is acknowledged. Third, it is commonly understood that aerospace is a specific industry with a limited number of OEMs, albeit a relatively large number of suppliers, and relatively high barriers to entry for potential suppliers (Williams *et al.*, 2002). Therefore, follow-up studies are encouraged to investigate and confirm the performance consequences of supply relationship configurations in other market environments. Future research can also examine how firms may benefit by forming partnerships with exclusive (sole) or shared suppliers to deepen and broaden their knowledge base (Yayavaram *et al.*, 2018).

In this research, a specific number of controls such as firm size and firms' financial leverage were utilized to control for additional effects. As a limitation, no interaction effects were investigated. However, other environmental factors might play a role. Other moderating and mediating effects could be examined in the future to gain a deeper understanding of the phenomenon. Additionally, the study was limited by the use of secondary data because the managerial perceptions and reasoning behind choosing a specific supply chain configuration could not be determined in this study. Future research might investigate this phenomenon by utilizing complementary methodologies such as case studies or behavioral experiments to uncover more insights into a supplier's decision-making.

Conclusion

In a competitive market environment, suppliers need to understand the performance implications of a chosen supply relationship configuration with their customers. However, only scant attention has been paid in the supply chain literature to how a supplier's relations impact its operational performance. Drawing on agency theory, this research contributes to the discipline by offering empirical evidence detailing that a supplier's operational efficiency can be influenced by the selected relations between the supplier and the buying firm. Furthermore, the research findings indicate that less-shared relationship configurations are associated with suppliers' higher inventory efficiency and asset turnover performance. Thus, this study contributes to the supply chain literature and provides relevant guidance for managers on how to enhance their organization's operational efficiency by emphasizing more exclusive relations with buying firms.

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