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Abstract

Purpose – Performance-based contracting (PBC) has been gaining popularity over the years. However, empirical studies investigating the impact of PBC features have been limited. The main purpose of this study is to investigate the effect of PBC features leading to quality investment that fosters financial benefits.

Design/methodology/approach – After examining the validity and reliability of scale items through confirmatory factor analysis, this study tested hypotheses using covariance-based structural equation modeling of survey data from 381 supply, logistics and operations managers.

Findings – The findings reveal the impact of PBC features (joint knowledge generation, goal congruence and incentive alignment) on financial benefits and the mediation impact of quality investment between these features and financial benefits. The upfront investment for quality enhancement was found facilitator of PBC features to achieve financial benefits. The findings also reveal the importance of collaborative communication and information sharing for knowledge generation that leads financial benefits through quality investment. This study shows that PBC governance strengthens the theory of relational view by empowering collaborative efforts and aligning goals and incentives within downstream suppliers for knowledge generation and quality enhancement.

Research limitations/implications – An analysis of PBC features by industry would be very beneficial in differentiating between and more thoroughly understanding the commonalities and differences across various sectors. Investigating how these change across industries would also help identify any bias in PBC implementation.

Practical implications – This study illustrates that it will be practical and beneficial for suppliers to understand the major drivers of quality investment and the relationship between quality investment and the financial benefits of selecting PBC.

Originality/value – Unlike most previous studies, this research contributes to the literature in that it is one of the relatively few examples of empirical research on PBC features. Overall, the findings of this study will improve our understanding of how PBC features enhance upfront investment in quality and improve financial benefits.

Keywords Performance-based contracting, Quality investment, Joint knowledge generation, Goal congruence, Incentive alignment, Relational view

Paper type Research paper

1. Introduction

Today, buyers' expectations for systems that require significant resources for after-sale support have shifted from owning such systems outright to obtaining the desired outcomes from suppliers (Wang *et al.*, 2020). Undoubtedly, procurement and contracting efforts are essential to shaping the fundamental relationship between a buyer and supplier, creating value for both parties regardless of the industry. In the past two decades, a new form of contractual design has emerged for high life cycle

cost systems (Qin *et al.*, 2021) in the defense, health care and transportation industries (Randall *et al.*, 2011). With this contractual governance, buyers aimed to reduce total life cycle costs and increase the availability of such systems for their use (Berkowitz *et al.*, 2005). This form of contracting has been labeled differently in various industries, such as performance-based logistics in public procurement (Randall *et al.*, 2011), power by the hour in the private sector (Ng *et al.*, 2013) and performance-based contracting (PBC) or outcome-based contracting in academic literature (Böhm *et al.*, 2016; Essig *et al.*, 2016; Glas *et al.*, 2018; Selviaridis and Norrman, 2014).

Quite different from transactional contracts, PBC is focused on delivering solutions for end-users, rather than providing goods or services (Mouzas, 2016). Based on the achievement level of the performance rate specified in the PBC, suppliers are either rewarded or penalized (Sols *et al.*, 2008). This incentive structure leads suppliers to take more risks and assume greater responsibility for delivering outcomes targeted in the contract (Berkowitz *et al.*, 2005; Kim *et al.*, 2007; Schaefers *et al.*, 2021; Sumo *et al.*, 2016). Also, in PBC, suppliers have more flexibility in delivering performance objectives that motivates them to develop innovative solutions to reduce the overall cost of achieving targeted outcomes (Kumar and Markeset, 2007). Because suppliers sell an outcome in a PBC, they are responsible for providing support to maintain the system. Therefore, suppliers can increase their profit by avoiding future costs associated with the maintenance and/or repair of any system or product failure (Kim *et al.*, 2007). Therefore, the structure of PBC encourages suppliers to find more long-term solutions through upfront investments to improve the quality and reliability of their systems. Upfront investment in a more reliable system improves the efficiency of the supported system for suppliers (Kim *et al.*, 2007) and brings financial benefits by allowing them to avoid future support costs (Randall *et al.*, 2010; Uvet *et al.*, 2019a, 2019b). Since suppliers cannot generate any revenue through after-sales support services within the PBC arrangements, suppliers prefer upfront investments for quality enhancement to avoid the cost of maintenance, spare parts, etc. in long-term contracts (Randall *et al.*, 2012). Therefore, considering the essential role of quality investment in successful PBC, it is critical to understand the features of PBC that lead to quality investment along the supply chain. However, there is a dearth of studies investigating the major drivers of quality investment among suppliers in PBC. This may be due to a lack of research generating a theoretical framework for PBC features. Previous work has lacked critical insights into the drivers of suppliers' quality investment decisions in PBC (Hypko *et al.*, 2010a; Selviaridis and Wynstra, 2015). Because the literature does not adequately explain drivers of quality investment within the PBC context (Glas *et al.*, 2018), this study contributes to the literature by investigating the PBC features that lead to quality investment, thus fostering financial benefits.

