Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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How COVID-19 pandemic has shaped buyer-supplier relationships in engineering companies with ethical perception considerations: A multi-methodological study

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ABSTRACT

In business-to-business (B2B) operations, prior studies have mainly explored transaction-based relationships with both buyers and suppliers opportunistic behaviors, driven largely by their intent to maximize their own benefits. These studies have also found that dependency on partners increases when supply materials are scarce. However, research is scant on how this relationship changes in the face of exogenous forces such as the COVID-19 pandemic, keeping in mind the ethical perception considerations. This study aims to bridge this gap in the literature by studying how buyers and sellers leverage collaboration and resource-sharing to tide over pandemic-like situations similar to the current COVID-19 pandemic while considering their ethical perceptions. We conduct a multi-methodological study consisting of an industrial survey and an interview-based thematic analysis. In the first phase, we collect primary data using a structured questionnaire and conduct a covariance-based structural equation modeling (CB-SEM) analysis. In the second phase, we conduct a post-hoc test. We find that non-regular suppliers will share strategic resources with buyers during uncertain times (e.g. COVID-19 pandemic) if they have a high ethical perception of the buying firm and share a candid relationship despite being their irregular customers. Our findings propose that B2B firms should maintain healthy relationships with alternative suppliers to build trust and avoid supply crises in times of disruptions.

1. Introduction

The COVID-19 pandemic spread its tentacles worldwide in early 2020. It has disrupted business activities (Butt, 2021; Yu et al., 2021; Mena et al., 2022) and caused immense damage to human life. It is reported that more than 3.8 million people have lost their lives across the globe (World Health Organization, 2021). The uncertainty and disruptions caused by COVID-19 are unprecedented; however, while the pandemic is showing signs to recede the uncertainty remains (Choudhary, Ramkumar, Schoenherr, & Rana, 2021). Nations announced stringent lockdowns to contain the spread of the virus, bringing almost all physical activity, including business activity to a halt. To hold shop in face of the crisis, businesses moved their operations to the online platform, wherever possible. In South Africa, the base of this study, the companies that were allowed to open could run floor production with only 50 % of their workforce (Islam & Alharthi, 2020; Ivanov, 2021). This had a long-lasting impact on B2B operations and buyer–supplier relationship management (Casidy & Yan; 2022; Mostafiz et al., 2022).

Ethical issues in the context of B2B, which have remained contentious even in best of times (Behera et al., 2022; Guo et al., 2022), compounded manifold during the pandemic (Moodley et al., 2021). Bowen et al. (2007a) and Bowen et al. (2007b) studied the ethical issues in the context of the construction industry in South Africa and found

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large-scale prevalence of unethical behaviour, such as corruption, bribery, misinformation, and unfair treatment of workers. The authors recommended that the companies could stem corrupt practices by implementing a code of conduct, such as the "The Organisation for Economic Co-operation and Development's bribery codes conditions," which establishes legally binding standards to criminalize bribery of foreign public officials in international business transactions.

Other studies (Aigbavboa et al., 2016; Bowen et al., 2012) too have examined the ethical practices followed by some South African firms and found large-scale prevalence of unethical practices, particularly among the engineering firms. Oyewobi et al. (2020) recommended that firms working in highly dynamic environment should implement their ethical practices when making strategic business decisions. The B2B industries, such as the construction and the engineering industries, have their own set of challenges that are unique to the nature of their business.

Arcelor Mittal, South Africa's largest steel manufacturer and the only company operating blast furnaces in the country, has been greatly impacted by the COVID-19 pandemic, resulting in a steel crisis (Business Live News, 2021) and manifesting in an acute shortage of steel plates, flat bars, round bars, and other industrial steel items required by other B2B businesses in light and heavy engineering projects. This situation has resulted in companies collaborating and sharing resources to tide over resource scarcity. For example, engineering firms share raw materials, equipment, and production facilities with business partners and customers. However, in times of crisis, with limited stock, suppliers find it difficult to satisfy the demands of their multiple customers who then look for alternate avenues to source their raw material. In this volatile environment, supply firms have to restrict their supplies to limited customers, shortlisting them based on several factors, including the ethical standards they follow and the level of trust they have in their relationship (Bag et al., 2022; Fready et al., 2022). Bendixen & Abratt (2007) stated that ethical standards and candid relationships shape ethical perceptions. Maintaining solid relationships with the suppliers based on trust and mutual respect helps firms position themselves with the suppliers (Bendixen & Abratt, 2007). In fact, developing candid relationships with suppliers also gives a positive return in the long-run, especially during uncertain times like COVID-19.

In addition, in the context of B2B relationships, the suppliers and the buyer can come together to strategize to buy raw material from alternative sources (Wang, 2022). This is possible when the buying firm maintains ethical standards and develops candid relationships with its suppliers. This is in line with the relational view theory, which highlights that sharing "*relation-specific assets, knowledge-sharing routines, complementary resources and capabilities, and effective governance*" between alliance partners can determine inter-organizational competitive advantages (Dyer & Singh, 1998).

The specialization of suppliers and scarcity of raw materials are two critical factors that are operationalized in this study. Specifically, we argue that buyers of engineering firms, especially those making light fabricated structures, generally buy laser-cut items directly from the suppliers and further fabricate them in-house because the suppliers specialize in the laser-cutting job. However, for significant fabrication jobs, the buyer would buy steel plates, flat bars, etc., directly from the steel merchants and not from the laser-cutting supplier. With the pandemic and the consequent disruption of the supply chain network adversely impacting supply of steel in the local and global market, firms are forced to source material from their laser-cutting suppliers, who maintain a vast stock to mitigate the current supply crisis situation (Makgetla, 2021; Rath & Ram, 2021). This example demonstrates that organizations must exchange resources in the market to complete the production targets during raw material scarcity resulting from the COVID-19 pandemic. In other cases, the engineering firms may import items from foreign suppliers rather than the local ones. However, these firms also keep the local source as an alternative option by conducting infrequent/irregular business transactions. Alternatively, they may procure some routine items from the local suppliers and not the strategic raw material. However, with the current scarcity, these firms are now also sourcing strategic material from the lower-tier suppliers. The shortage of resources and closure of borders limits ability of firms to arrange all items from international sources or get everything manufactured in-house. As a result, the present research argues that organizations need to strengthen their interdependence and foster collaboration strategies to tide over unforeseen disruptions, while also minimizing environmental uncertainty and engaging in these exchange relationships (Thompson, 1967; Blessley et al., 2018). These relationships enable resource sharing among these business partners in the network.

However, existing literature has not yet found a well-agreed reason explaining why the suppliers may share resources with selected customers'/business partners (and not with every-one) under a pandemic like COVID-19. As a matter of fact, many customers do not have service level agreements (SLA) with their local suppliers. In light of this, we find that prior studies have not explored why such engineering firms (i.e., buying firms) gain access to supplier resources during this pandemic. Is it because of the engineering firm's high ethical standards and candid relationships? Is it the ethical perception of the supplier about the buying firm that triggers the supplier to make the resource-sharing choices with selected customers to build long-term relationships/strengthen the existing relationship? To explain the above phenomenon, we attempt to answer the following two research questions:

*RQ1: What is the B2B relationship between the buyer's ethical standards, candid relationships, and the supplier's ethical perceptions [towards the engineering firms (*i.e., *buyers)]?*

RQ2: How do the supplier's ethical perceptions towards the buyers influence resource-sharing in the B2B relationship during the COVID-19 pandemic, with the propensity for collaboration playing the mediating role?

Using a multi-methodological approach (Choi, Cheng, & Zhao, 2016; Li, Hua, Cheng, & Choi, 2022) with survey data from 318 employees of engineering firms, and as well as post-analysis interviews, we answer the above research questions. We find empirical evidence that supply chain managers need to understand why non-regular suppliers share strategic resources during crises (when regular suppliers do not have the required strategic raw material in stock). In particular, our research findings show that non-regular suppliers will share strategic resources during uncertain times if the supplier has a high ethical perception towards the buying firm and if the buying firm always maintains a candid relationship (despite being an irregular customer). Therefore, managers working in engineering firms in developing countries must maintain candid relationships with alternative suppliers to build trust and avoid supply crises in pandemic situations. As COVID-19 has significantly affected buyers' and suppliers' behaviours regarding trust or distrust matters, our study substantially contributes to the literature on B2B buyers'-suppliers' relationships with a particular focus on ethical behaviours under a global pandemic like COVID-19.

The rest of this paper is structured as follows. Section 2 presents the literature review on how buyer–supplier relationships have evolved and how COVID-19 has shaped these relationships. It also provides the theoretical model using a relational view. In Section 3, we report the quantitative empirical analysis and present the steps related to research methods, i.e., sampling strategy, instrument, and data collection. In Section 4, we conduct the data analysis using covariance-based structural equation modeling (CB-SEM) and interview-based thematic analysis. We present the theoretical and practical implications in Section 5 and conclude in Section 6. The semi-structured questions are presented in Appendix A1.

2. Literature review

This section first details the ethics that govern B2B buyer–supplier relationships. It then studies the impacts of COVID-19 on engineering firms' supply chains and buyer–supplier relationships and uncovers gaps in existing literature on the subject. Finally, it establishes the theoretical

framework and develops the hypotheses.

2.1. Ethics and B2B buyer–supplier relationships

Business-to-business (B2B) marketing is very important in the current digital era. In order to be effective in B2B marketing, businesses must first understand, create, and properly provide value to customers. It is equally critical to build working relationships (transactional/collaborative) (Anderson et al., 2011). B2B marketing management, also known as industrial marketing management, is a fascinating research area attracting increased research interest (Behera et al., 2022) which has unearthed interesting insights. Research in recent years has focussed on: (i) How corporate brand image influences managers' decision-making in choosing an industrial corporate brand (Balmer et al., 2020) in B2B operations; (ii) the role of social media in customer engagement (Cortez & Dastidar, 2022); (iii) brand loyalty in B2B markets (Nyadzayo et al., 2018); (iii) integration of B2C and B2B models (He & Zhang, 2022); (iv) the influence of "entrepreneurial self-efficacy" on B2B sales performance (Edwards et al., 2022); and (v) how B2B interactions and dynamism affect financial successes (Chung et al., 2021). Nevertheless, B2B marketing has an involved link with supply chain management (SCM) since working relationships between buyers and suppliers are crucial for achieving sustainable competitive edge (Fukukawa & Moon, 2004; Terpend et al., 2008; Jääskeläinen, 2021). Related features of buyer–supplier relationships include the mutual benefits they accrue, and how mutual cooperation helps to overcome the challenges of adverse situations (Moeller et al., 2006; Quintana-García et al., 2021). Supply chain networks of firms lay high emphasis on sophisticated and collaborative buyer–supplier relationships, leading to the co-development of high quality products (Slobodow et al., 2008; Bag et al., 2018; Seyedghorban et al., 2020).

Firms that develop long-term collaborative relationships with their suppliers also increase the likelihood to benefit from increased supplier responsiveness (Chen et al., 2004), lower prices, enhanced flexibility (Sorenson, 2003), and reduced levels of risk (Mwesiumo et al., 2021). When buying firms commit to long-term contracts, suppliers are more likely to invest in resources (Krause, 1999) leading to more ethical activities between the suppliers and the buying firms (Chonko et al., 1996). Constructive collaboration based on "deep-rooted ethical values" has also been suggested to be useful in buyer–supplier relationships. Furthermore, idiosyncratic relationships with suppliers can generate extraordinary profits for firms since competitors cannot easily duplicate these interactions (Quintana-García et al., 2021). Hence, collaborative supply chain relationships have gained in popularity, and importance in theory and practice (Flynn et al., 2010).

There are various drivers of constructive collaborative buyer–supplier relationships. Sharing costs and information, co-developing relationship-specific assets, pooling technology, and creating scale economies where possible are some of these drivers and measures (Rungsithong & Meyer, 2020; Bag et al., 2021a,b). These types of actions should be fine-tuned with respect to the corporate cultures (Ribbink & Grimm, 2014), level of trust (Selnes & Sallis, 2003), and expectation (i.e., "expected mutuality and continuity") (Johnston et al., 2004). Mutual trust in a partnership can also be considered a function of the ethical behaviours of participants (Gullett et al., 2009; Agarwal & Narayana, 2020).

Ethics refers to the question of what is right and what is good, and what makes for good behaviours (Becker, 2018). In fact, business ethics has become increasingly relevant to firms in a complex business environment (Gundlach & Murphy, 1993). To that end, being honest, reliable, and trustworthy is commonly regarded as a critical driver for long-term success (Becker, 2018). The ethical perceptions of one another are, therefore, of utmost importance in establishing buyer–supplier relationships. In the related literature, Bendixen & Abratt (2007) find that suppliers form ethical perceptions of buyers based on the ethical standards they demonstrate.

2.2. Impact of COVID-19 on engineering firms' supply chains and buyer–supplier relationship

The COVID-19 pandemic has caused unprecedented supply chain disruptions worldwide across industries (World Economic Forum, 2021; Chowdhury, 2021) with most firms found unprepared for the impact thereof (Black & Glaser-Segura, 2020). Pandemics are unique in their disruptions of supply chains due to their wide geographical footprint, long-term existence, disruption reproductions, and simultaneous impact on supply and demand and logistics networks (Ivanov, 2020). Furthermore, the pandemic is dynamic and fluid in nature which moves in waves from one region to another (Black & Glaser-Segura, 2020; Hudecheck, Sirén, Grichnik, & Wincent, 2020). Supply chains are interconnected by nature and a disruption of one supply chain is likely to affect others and extend to multiple supply chains, sometimes on a global scale (Manuj & Mentzer, 2008). Firms, therefore, have to face greater recovery challenges from pandemics and require more robust and versatile recovery strategies (Kim et al., 2005; DuHadway et al., 2019) in order to survive.

A common challenge experienced by engineering firms during the COVID-19 pandemic is the scarcity of resources like steel plates, industrial gas, and other raw materials in the local market. On the other side, the international supply lines are cut on a temporary basis due to the closure of international borders, lack of container availability, and congestion at ports (Bag et al., 2021b). Regarding this challenge, firms would easily experience the bankruptcy of international suppliers and the closure of their own operations (Clarke & Boersma, 2017; Bag et al., 2021b). Other challenges reported include difficulties in ramping up production capacity and reconfiguring supply chain processes (Sharma et al., 2020).

Under the COVID-19 pandemic, supply chain risk mitigation among firms in different operations is a critical aspect to be addressed based on various strategies. For example, the following topics are examined in the recent literature: Using mobile logistics to support service operations (Choi 2020), sourcing from alternative supplier selection (Chen et al., 2021), increasing the supplier base, insourcing, keeping additional inventory (Rönkkö et al., 2021), making use of blockchain (Choi & Shi, 2022a) and other technologies (Xu, Siqin, Chung, & Choi, 2021), and supply guarantee deposit payments (Choi & Shi, 2022b). In the related literature, Mwesiumo et al. (2021) stressed the need for building a closer buyer–supplier relationship to deal with the challenges posed by the COVID-19 pandemic. In fact, collaborative buyer–supplier risk identification is highlighted as a critical method to strengthen a firm's supply chain resilience. This includes an assessment of the ability of a supplier to handle risks (Mwesiumo et al., 2021). Bag et al. (2021a) found that collaborative culture leads to collaboration among engineering firms' supply chain partners, which finally shortens the response times for customer orders and also improves supply chain resilience. It can, therefore, be argued that the relational aspect of supply contracts is of increasing importance to firms recovering from the COVID-19 pandemic.

2.3. Research gaps

During COVID-19, which is an economic downturn, long-term collaborative B2B buyer–supplier relationships seem to be critical to maintaining supply chain network performance (Matopoulos et al., 2019). Good relationships with suppliers are a source of supply chain resilience among engineering firms in times of crisis because buyers who have collaborative relationships with their suppliers must be prioritized for restocking (Hobbs, 2020). Unforeseen events and economic downturns can undermine these existing relationships (Krause & Ellram, 2014). This brings about the opportunity to exploit buyers due to short-term scarcity.

The nature of B2B relationships differs depending on the industry. Several studies have focused on buyer–supplier relationships in the fast-

moving consumer goods sector and food supply chains in times of economic downturn (Matopoulos et al., 2019; Vanichchinchai, 2021). This sector by nature is characterized by transactional relationships owing to the high levels of dynamism and competitiveness (Hobbs, 2020). However, in times of economic downturn, these relationships have been shown to fizzle out as opportunistic pricing is implemented to maximize profits (Matopoulos et al., 2019). Buyers have been shown to reciprocate by switching suppliers to find more favourable prices. Existing studies exploring the impact of COVID-19 on buyer–supplier relationships among engineering firms are limited but their numbers are expected to grow (Agyekum et al., 2021; Zimmerling & Chen, 2021). These studies have focused on various industries including food supply chains, fast-moving consumer goods sector, and textiles but engineering companies remain understudied (Vanany et al., 2021).

Despite the fact that tension is frequent in B2B relationships, previous research has paid little attention to the potential negative consequences of psychological strains (Zheng et al., 2022). Matopoulos et al. (2009) investigated the perceptions of justice in buyer–supplier relationships in times of economic crisis and found that suppliers who perceive their buyers as fair devote extra effort to fulfil their orders in times of crisis. Hobbs (2020) investigated the impact of COVID-19 on the resilience of food supply chains in Canada. The author found that the just-in-time supply chain model is vulnerable and businesses must foster strong relationships to be more resilient. Stammarnäs (2021) investigated the impact of COVID-19 on the ready-made garment buyer–supplier relationships in Bangladesh. The author found a shift in power dynamics under the pandemic as the supplier obtained more power with the buyer–supplier relationship undergoing significant erosion.

The theory is a declaration of the relationships between concepts within a defined set of premises and restrictions (Bacharach, 1989). We take help of the relational view theory proposed by Dyer & Singh (1998), which contends that crucial resources for a company could cross organisational borders and be ingrained in inter-firm practises and routines. In order to comprehend competitive advantage, one must look at how organisations interact with one another and locate potential sources of inter-organizational competitive advantage. However, the COVID-19 pandemic has challenged some of the assumptions. For instance, although effective governance is one of the key determinants of relational benefits, the COVID-19 pandemic has created a situation that has shaken the foundation of sustainability. In such a situation many firms lost their ability to employ formal/informal self-enforcement of governance mechanisms leading to chaos in the early stages of the pandemic. Second, from the relation-specific assets point of view, two things are possible (a) higher the investment in relations, higher the potential for relational rents, and (b) higher the number of transactions, higher the possibility for creating relational rents. However, it is seen that suppliers who did not get much attention (buying firms) or regular business (i.e. low transactions) from customers have gone out of their way to help them (buying firms) during this pandemic by sharing resources. Ethical dimensions have been seen to play a critical role in sustaining these relationships and deriving mutual benefits. Alvesson & Sandberg (2011) recommended the problematization approach to create research questions. We believe that the current study has been able to question the assumptions in context of engineering buyers and suppliers and further assess the alternate assumption ground.