Although there is a risk associated with compensation for upfront investment in quality (Selviaridis and Norrman, 2014), the long-term commitment stimulates suppliers to engage in quality investment (Howard *et al.*, 2016) to avoid future support expenses (Randall *et al.*, 2015) that might emerge within the contract term. Without understanding the impact of PBC features on quality investment, it would be difficult to achieve successful PBC arrangements. To fill this gap, we posit that the major features of PBC (Patra *et al.*, 2019; Uvet *et al.*, 2020), which are joint knowledge generation, goal congruence and incentive alignment, are the primary drivers of quality investment, leading to financial benefits in PBC. PBC governance creates an environment that encourages suppliers to align their goals with the outcomes specified in the contract (Ng *et al.*, 2013). In PBC, transferring the risk from the buyer to the supplier (Howard *et al.*, 2016; Glas *et al.*, 2019) facilitates information sharing (Kleemann and Essig, 2013) through communication channels established for knowledge creation (Randall *et al.*, 2010), which is a critical source of innovative value offerings in PBC (Randall *et al.*, 2015) and quality investment for product development (Yu-Xiang and Shiu-Wan, 2013). Thus, the role of collaborative communication and information sharing among suppliers were investigated in the proposed model as an antecedent of knowledge generation. Accordingly, this study focused on the following research questions:

RQ1. What is the impact of PBC features – goal congruence, incentive alignment and joint knowledge generation – on quality investment?

RQ2. What is the impact of PBC features – goal congruence, incentive alignment and joint knowledge generation – on financial benefits of PBC?

RQ3. How does quality investment mediate the impact of these features on the financial benefits of PBC?

Additionally, although there are a substantial number of studies on PBC that use a variety of methodologies, there is limited empirical research using quantitative investigation (Glas *et al.*, 2018; Holmbom *et al.*, 2014; Hypko *et al.*, 2010a; Selviaridis and Wynstra, 2015). This research contributes to the PBC literature by using survey methodology to develop and test a research model for successful PBC arrangements. Additionally, the findings will increase our understanding of the importance of quality investment in PBC features and the financial benefits of this contracting approach. Consequently, we explored the mediating effects of quality investment on PBC features and the resulting financial benefits. The findings will also enhance our appreciation of the linkage between collaborative communication and information sharing, and between information sharing and joint knowledge generation among suppliers engaging in the PBC.

The remainder of this research is organized as follows. First, we examine the related literature on PBC to establish the basis for this study in Section 2. After providing a theoretical background and research model in Section 3, we present the research design and methodology in Section 4. The results of the data analysis and discussion of results are reported in Section 5 and Section 6. Finally, we discuss the theoretical and managerial implications and limitations of this study and make suggestions for future research avenues in Section 7.