This current study contributes to the growing body of knowledge on buyer–supplier relationships in the context of COVID-19 disruptions for engineering companies. The focal point is the impact of ethical standards and candid relationships on ethical perceptions and their impact on resource-sharing during the pandemic. The propensity for collaboration, as a mediating variable, is also examined. Novel insights are generated which contribute to the literature and help the managers to advance their understanding of industrial practices in the engineering supply chain network. We have performed theory testing (Fisher & Aguinis, 2017) by creating hypotheses from the relational view. The details are presented in the next section.

2.4. Theoretical framework and hypotheses development

2.4.1. Relational view

The theoretical perspective that this research adopts is the relational view (Gupta et al., 2019). From the research of Dyer & Singh (1998), we identify that sociological and ethical relationships between two individuals and their networking capability are crucial components for understanding firm performance. The relational view perspective also highlights the fact that buyers and suppliers create values between them when they identify ethical standards with candid relationships to build ethical perception. This is possible when they build high levels of collaboration, share resources and make investments for long-term relationships in order to be sustainable (Kale et al., 2002; Walter et al., 2006; Lavie et al., 2012; Tanskanen & Aminoff, 2015; Zhong et al., 2017; Dyer & Smith, 2021). In line with this, we also argue that buyer–supplier relationships are more important for achieving resource-sharing-based advantage, both in and after the pandemic situation (Craighead et al., 2020; Carmine et al., 2021). The relational view also provides a good fit with the propensity of collaboration arrangements between buyers and suppliers, as both the firms have the intention to establish an ongoing ethical and resource-sharing relationship that can create a competitive edge (Borgatti & Cross, 2003; Gold et al., 2010; Liu et al., 2021). Therefore, the theory of "relational view" has been applied in this study to build the conceptual model to explain the buyer–supplier relations. As a remark, to the best of our knowledge and evidence from recent literature, this is the first study to apply the relational view theory to shape buyer–supplier relationships among engineering firms in the context of the COVID-19 pandemic.

2.4.2. Theoretical framework

Moral and healthy relationships between inter and intra-stakeholders are vital for the organization's progress (Butt, 2019), and the same applies to buyer–supplier relationships. Organizations having ethical values may become more sustainable in the long-term. Ethical standards are an important component of any B2B business relationship. An adequate ethical standard should be established to preserve the supplier–buyer relationship (Quintana-García et al., 2021). The ethical standard of the business enhances the candid relationship between buyers and suppliers (Islam & Alharthi, 2020). A candid relationship plays a very crucial role, particularly in an uncertain environment. Ethical standards and candid relationships lead to ethical perceptions. The relationship between buyers and suppliers is improved by ethical perception. The corporate identity and reputation of the buying firm are strongly intertwined with ethical perceptions of suppliers and vice versa. Ethical perception enables an open relationship between buyers and sellers based on trust and mutual understanding, resulting in the quick resolution of challenges (Bendixen & Abratt, 2007). In an uncertain environment, the propensity for collaboration helps the buyers to overcome the problem of resource scarcity (Wiedmer et al., 2020) and this altruistic behaviour is well-treasured (Choi & Zhang, 2023). Appropriate resource-sharing mechanisms are essential to keep the supply chain running during a pandemic (Kumar et al., 2020).

In this paper, we argue that ethical standards and candid relationships have a positive relationship with the ethical perception of suppliers related to the buyer/buying firm. We also believe that ethical perceptions would lead to positive relationships and resource-sharing owing to the mediating role of collaboration. In our proposed conceptual model, the control variables are the relationship length and firm size. The theoretical framework is developed based on the preceding literature discussion and presented in Fig. 1. While previous studies focus mostly on using transaction cost economics and the resource dependence theory to explain buyer–supplier relationships, our model uses a relational view to develop the theoretical model. Our proposed theoretical model highlights that ethical standards and candid relationships of engineering companies are the key antecedents that influence ethical perception of suppliers, which further motivates them to

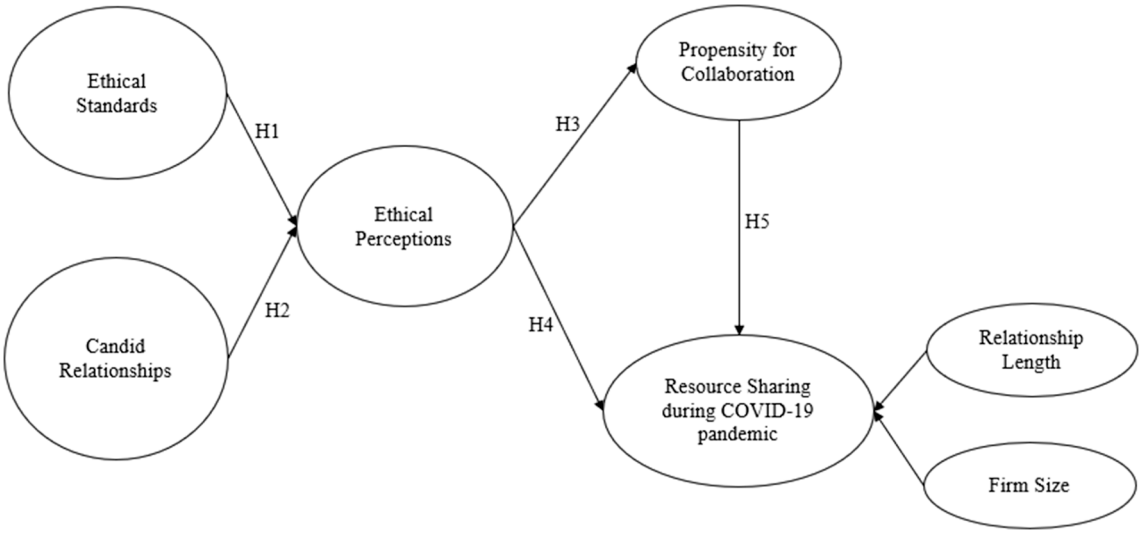

Fig. 1. Theoretical framework.

collaborate and share resources with the buyers during COVID-19. Therefore, our work is unique and important because engineering companies commonly face related challenges under COVID-19.

2.4.3. Hypotheses development

2.4.3.1. Ethical standards and ethical perceptions. The existence of ethical standards is essential to maintain a candid relationship between buyers and suppliers. In fact, a company's external stakeholders are just as important as its internal stakeholders. It is well argued that an organization's ethical standards should be high, and all internal and external stakeholders should adhere to them. This is critical to establishing a trusting and open connection between buyers and suppliers. Ethical standards must be followed in business communication. In the context of B2B, the term ethical standards mean that the ability to assess "what is good" and "what is wrong" in the organization is enhanced by ethical standards. Maintaining an ethical standard in the workplace is a difficult task (Bendixen & Abratt, 2007). The basic foundation of ethical standards rests on values and norms, which determine the organization's standard codes of conduct. Ethical codes of conduct have a major positive impact on stakeholders' attitudes guiding them in realizing their ethical expectations and perceptions (Leonidou et al., 2013). The COVID-19 pandemic has disrupted existing practices prompting firms to redefine their business models and collaborate with one another to tide over the turbulent times. Supply chain partners of engineering firms are seen to be pooling in their resources to perform better and obtain a competitive advantage. The buyer–supplier connection can be developed by applying the philosophical foundation of the relational view theory (*Refer to Section 2*) which emphasizes the need to cultivate high-quality relationships among all stakeholders. The COVID-19 pandemic has transformed the corporate environment (following the relation view's idea) (Crick & Crick, 2020) with the relationship between buyers and suppliers moving from transactional to relationship-oriented. Maintaining high ethical standards in engineering firms enhances the ethical attitudes of stakeholders which, in turn, helps in managing buyer–supplier relationships (Turkmen, 2013) during the COVID-19 pandemic (He & Harris, 2020). Therefore, we propose the first hypothesis:

H1: Ethical standards have a positive relationship with ethical perceptions for engineering firms and their suppliers during the COVID-19 pandemic.

2.4.3.2. Candid relationships and ethical perceptions. The candid relationship enhances transparency, ensures clear business communication, and quick actions and settlement of problems between customers and suppliers (Doney et al., 2007; Kingshott et al., 2020). Engineering companies are striving hard to improve their stakeholder relationships. Ethical behaviour is critical in developing and maintaining long-term buyer–supplier relationships (Bendixen & Abratt, 2007). The relational view theory includes ethical perception as a key component. Trust and commitment in the buyer-and-supplier relationship, relationship quality concepts and value creation objectives are influenced by the ethical perceptions of the buyer and supplier. A positive ethical view decreases the risk and uncertainty that comes with the commitment to a relationship. Ethical perception is considered a prelude to ethical behaviour (Nadeem et al., 2020). The COVID-19 pandemic has created threats to engineering businesses. The shutdown of plants and businesses due to supply crisis or lack of customer orders is seen to exacerbate the issue. Through honest buyer–supplier relationships, engineering companies enjoying trust and commitment with their supply chain partners are seen to be surviving the pandemic more easily than the ones lacking in these areas. The COVID-19 pandemic has thus intensified the buyer–supplier connection to deal with ethical issues. Their combined efforts should assist them in getting their businesses back on track (Cortez et al., 2020). We argue that clear communication and transparency of the buyers (engineering firms) can enhance ethical perception among suppliers helping to solve many supply-related problems caused by the COVID-19 pandemic. Therefore, we propose the second hypothesis:

H2: Candid relationships between engineering firms (buyers) and suppliers have a positive relationship with ethical perceptions during the COVID-19 pandemic.

2.4.3.3. Ethical perceptions and propensity for collaboration. Relationship management relies heavily on ethical perception. To boost sales volumes, suppliers concentrate on relationship marketing. To achieve a common objective, ethical perceptions are linked with both customers (i.e., buyers) and suppliers. The ethical values of the company are defined by its characteristics of ethical perception (Bendixen & Abratt, 2007). Relationship rooted in an ethical mind-set assists engineering firms in obtaining supplies from suppliers during times of resource scarcity. The purchasers' perceptions influence their decisions, reactions, and scarcity uncertainty. The likelihood that a buyer may consider adopting a collaborative mitigation strategy with a large supplier in response to an expected resource restriction is known as the propensity of collaboration. All parties linked with engineering firms must work together in the situation of resource scarcity, similar to COVID-19. In an uncertain environment, suppliers continue to supply

scarce resources to the buyers due to the high propensity for collaboration, which plays a crucial role in minimizing the opportunistic behaviour among the suppliers, leading to mutual benefits (Wang, 2021; 2022). Buyers and suppliers benefit from the quality and quantity of contracts that help them manage their business and transfer resources during the COVID-19 pandemic. With the change in business climate brought about by the COVID-19 pandemic, buyers and suppliers should form relationships based on positive social value. By pooling resources to overcome the pandemic crisis, they can attain a goal that would be impossible to reach on their own. The COVID-19 pandemic has altered traditional business practices, promoting ethical relationships among partners (Cortez & Johnston, 2020). We argue that the suppliers' ethical perception of engineering firms is crucial in triggering the propensity for collaboration. Therefore, the third hypothesis is:

H3: Ethical perceptions of buying firms in the mind of suppliers have a positive relationship with propensity for collaboration during the COVID-19 pandemic.

2.4.3.4. Ethical perceptions and resource-sharing during the COVID-19 pandemic. Ethics influence both behaviours and success in engineering firms. Having a positive ethical perception in the mind of suppliers probably indicates that the buyers have addressed unethical, immoral, and undesirable practices within their organization (Michaelidou & Micevski, 2019). People's ethical perceptions are diverse. The supplier's ethical perceptions are enhanced by information and procedural fairness shown by the buyers (engineering firms). It is known that ethical perception reinforces positive relationship between buyers and suppliers (Mpinganjira & Maduku, 2019). COVID-19 has created many social sustainability problems, such as delayed supplier payments, inability of the labor contractors to come to the factory, and the resultant pay-cuts, leading to human rights violations and associated concerns (Bag et al., 2022). The pandemic has brought to light the need for the supplier to implement improved environmental and social sustainability practices. While supply of resources has become scarce, it is seen that suppliers are prioritizing supply to buyers whom they perceive as ethical (Valenzuela & Villacorta, 1999) enabling them to tide over the uncertainties caused by the pandemic (Kumar et al., 2020). Therefore, we hypothesize:

H4: Ethical perceptions have a positive relationship with resource-sharing between engineering firms (buyers) and suppliers during the COVID-19 pandemic.

2.4.3.5. Mediating role of the propensity for collaboration in the relationship between ethical perceptions and resource-sharing during the COVID-19 pandemic. The propensity for collaboration is essential for resource-sharing between buyers and suppliers. Buyer-supplier collaboration enables real-time expertise sharing, information interchange, and development of synergies. The best risk mitigation method is probably collaboration. Collaborative propensity reduces supply chain risks substantially. Buyers benefit from collaborative relationships because they may access scarce resources from suppliers at critical times such as COVID-19. The extent to which providers examine and attempt to overcome the challenge of scarce resources can be measured by their willingness to collaborate (Wang, 2022). The collaborative techniques used by corporate partnerships during the COVID-19 epidemic can be examined by using the relation perspective theory. The ability of companies to compete allows them to cope with the COVID-19 pandemic (Crick & Crick, 2020), which has disturbed the global supply chain, the distribution system, and as well as the transportation linkages.

We argue that suppliers' ethical perceptions toward buying (engineering) firms would determine the willingness to share/not share their scarce resources with them. This relationship is mediated by their propensity for collaboration during the critical period of the COVID-19 outbreak. Therefore, we propose the final hypothesis:

H5: Propensity for collaboration plays a mediating role in the relationship between ethical perceptions and resource-sharing between engineering firms (buyers) and suppliers during the COVID-19 pandemic.

3. Research methods

This paper adopts a multi-methodological approach (Choi et al., 2016), which first includes a quantitative empirical study described below. Then, to drill deeper and enhance research rigor, we also conduct a thematic analysis with qualitative interviews, reported in Section 5.

3.1. Research setting

This study focuses on exploring the B2B buyer–supplier relationships among the engineering firms (as buyers) from South Africa. In today's highly volatile and competitive marketplace, engineering firms are applying multiple strategies to reduce overhead costs, lessen financial losses, and reduce unnecessary expenses (Aboelmagd, 2021; Wang, 2022). Ethical practices within the engineering industry players have attracted the attention of professionals, researchers, and policymakers (Chance et al., 2021; Smith et al., 2021) primarily because organizations across the spectrum have realized the need to follow ethical practices and build mutually-beneficial relationships to face disruptions, similar to the ongoing pandemic. Resource-sharing is one such collaborative activity which is based on how suppliers perceive the buying firm. Higher the ethical perception, more likely for the supplier to prioritize supply to the firm in times of resource scarcity (Dubey et al., 2014). This study considers South African engineering firms as they are similar in nature to most global engineering firms in managing and delivering innovative and complex projects (Van Zyl & Lazenby, 1999; Habtemichael & Cloete, 2010). Moreover, the light and heavy engineering projects are characterized by the high intensity of buyer and supplier relationships which ensure the success of these industry players (Hines, 1996; Hartmann, 2002; Miocevic & Crnjak-Karanovic, 2012; Bai et al., 2021). The principal rationale for selecting light engineering firms and the heavy engineering industry context of South Africa lies in its inherent nature of resource scarcity and tight competition, which makes it a perfect plot for the study (Koonin, 2020; Salo et al., 2020). Moreover, the engineering industry is developing rapidly and is considered the economic backbone of developing nations (Deshmukh & Haleem, 2020; Madakam & Revulagadda, 2021). It is also heavily affected by COVID-19. The sector is swiftly growing driven by intense competition and high expectations of stakeholders. In the global aspect, empirical evidence testifies to a considerable number of unethical practices followed by the engineering firms, which are affecting the industry's reputation. This situation is amplified by a lack of ethical practices, trust-oriented relationships, and collaboration practices, which ultimately affect the low rate of resource-sharing attitude among the engineering firms and their suppliers (Sohail & Cavill, 2008; Tow & Loosemore. 2009; Jones et al., 2017; Smith et al., 2021).

As mentioned above, firms in this sector need to identify ways to foster their resource-sharing capability, which the current study posits can be achieved through improvising propensity for collaboration (Cortez & Johnston, 2020; Chowdhury et al., 2021). Correspondingly, many firms under light and heavy industry businesses are actively focussing on ethical practices and propensity for collaboration to build and maintain resource-sharing capability during the COVID-19 pandemic in their highly competitive markets (Carroll & Buchholtz, 2014; Chowdhury, Paul, Kaisar, & Moktadir, 2021; Quarshie, Salmi, & Leuschner, 2016; Hudecheck, Sirén, Grichnik, & Wincent, 2020). Within this framework, the study empirically explores some linkages among ethical standards (EST), candid relationships (CAR), ethical perceptions (ETP), propensity for collaboration (PRC), and resource-sharing during the COVID-19 pandemic (RES), as shown in the proposed hypotheses.

3.2. Measures

The measures of the study are adapted from well-established scales

and administered on a five-point Likert scale (see Table 1), which is commonly used to measure the latent constructs in supply chain operations management (Tan et al., 2002; Jharkharia & Shankar, 2006; Dehgani & Navimipour, 2019; Melander and Arvidsson, 2021). To measure ethical standards, this study uses eight items adapted from Bendixen & Abratt (2007). Candid relationships are measured by five items adapted from Bendixen & Abratt (2007). Ethical perceptions are measured by three items adapted from Bendixen & Abratt (2007). The propensity for collaboration is measured by three items adapted from Wang (2022). Resource-sharing is measured by six items adapted from Jiang et al. (2015). Relevant customizations are made based on the feedback of experts to ensure that all the items fit our study context. The details are presented in Table 1.

3.3. Sampling and data collection

The sampling frame refers to the members of the light engineering industries association of South Africa (LEIA) and the Steel and Engineering Industries Federation of Southern Africa (SEIFSA).

Data is collected using a structured questionnaire and disseminated electronically via Google forms to 1000 potential respondents working in the engineering industry in South Africa. The respondents are drawn randomly from LEIA and SEIFSA. The measurement of each item in the questionnaire is done on a Likert 5-point scale with anchors ranging from 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

Preliminary analysis of the pre-test and pilot study is conducted to illustrate both content validity and reliability of the data. The pre-test and pilot test also help verify the psychometric properties of the measurement items. In total, ten management experts from different higher learning institutions are randomly selected and requested to provide necessary feedback on the instructions, wording style, length of each item, and clarity of the overall instrument. The researchers received a number of suggestions from the experts, the relevant feedback was addressed accordingly, and each scale is adapted from the existing studies (P.S.: We discussed above).