2. Literature review

This section provides a review of existing PBC literature, with a focus on the fundamental features of this contracting governance (Table 1). The conceptual papers in PBC were focused on the investigation of enablers, barriers and features of

Table 1 Findings of PBC literature review

References	Major findings	References	Major findings
Kim *et al.* (2007)	They found that suppliers' actions are observable (the first-best solution) when supplier and customer are risk neutral	Kumar and Markeset (2007)	They found PBC leads a win-win situation for both parties by reducing total cost while improving service quality
Sols *et al.* (2007)	They proposed that successful implementation of PBC depend on the appropriate selection of the metrics	Sols *et al.* (2008)	They proposed specification of incentives for various performance metrics to more accurately monitor the overall performance of supplier
Ng *et al.* (2009)	They revealed that outcome-based contracts were drivers for value coproduction in service delivery for complex systems	Straub (2009)	He highlighted the importance of long-term contracts and an early supplier involvement for product and process improvements to decrease total costs
Kim *et al.* (2010)	They found that PBC incentives suppliers to invest in service capacity. They also found that when a system is highly reliable, implementation of PBC may be least efficient	Hypko *et al.* (2010a)	They revealed importance of independent service providers with ability of maintenance support for success of PBC
Hypko *et al.* (2010b)	They found that buyers increase their dependence to suppliers while getting more innovative technologies with a decreased cost	Randall *et al.* (2010)	They proposed antecedents for value creation in PBC that have an impact on amount of knowledge and resources to achieve performance objectives
Mirzahosseinian and Piplani (2011)	They found that to achieve targeted availability level, the supplier should increase the reliability of product, rather than increase the base stock level of the spare parts under the PBC	Randall *et al.* (2011)	They found the significant impact of antecedents of investment climate, relational exchange, leadership, and business sector on effectiveness of PBC
Guajardo *et al.* (2012)	They found that reliability of products is much higher (25%–40%) under PBC than under time and material-based strategy	Jin and Wang (2012)	They showed that under a longer service agreement in PBC, suppliers as OEMs are eager to invest in reliability improvement
Randall *et al.* (2012)	They found that while long-term PBC enable to translate knowledge into innovation and reliability improvement, short-term PBC enable to improve existing logistics processes	Kleemann and Essig (2013)	They highlighted the importance of interest alignment and cooperative relationship to integrate sub-suppliers towards PBC objectives
Glas *et al.* (2013)	They proposed a portfolio to show which logistics tasks should be outsourced using PBC and to what extent is a private-sector provider willing to agree to a PBC	Sols and Johannesen (2013)	They identified an alignment of performance metrics with goals and incentives with performance achievements, life-cycle support perspective, partnerships, performance bonus warranties as an enablers of PBC
Ng *et al.* (2013)	They found the importance of behavioral and information alignment between suppliers to achieve outcomes in PBC	Caldwell and Howard (2014)	They found that within the PBC, buyer seeks innovation while transferring the responsibility to the contractor who coordinates supply chain
Holmbom *et al.* (2014)	They proposed that measurements of performance metrics and incentive mechanism are significant features of PBC	Selviaridis and Norrman (2014)	They found four influencing factors that have an impact on suppliers' willingness to take the PBC-induced risk. These are performance attributability; relational governance; balanced incentives; and suppliers' power to transfer risk to sub-suppliers
Bakshi *et al.* (2015)	They found that customers are eager to accept PBC when mature technologies available for acquired products rather than products with newly developed technology	Selviaridis and Wynstra (2015)	They addressed importance performance requirements and assessment, the effects of incentives on supplier strategies and risks allocation between buyers and suppliers in PBC
Randall *et al.* (2015)	They found that aligned goals bridge interfirm relationships to create innovative solutions in PBC	Mouzas (2016)	He found that sharing knowledge deepens supplier communication and lead to improvement of contractual objectives
Sumo *et al.* (2016)	They found that PBC provides autonomy in their operations that enables supplier-led innovation	Glas and Kleemann (2017)	For the successful PBC, they found the importance of explicit and measurable performance indicators and collaborative culture to utilize core assets
Kim *et al.* (2017)	They found that PBC motivates suppliers to make the upfront investment for reliability improvement by powerful incentives	Glas *et al.* (2018)	They concluded that the necessity of researches on performance management in PBC for its theoretical framework and empirical analysis
Nowicki *et al.* (2018)	They found that investment in knowledge and skills will lead to creation of value that enables life-cycle affordability in PBC	Uvet *et al.* (2019a, 2019b)	They found that long-term PBC motivates suppliers for reliability investment and explored that increasing spare parts have little impact for achievement of targeted availability rates in PBC
Glas *et al.* (2019)	They found that risk perception of buyers significantly different based on PBC experience	Uvet *et al.* (2020)	They found the importance of supply chain collaboration for successful PBC arrangements