To verify the reliability and validity of items under each construct, we conducted a pilot test. This test includes 43 responses. Afterwards, we test the reliability by checking Cronbach's alpha (α). The result appears to be acceptable (Hair et al., 2017). The results allow us to check and validate the questions in the survey and pursue the main data collection. The respondents who participated in the main survey did not take part in the pilot test. The data collection process took place in early 2021 for>4 months. In total 187 were early responders, and 131 were late responders. We personally followed up with the members and encouraged them to participate in the survey. However, no financial or

Table 1
Operationalization of constructs and list of keywords abbreviation.

Constructs	Item No	Items	Sources[1]
Ethical Standards (EST)	EST1	"Our firms have a strict code of ethics"	Bendixen & Abratt (2007)
	EST2	"Our management and staff adhere to the code of ethics"	
	EST3	"We have respect for the confidentiality of suppliers' information and products"	
	EST4	"When there is a product quality problem or a query, I know whom to contact from our supplier base"	
	EST5	"Receiving gifts/incentives is not part and parcel of doing business with our suppliers"	
	EST6	"Contracts are clear and precise in which every-one knows what is expected"	
	EST7	"Family and friends are never given preference when contracts are awarded"	
	EST8	"Staff members of our supplier firms are polite"	
Candid Relationships (CAR)	CAR1	"We practice speedy resolution of problems"	Bendixen & Abratt (2007)
	CAR2	"We respect our suppliers"	
	CAR3	"We maintain transparency with our suppliers"	
	CAR4	"We do clear communication with our suppliers"	
	CAR5	"We do fair but firm negotiations with our suppliers"	
Ethical Perceptions (ETP)	ETP1	"The relationship-related activities are aligned so that both parties may achieve their goals"	Bendixen & Abratt (2007)
	ETP2	"The building and maintenance of open relationships with suppliers that are based on trust and mutual respect"	
	ETP3	"Our corporate reputation is highly regarded by our suppliers"	
Propensity for Collaboration (PRC)	PRC1	"We closely partner with the major suppliers to find a solution to any potential problem related to the strategic raw material"	Wang (2022)
	PRC2	"We share ideas with major suppliers on how to secure the future supply of strategic raw material"	
	PRC3	"It is important to involve the major supplier in changes related to product innovation and the sourcing of alternative raw material"	
Resource Sharing (RES)	RES1	To what extent do your firm and the partner share those resources in the following areas during COVID-19 pandemic: Financial assets	Jiang et al. (2015)
	RES2	Equipment	
	RES3	Patent	
	RES4	Technologies for developing new products or services	
	RES5	Knowledge of production and process know-how	
	RES6	Knowledge of marketing and sales know-how	
Name of the Keywords		**Abbreviation**	**Sources**
COVID-19		COVID-19 stands for coronavirus disease which started in 2019.	https://www.goodrx.com/conditions/covid-19/what-does-covid-19-mean-who-named-it
Business-to-Business (B2B)		Business to Business (B2B) involves a commercial exchange between two parties- i.e., buyers and sellers.	IBM (2001)
CB-SEM		Covariance-based structural equation modeling	Hair Jr. et al. (2017)

[1]The items are adapted from the cited sources.

other kinds of incentives were provided for participation. They willingly shared data as they understood the importance of the survey for academic research. A total of 318 completed responses were collected, representing a response rate of 31.8 %. We used a simple thumb rule to check the minimum sample size, i.e., ten samples per item. The survey instrument consisted of 25 items, and therefore, we required a minimum of 250 samples. In this study, we have met the minimum sample size requirement criterion since we received data from 318 samples. The demographic profile of respondents is presented in Table 2.

3.4. Non-response bias

Non-response bias is one of the vital issues in any form of survey research, which may compromise the scientific results (Groves, 2006; Armstrong & Overton, 1977; Sax et al., 2013). In this paper, we have compared the respondent's early and late responses concerning all the questionnaire items (Armstrong & Overton, 1977). The final sample was further separated into two distinct groups based on the period on which the questionnaires arrived. One hundred eighty-seven heavy and light engineering firms' employees were early responders, and one hundred thirty-one firms submitted their responses a bit late. We conducted t-tests of these two groups and found no statistically significant differences between the responses of the two groups ($p > 0.05$). The result of the findings from the *t*-test shows that no significant non-response bias exists in our dataset.

3.5. Data analysis method

We apply a two-step method of data analysis, including confirmatory factor analysis (CFA) and covariance-depended structural equation modeling (SEM) by using maximum likelihood estimation to examine the proposed conceptual model in a multivariate context (Anderson & Gerbing, 1988). For CFA, the seminal study on the maximum likelihood factor analysis is Jöreskog (1967). Its later extension helps yield the estimation of structural equation systems (SES) (Jöreskog, 1973), which then yields the structural equation modeling (SEM) method, which is one of the most applied methods in empirical research (Jöreskog & Sörbom, 1982; Zhang et al., 2021). We test an estimated set of model parameters that make use of data analysis tools such as covariance-based SEM (CB-SEM) to estimate the set of model parameters. This helped us to ensure the theoretical covariance matrix through the process of structural equations in order to justify the empirical covariance matrix observed within the estimation sample (Reinartz et al., 2009). Note that in the literature, SCM studies also apply the CB-SEM to test and validate the proposed conceptual models (Dubey et al., 2019; Matopoulos et al., 2019). We hence follow this stream of literature and conduct CB-SEM analysis, using AMOS 20.0.

In the first stage of data analysis, CFA is applied to verify the quality of the measurement constructs in terms of unidimensionality, reliability, and validity (Anderson & Gerbing, 1988; Habtemichael & Cloete, 2010). In the second stage, SEM applications are used to test the hypotheses in order to improve the effectiveness of the process used to evaluate the reliability and validity of the multi-item structure of measures and the assessment of structural model relationship (Byrne, 2013).

In the second stage, SEM is applied. SEM facilitates the concurrent evaluation of the structural path and measurement model (Hair et al., 2017). In addition, the SEM approach allows us to study the variance at a higher level in the context of the dependent variable(s), compared to the multiple regressions because it considers both direct and indirect effects (Afthanorhan, 2013; Henseler, 2017). Using SEM, the critical relationships in the hypotheses are evaluated.

Finally, we examine the mediation effect of the construct propensity for collaboration (i.e., as a mediator) in the relationship between ethical perceptions and resource-sharing among engineering firms during the COVID-19 pandemic. The testing process of mediation analysis follows the recommendation of Baron & Kenny (1986). Therefore, the study follows three rules: a) the construct- ethical perception positively influences the mediator (propensity for collaboration); b) the propensity for collaboration positively influences the "dependent variable" (resource sharing during the COVID-19 pandemic), and c) the mediator (propensity for collaboration) positively influences the "dependent variable" (resource sharing during the COVID-19 pandemic) when being regressed in conjunction with the "independent variable" (ethical perception). Providing these rules are met, the effect of the "independent variable" (ethical perception) on the "dependent variable" (resource sharing during the COVID-19 pandemic) must be lower in the third step than in the second step (Baron & Kenny, 1986). In performing the above-mentioned principle of mediation test, the study follows (Hair et al., 2017) and applies a bootstrapped sample distribution of each indirect effect with 5,000 iterations to estimate its 95.00 % bias-corrected confidence interval.

3.6. Fit measures

The study assesses the measurement model with the appropriate range of four fit indices (Sivo et al., 2006; Kenny & McCoach, 2013; Ryu, 2014) categories: 1) absolute fit, 2) relative fit, 3) non-centrality based fit; and 4) parsimonious fit index. The fit indices include: "NFI = Normed fixed index; TLI = Tucker-Lewis index; CFI = Comparative fit index; GFI = Goodness of fit index; PNFI = Parsimony adjusted normed fit index; PCFI = Parsimony-adjusted fit index; RMSEA = Root mean square error of approximation" (Steiger, 2007).

3.7. Common method bias

To avoid method bias, we conduct tests for common method bias (CMB) (as suggested by Podsakoff et al., 2003). For the non-statistical test, we mix all the scale items of the constructs throughout the questionnaire to reduce the likelihood of CMB (Ranaweera & Jayawardhena, 2014; Karikari et al., 2017). Additionally, we also deploy Harman's single-factor test to examine the existence of CMB if single constructs can explain>50 % of co-variance (Podsakoff et al., 2003). The results from the un-rotated principal component exploratory factor analysis revealed that the 1st factor reflects only 29.50 % (i.e., < 50 %) of the variance, supporting that CMB is not an issue in this study (Podsakoff et al., 2003). Besides, the correlation among the construct items is not extremely high, showing the absence of high correlation values in our dataset; CMB is not an issue here (e.g., < 0.90; Pavlou et al., 2007).

Table 2
Descriptive statistics of study participants.

Details of respondents	Number	Percentage
Your Designation		
General Manager/CEO	46	14.47 %
Senior Manager	134	42.14 %
Manager	50	15.72 %
Junior Manager	45	14.15 %
Others	43	13.52 %
Your Work Experience (In Years)		
Above 20	46	14.47 %
10 to 20	184	57.86 %
6 to 9	51	16.04 %
Below 5	37	11.64 %
Nature of Business Activities		
Heavy Engineering Industries	126	39.62 %
Light Engineering Industries	192	60.38 %
Age of your Firm (In Years)		
Above 20 years	196	61.64 %
10 to 20 years	110	34.59 %
Below 10 years	12	3.77 %
Annual Turnover (In ZAR)		
<10 million	0	0.00 %
10–50 million	26	8.18 %
Above 50 million	292	8.18 %

Furthermore, the study also applies a common latent factor test and all indicators of the constructs included in the model produce a value of 0.461. We compute the common method variance which equals 0.212 (21.2 %). As the values fall below 50 %, the likelihood of CMB is not at all an issue (Ranaweera & Jayawardhena, 2014). Finally, the test of multicollinearity for each construct is also examined by applying the variance inflation factor (VIF) analysis. The results show that none of the variables have VIF values that are above the critical value of 3.0. Thus, the resulting multi-collinearity is acceptable (Hair et al., 2013).

4. Data analysis (SEM followed by qualitative Interviews)

4.1. Measurement model

The study applies CFA analysis to assess the measurement model of 25-items, consisting of eight items from the ethical standard, five items from the candid relationship factor, three items from the ethical perceptions construct, three items from the firm's propensity for collaboration factor, and six items from firm's resource-sharing. The results from the measurement model reflect a good fit to the data (please see Table 3). The measurement model also reflects a significant level of standardized loadings for items under each latent construct within the range of 0.70 to 0.80, suggesting that the dataset well meets the criteria for both reliability and convergent validity (Anderson & Gerbing, 1988). The study also assesses the internal data consistency by checking the composite reliability values. All the respective values under each construct exceed 0.70, which shows that the items to measure under each construct have achieved internal consistency (Nunnally & Bernstein, 1994). In addition, we also examine the value of the average variance extracted (AVE) under each construct. All values of AVE exceed 0.50, confirming that the measurement model has assured convergent validity (Hair et al., 1998). Additionally, all the construct's AVE values are greater than the square of their respective correlations, supporting the discriminant validity of the data (Fornell & Larcker, 1981). The overall summary of the findings of the CFA analysis is presented in Tables 3–5.

4.2. Structural model

The result from the measurement model justifies the goodness of fit of the data and allows us to proceed with the subsequent tests. In this stage, we apply a structural equation model to the proposed hypothesized model in Fig. 1. The results from the SEM model well reflect a good fit with the data, and support the hypothesised direct relationships as shown in Table 5 and Fig. 2 [χ^2(df = 38) = 82.054, $p < 0.05$, $\chi 2/df = 2.150$, RMSEA = 0.037, SRMR = 0.019, RMR = 0.016, CFI = 0.950, NFI = 0.948, GFI = 0.965). The study also applies standardized coefficients estimation by using the standard maximum likelihood method to test the hypothesized relationships among the variables. The results show that H1-H4 are all supported by the data (see Table 6 and Fig. 2). To be specific, the statistics for these four hypotheses are listed as follows: H1 ($\beta = 0.348$; $t = 4.437$, $p = 0.001$); H2 ($\beta = 0.351$; $t = 4.873$, $p = 0.001$); H3 ($\beta = 0.287$, $t = 3.798$, $p = 0.001$); H4 ($\beta = 0.390$, $t = 4.964$, $p = 0.001$).

Table 3
Goodness-of-fit measures for the measurement model.

	Measurement Model	Indexes of the Model	Goodness of fit Criterion
Model fit statistics	Chi-square	549.117	
	Degree of freedom	309	
	Normed chi-square	1.706	1.0–3.0
	Incremental Fit Index (IFI)	0.954	>0.90
	Normed Fit Index (NFI)	0.902	>0.90
	Comparative Fit Index (CFI)	0.954	>0.90
	Tucker-Lewis Index (TLI)	0.946	>0.90
	Root Mean SquareError of Approximation (RMSEA)	0.052	<0.05

For testing the indirect effect of the propensity for the collaboration acts construct, we employ the bootstrapping method (Hayes, 2012; Hayes & Scharkow, 2013).

The results of Table 7 show that that the engineering firms' ethical perceptions and resource-sharing during the COVID-19 pandemic are mediated by the propensity for collaboration. Hence, the study accepts H5, which suggests that propensity for collaboration plays a statistically significant mediating role in the relationship between ethical perceptions and resource-sharing during the COVID-19 pandemic.

Meanwhile, as this study explores mediation, the effect of X (ethical perception) on Y (resource sharing during the COVID-19 pandemic) is mediated by another variable M (propensity for collaboration). The variable, propensity for collaboration is mediating the impact of ethical perception on resource sharing during the COVID-19 pandemic. Before analyzing the results of the mediation, we calculate the direct relationship between a firm's ethical perception and resource-sharing during the COVID-19 pandemic. The result will assist us to understand: a) the scenario when the propensity for collaboration acts as the mediator (i.e., ethical perception and resource sharing relationship will not be meaningful for managers and policymakers without considering the propensity for collaboration); and b) the effect in the absence of having the "propensity for collaboration" acting as the mediator (i.e., direct effect between ethical perception and resource-sharing relationship) (see Fig. 3).

We further calculate R^2 for both resource-sharing during COVID-19 and propensity for collaboration. A firm's ethical perception is an independent variable, and SEM analysis has calculated its impact on propensity for collaboration and resource-sharing during COVID-19, which are the dependent variables. The results from the statistical test uncover that engineering firms' ethical perceptions have a positive and significant impact on propensity for collaboration and resource-sharing during COVID-19 (See Fig. 3). In fact, the engineering firms' ethical perception contributes to 29.85 % changes in resource-sharing during COVID-19, which is undoubtedly a critical impact. On the other hand, the engineering firms' ethical perceptions have a 34.62 % statistically significant change in the propensity for collaboration. The results from this analysis reveal that the engineering firms' managerial focus on the relationship between the firm's ethical perception and resource-sharing is mediated by the propensity for collaboration. The path coefficients show that the engineering firm's ethical perception can affect their resource-sharing during the COVID-19 pandemic through propensity for collaboration enhancement. A firm's ethical perception will have a more impact on resource-sharing during the COVID-19 pandemic if heavy and light engineering firms improve their propensity for collaboration acts.

4.3. Qualitative interviews and thematic analysis

In this multi-methodological study, after conducting the quantitative statistical analyses, we move to the qualitative interviews. In this stage, we apply the triangulation technique which is a methodological process that compares quantitative and qualitative methods to yield an in-depth and comprehensive understanding of the study. Therefore, we conduct a post-hoc test via semi-structured interview. Note that this multi-method approach is well-advocated in the SC literature (Siemsen, 2011; Singhal & Singhal, 2012; Behera et al., 2015; Choi et al., 2016).

For the semi-structured interviews, the participants are chosen only from the respondents of the main empirical survey. Since the research scope consists of two categories (heavy and light engineering industries), it is important that the sample selected for qualitative research also demonstrate the representativeness of these categories. Accounting

Table 4
Confirmatory factor analysis (CFA) results.

Factors	Mean	SD	Standardized loading	*t*-Statistic	CR	AVE	MSV	ASV	Cronbach's Alpha
Ethical Standards (EST)					0.891	0.6201	0.334	0.413	0.881
EST1	4.21	0.741	0.777						
EST2	4.20	0.802	0.789	14.297**					
EST3	4.28	0.781	0.761	14.127**					
EST4	4.29	0.753	0.757	14.018**					
EST5	4.56	0.791	0.748	14.015**					
EST6	4.30	0.716	0.784	14.287**					
EST7	4.12	0.741	0.798	14.461**					
EST8	4.07	0.726	0.721	13.712**					
Candid Relationships (CAR)					0.884	0.606	0.313	0.486	0.879
CAR1	4.10	0.813	0.715						
CAR2	3.97	0.750	0.709	11.895**					
CAR3	4.88	0.616	0.814	14.761**					
CAR4	4.19	0.841	0.842	14.869**					
CAR5	4.06	0.768	0.804	13.802**					
Ethical Perceptions (ETP)					0.884	0.718	0.336	0.310	0.885
ETP1	4.42	0.712	0.842						
ETP2	4.12	0.751	0.869	21.012**					
ETP3	4.36	0.718	0.832	18.237**					
Propensity for Collaboration (PRC)					0.866	0.683	0.325	0.313	0.882
PRC1	4.29	0.771	0.872						
PRC2	4.39	0.708	0.798	13.527**					
PRC3	4.31	0.609	0.809	13.689**					
Resource Sharing (RES)					0.886	0.687	0.314	0.489	0.884
RES1	4.27	0.817	0.802						
RES2	4.62	0.789	0.781	19.010**					
RES3	4.57	0.745	0.771	18.123**					
RES4	4.69	0.739	0.762	12.658**					
RES5	4.71	0.712	0.751	11.343**					
RES6	4.59	0.762	0.731	10.082**					

** $p < 0.01$. CR - Construct Reliability; AVE – Average Variance Extracted; MSV - Maximum Shared Variance.

Table 5
Measurement model discriminant validity.

Constructs	Ethical Standards (EST)	Candid Relationships (CAR)	Ethical Perceptions (ETP)	Propensity for Collaboration (PRC)	Resource Sharing (RES)
Ethical Standards (EST)	**0.787**				
Candid Relationships (CAR)	0.448*	**0.778**			
Ethical Perceptions (ETP)	0.238*	0.471*	**0.847**		
Propensity for Collaboration (PRC)	0.398*	0.391*	0.419*	**0.826**	
Resource Sharing (RES)	0.347*	0.462*	0.479*	0.473*	**0.828**

Note: The figures in bold depict the square root of AVE, *Correlation is significant at 0.05 level; N = 318.

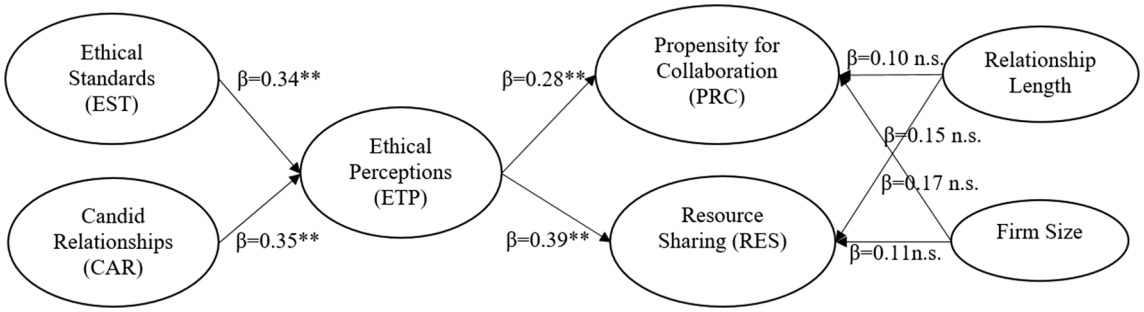

Fig. 2. Hypotheses testing results. Note: n.s. = not significant.

for these conditions, 10 executives (labelled R1 to R10) working in the light and heavy engineering industry in South Africa (SA) were carefully selected for the semi-structured interview (see Online Appendix- A1). We contacted these interviewees via telephone calls and invited them to participate. The interview-based study was followed by the "thematic analysis" with the purpose to achieve triangulation of results (Voss et al., 2002). Note that thematic analysis is a powerful technique for extracting various themes from discussions (Braun & Clarke, 2006; Gupta et al., 2019). We report the details as follows.

4.3.1. Theme A: Influence of buying firm's ethical standards on the ethical perception of suppliers

When analysing the semi-structured data, we find that the majority of interviewees have perceived the urgency of ethical standards

Table 6
Hypotheses testing results.

Path	Standardized Estimate	*t*-Statistic	p-Value	Remarks
Ethical perceptions ← Ethical standards (H1)	0.348	4.737	0.041**	+As hypothesized
Ethical perceptions ← Candid relationships (H2)	0.351	4.873	0.032**	+As hypothesized
Propensity for collaboration ← Ethical perceptions (H3)	0.287	3.798	0.037*	+As hypothesized
Resource sharing during a COVID-19 pandemic ← Ethical perceptions (H4)	0.390	4.964	0.050**	+As hypothesized

** $p < 0.05$.

practices in the supply process. They also believe that the ethical standards may allow firms to shape ethical perceptions. Take R5 and R7 for example. The respondent R5 has highlighted the major challenges in the adoption of an ethical climate under COVID-19. In his words:

> *"The COVID-19 pandemic generated a disaster in the engineering businesses in SA. This country has witnessed the exploitation of locals and corrupt practices in the past; amid this pandemic, multinational engineering companies operating in SA changed their policies related to yearly increments and declared that no increment will happen in this FY due to business losses. Also, the contractual labors working in the factory for the last three years were stopped from coming to work showing a lack of customer orders as the main reason."*

Another respondent R7 confirmed that firms are spending heavily on uplifting ethical standards and monitoring the progress continuously through audits and training programs under COVID-19.

> "*In the last three years, we have spent a large amount of money on ethics audits and ethics training for enhancing our corporate reputation*."

On the other hand, R1 stated that in some instances, the organization's ethical standards between buyers and suppliers are not practiced appropriately. Specifically, the ethical climate in the SA engineering industry, it is found to be unfavourable after the COVID-19 pandemic. In R1′s words:

> "*The buyers from our customer-side decide our orders not only based on the quality of products and good services that we are ready to offer. The fate of any proposal is determined by expensive gifts and dinner invitations that we can afford. On the other side, our local suppliers are full of tantrums and they are always ready to take us for a ride since they are fully aware that few suppliers in this market sells special steel products, which makes it difficult for us to improve profit margins.*"

4.3.2. Theme B: Candid relationships influence ethical perceptions

The interviewees also mentioned that the ethical standards of engineering firms require candid relationships between buyers and suppliers and these further assist in shaping the ethical perception between the two.

Respondent R6 has indicated that:

> *"Due to political and other financial issues, Arcelor Mittal was forced to stop production of steel temporarily in 2020 amid the COVID-19 pandemic. Later they resumed production but there was a huge backlog and therefore, failed to satisfy the market demands. This created stress in the entire supply chain of engineering companies. For instance, due to the shortage of 12 mm steel plates (size: 4 m × 2 m), 6 mm/12 mm round bars, and 6 mm flat bars in the market our production was severely affected. No one was ready to help us with the supply as every company was trying to save their available inventory without caring for others. Luckily, few of our fabricating suppliers had an old stock of steel that they supplied to only selected customers like us operating in the light and heavy engineering industry. While discussing over the telephone, the fabricating supplier clearly told us that are ready to help us in this crisis situation since they have received fair treatment from us in the past (both in terms of information sharing and right procedures) and they have witnessed transparency in our previous business dealings.*"

4.3.3. Theme C: Ethical perception boost collaboration and resource sharing among buyers and suppliers

In the scope of a collaborative approach to manage supply risks and resource-sharing, a number of interviewees stated that ethical practices of buyers are extremely important to attract suppliers for collaboration and gain access to their resources during the COVID-19 pandemic. For instance, respondent R2 said that:

> *"Although we perform tight negotiation with our suppliers for every fabrication job, however, we always avoid ethical issues by adhering to the code of ethics. We also maintained clear communication about the technical specifications, commercial terms, and conditions, and discussed customers' special requirements if any, with our suppliers. During the execution of any big order, for example, recently we awarded an order for a chute fabrication to one of our local suppliers. Later some issues emerged related to engineering drawing. There was also an issue related to*

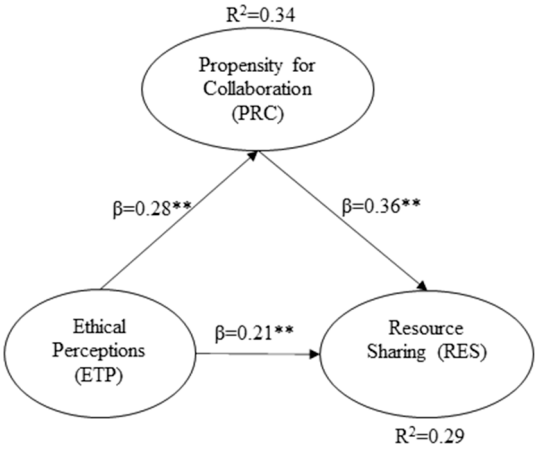

Fig. 3. A structural model with mediation effect. Note: Ethical perceptions → Propensity for collaborations → Resource sharing during COVID-19 ($p < 0.005$).

Table 7
Mediating effects (bootstrapping method).

The indirect effect of Propensity for collaboration on firm's resource sharing during a covid-19 pandemic						
Hypotheses	**Mediators**	**Indirect effect**	**Boot SE**	**Boot LLCI**	**Boot UCLI**	**Results**
H5	Propensity for collaboration	0.358	0.0205	0.3478	0.4216	Significant (Partial Mediation)

Notes: Boot LLCI (The lower limit of the 95% confidence intervals), Boot UCLI (The upper limit of the 95% confidence intervals) for the population value of the suggested indirect effects.

the availability of raw materials in the market. We jointly discussed the matter with our design team and the sales team in presence of our supplier's design team and further arrived at a solution. As part of the solution, the drawing of the chute was revised and further the raw material was decided to be supplied in part by us and the rest by the same supplier (as they had the hardox 50 and 100 mm wear-resistant plates in stock). The chute manufacturing was a very critical project for a local mining customer and despite several challenges, we completed the project within the deadline."

Also, respondent R4 stated that:

"During the COVID-19 pandemic, we faced serious problems related to the availability of fitters and mechanics for attending breakdown of our toolroom machines. Once, our CNC oxyfuel cutting machine faced a breakdown situation and we did not see the mechanic from the OEM's company for almost 3 days. Since we were running production for some urgent orders in our hydraulic presses, therefore, we had to request our local suppliers to arrange the cutting of the plates in their workshop but they refused as their capacity was tight. Luckily, later that day one local supplier agreed and we transported our plates to them and you would be surprised to know that they finished cutting all the plates in the night shift. We were charged normal rates and during the discussion, they said that they might face similar issues in the future, and then they will come to us for assistance. Later, they approached us for borrowing a gas cutting machine and industrial gas cylinders where we helped them out in that situation. We have faith in each other and know that shared equipment and resources will be returned in good working conditions"

Respondent R10 added that:

"No one knows when some small suppliers would be needed during this COVID-19 crisis situation but only a few suppliers help their buying firms knowing that the buying firms have always acted ethically in the past and will remain like that in the future".

4.3.4. Theme D: Focus on collaborative approaches between buyer and supplier in influencing ethical perceptions on resource-sharing during COVID-19

One of the interviewees highlighted multiple challenges faced by engineering firms while adopting an ethical climate amid the COVID-19 pandemic. Supply chain partners in the engineering industry have adopted a collaborative approach to overcome the challenges and achieve short- and long-term gains. Therefore, engineering firms have practiced collaborative strategies in various forms under COVID-19 in order to improve business performance and sustainability. This is reflected in the words of respondent R2:

"*The COVID-19 pandemic attacked the business suddenly without giving much time for preparation. The pandemic resulted not only in the mismatch of supply and demand (due to supply crisis, and changes in customer demands) but also generated ethics related issues in the industry. Businesses in current times violated the ethical codes of practice. This was reflected clearly when suppliers raised the prices of raw materials abnormally high without any prior notice/ or discussion with business partners. Some buyers started taking bribes from suppliers/ contractors for approving supplies of raw materials and daily contract labours. To avoid these kinds of issues the board in our company decided to monitor all procurement activities closely and strategically provided future collaborative opportunities to our key suppliers."*

The next section discusses the insights and implications from both the survey study and interviews.

5. Discussions

5.1. Theoretical implications

Bendixen & Abratt (2007) argued that ethical standards and candid relationships influence the ethical perceptions of the buyer in the mind of the supplier, thereby, impacting supplier performance. Wang & Zhang (2021) proposed that by promoting supplier information and knowledge-sharing, customer entitlement would improve supplier performance.

In this study, we have empirically tested B2B relationship in the context of the engineering industry during the COVID-19 pandemic with a focus on the resource scarcity problem in South Africa. We have found from the proven H1 and H2 that the referred relationships i.e., both ethical standards and candid relationships positively influence the ethical perceptions of the buyers in the mind of suppliers and therefore corroborate with Carter (2000); Bendixen & Abratt (2007) and Kleyn et al. (2012). This is also confirmed by the collected inputs under Theme A and Theme B of the thematic analysis.

Wang (2022) found that the expected resource scarcity positively influences the propensity for collaboration. However, in this study, we have revealed that ethical perceptions of the buying firm in the mind of suppliers would positively influence the propensity for collaboration, particularly during the supply crisis. The findings explain why suppliers prefer to share resources with selected buying firms and not with all of them (Pulles et al., 2016; Moradlou et al., 2022; Patrucco et al., 2022). Prior literature also indicates that transaction-based B2B buyer–supplier dealings will actually fail to work under COVID-19. In our study, H3 and H4 are supported. These two hypotheses are also confirmed by interview inputs from Theme C of the thematic analysis and find support from previous research findings as well (Gullett et al., 2009; Busse, 2016; Brito & Miguel, 2017).

Although the relational view is used as a theoretical lens to support the model in this research, it is important to remember that the relational view is applicable to strategic and bottleneck items. In this study, we have considered the strategic raw material (steel) and framed the research problem; nonetheless, buyers should develop long-term relationships with suppliers for both items. In line with a relational view, the findings also highlight that informal contracts (also called "relational contracts") are important in creating relational rents, rather than focusing on formal "complete" contracts.

Moreover, the findings from present research also reflect that buyers prefer to reduce uncertainties by engaging suppliers in exchange relationships which may reduce environmental uncertainties (Dyer & Singh, 1998; Turkmen, 2013). This is consistent with Bag et al. (2022) who have highlighted that collaborative buyer–supplier relationships can enhance social sustainability under the moderating effect of justice and big data analytics. Zhou et al. (2022) also emphasized the importance of trust and investment costs.

Our study highlights that such exchange relationships are only possible when the ethical perceptions of buyers in the suppliers' minds are high and positive. The resources are more likely to flow from the supplier to the selected buying firms whose corporate reputation is high, which is established by having high ethical standards and candid relationships (P.S.: H5 is supported) (Anderson et al., 2006; Chipp et al., 2007). This is also confirmed by the interview findings in Theme D of the thematic analysis. Apart from that the World Bank collaborating with Sedex Global, other relevant supply chain aggregators like Ecodesk have built an open supply chain platform which enables all the firms globally to fairly upload, track, and share basic environmental, social, and governance (ESG) information by considering any one of the indicators, such as business ethics (Wang, 2014). In addition, the report from OECD (2020) also argues that managing the challenges of COVID-19 crisis requires all the parties of supply chain network for adopting responsible business conduct embedded with ethical practices, collaboration, and resource-sharing practices to address the COVID-19 crisis and avail the short-term and long-term benefits of such an approach. In context of South Africa, C.I.S Engineering, a leading engineering company is seen to be adopting best supplier practices by continuously enhancing their skill base, applying cutting-edge technology and best production processes to fulfil customer requirements and expectations by adhering to

ethics and best business practices (CIS Engineering: Superior Steel Products, 2022).

Therefore, the current study fills the research gap in the literature by highlighting that (a) ethical standards and (b) candid relationships are important to developing ethical perceptions. To a certain extent, our findings indicate that candid relationships are essential in improving ethical perceptions among engineering firms. Also, our study showcases that those ethical perceptions strongly lead to resource-sharing while the propensity for collaboration acts as a mediator. The empirical findings are also supported by the thematic analysis.

5.2. Practical implications

The implications for practitioners are as follows: COVID-19 pandemic has significantly changed the norms and rules in B2B purchasing and supply management. The first wave of COVID-19 created negative effects that disrupted supply chain networks. The second wave greatly affected engineering firms in B2B businesses mainly due to the resultant shortage of raw materials, particularly steel, even bringing production in many plants to a halt. Comparing the production plan and actual production reveals a huge gap caused largely by the shortage of raw material supplies. The business performances of engineering firms, like Tega Industries Africa Pty ltd, Multotec South Africa, Jan Lux, Metso Outotec, FLSmidth, and Combaflex, have been seriously affected. The steel-related crisis situation has actually been discussed in the "Engineering News". Also, the consequence of COVID-19 on South Africa's steel industry has appeared in the Policy Brief: 7/2020. Our findings can thus be of interest to the engineering firms, bringing to focus the need to improve their ethical practices, and achieve priority services from suppliers in times of raw material crisis. Our results also show that non-regular suppliers will share strategic resources during these uncertain times (COVID-19) in case the ethical perceptions of the supplier related to the buying firm are high, and that they share a candid relationship. Additionally, if the supplier provides scarce resources to a buying firm during crisis, it is very likely the latter would turn into potential client for the long-term. Practitioners can leverage our findings to design appropriate strategies, for instance, develop strategic supplier relationship matrix that shows who to consider as a supplier and how much relationship investment is required (determine optimal level) to build a candid relationship. Further, they can develop and implement ethical codes of practice and also formulate the inventory model for strategic raw materials. Action plans could include regularly meeting strategic suppliers, keeping local suppliers alive by continuing business with them even if they are not their preferred clients, practicing fair and ethical trade practices and jointly working with suppliers on social and environmental projects. Action plans should also consider ethical training and audits on a regular basis. Developing a healthy and ethical culture can solve many business problems in engineering business. In sum, we find that the buyers' (i.e., engineering firms') ethical standards and candid relationships influence the ethical perception of suppliers, which further influences the propensity for collaboration and resource-sharing under COVID-19.

[1]Engineering News: https://www.engineeringnews.co.za/article/expedited-change-in-stainless-steel-industry-expected-2020–05-12.

[2]Policy Brief: https://www.tips.org.za/images/TIPS_Policy_Brief_COVID-19_The_South_African_steel_industry_April_2020.pdf.

[3]The items are adapted from the cited sources.

6. Concluding remarks, limitations and future research directions

Using the relational view theoretical lens, this study aims to answer two research questions: Firstly, what is the relationship between ethical standards, candid relationships, and ethical perceptions of the supplier towards the buyer firm? And secondly, how do ethical perceptions of the supplier towards the buying firm influence resource-sharing during the COVID-19 pandemic with the propensity for collaboration playing a mediating role? This study attempts to address these two questions during the COVID-19 pandemic.

With both quantitative survey-based empirical study and qualitative interviews, we derive important findings and implications (see Section 5 for the details).

We believe that this study has added to the existing literature by explaining how the COVID-19 pandemic has shaped buyer–supplier relationships in the B2B setting. This study highlights a very unique business problem and provides solutions for supply chain managers.

Although we have taken all precautions in setting up the research design, the study still has its share of limitations. Firstly, cross-sectional data from a developing country is used in this work. Longitudinal data collection is time-consuming and expensive. Secondly, as uncertainty with regard to COVID-19 remains, we have opted for cross-sectional data. Secondly, the theoretical model is tested based on the data collected only from engineering firm managers. The result may not be true in other industries. We caution readers to interpret the findings in light of the above limitations. Future studies could test the model (a) by considering larger samples from other industries and (b) by examining the model in context to disaster situations arising from nature/man-made situations. We have only removed the surface layer of a real problem. More work is required to understand the new trends in supplier development since the exploitation of suppliers in low- and middle-income countries have cracked their backbone especially of suppliers in tier 2 or tier 3 (upstream SC players) during COVID-19. Future researchers may help redefine supplier development based on the learnings from the COVID-19 pandemic. Last but not least, governments and policymakers may also play a critical role (Xu et al., 2022a, Xu et al. 2022b) in facilitating the development of buyer–supplier relationships during the pandemic. Further studies may consider related topics.

CRediT authorship contribution statement

Surajit Bag: Methodology, Data curation, Conceptualization, Formal analysis, Investigation, Project administration, Resources, Software, Supervision, Validation, Writing - original draft. **Muhammad Sabbir Rahman:** Methodology, Formal analysis, Writing – original draft. **Tsan-Ming Choi:** Writing – review & editing, Supervision. **Gautam Srivastava:** Writing – original draft. **Peter Kilbourn:** Writing – review & editing, Writing – original draft. **Noleen Pisa:** Writing – review & editing, Writing – original draft.

Declaration of Competing Interest

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

Appendix A1

The semi-structured interview questions used in this study are listed below:

1.What are your opinions about the heavy and light engineering industry's implementation of ethical approaches to undertaking business in South Africa?

2.In your opinion, what are the different challenges that a business may face when adopting ethical standards for doing business in South Africa?

3.How does ethical standards and candid relationships shape the ethical perceptions of suppliers in the heavy and light engineering industry in general?

4.How does the intention to the collaboration affect the ethical perception and resource sharing during COVID-19 pandemic with your business partners at large?

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