PBC. In these papers, authors highlighted the importance of aligning goals with measurable performance metrics (Patra *et al.*, 2019), the team environment and partnerships to generate innovative solutions (Gustafsson *et al.*, 2010; Randall *et al.*, 2014; Randall *et al.*, 2015), as well as the necessity of effective reward mechanisms and payment schemes (Sols *et al.*, 2007), the transferring of responsibility and risks to the supplier (Caldwell and Howard, 2014; Schaefers *et al.*, 2021; Selviaridis and Norrman, 2014) and the importance of the life cycle support perspective in PBC (Berkowitz *et al.*, 2005; Nowicki *et al.*, 2018; Randall *et al.*, 2012). On the other hand, case studies and experimental research have been conducted to investigate the success of PBC in which the authors emphasized the importance of long-term contracts (Mouzas, 2016; Randall *et al.*, 2012) to enable suppliers to translate knowledge into innovation and monetize their investment efforts (Kratz and Diaz, 2012; Randall *et al.*, 2011; Randall *et al.*, 2015; Sumo *et al.*, 2016). Moreover, the importance of early supplier involvement in product improvement (Kleemann and Essig, 2013; Randall *et al.*, 2010) and supplier collaboration (Ng *et al.*, 2009; Uvet *et al.*, 2020) for these investments were underscored. Additionally, the impact of PBC contract features, such as contract length, reliability investment and spare parts inventory level on PBC benefits, were investigated by using mathematical models. In these studies, authors found greater benefits from reliability investment than from increasing spare parts to achieve availability of systems that defined as a performance objective (Bakshi *et al.*, 2015; Jin and Wang, 2012; Kim *et al.*, 2010; Kim *et al.*, 2017). Furthermore, the importance of longer contract terms stressed for suppliers' opportunity to compensate their investments to increase the quality of products/components (Jin *et al.*, 2015; Uvet *et al.*, 2019a). Additionally, the investment in quality was determined to reduce the total service cost for suppliers while increasing the availability of the system in PBC (Uvet *et al.*, 2022).

With regard to delivering performance objectives, several studies in the extant PBC literature have examined the trade-off between increasing spare parts and reliability growth (Selviaridis and Wynstra, 2015). The authors found that increasing the spare parts inventory does not necessarily have a major impact on performance objectives defined according to the availability rate of the system (Jin *et al.*, 2015; Kim *et al.*, 2007; Uvet *et al.*, 2020). Therefore, considering the flexibility of suppliers in delivering performance objectives while also minimizing overall support cost, they are more motivated to increase the reliability of their systems by investing in their quality (Guajardo *et al.*, 2012; Kim *et al.*, 2017). Discussions in the PBC literature highlight the significance of quality investment through reliability growth to achieve performance objectives (Bakshi *et al.*, 2015; Kim *et al.*, 2010; Kim *et al.*, 2017; Uvet *et al.*, 2019b). Upfront investment to increase product quality helps reduce the overall costs associated with after-sales support. The review of research related to reliability/quality investment in PBC revealed that there is a lack experimental studies analyzing quality investment and its role in facilitating financial benefits from PBC. In a study examining quality investment, Mirzahosseinian and Piplani (2011) found that enhancing the durability of components is required to achieve performance outcomes such as system availability. Additionally, in their game theory model, Kim *et al.* (2017) demonstrated that the incentive structure of PBC motivates suppliers to make upfront investments in high-quality products, generating savings by reducing acquisition and holding costs for spare assets. Ulloa *et al.* (2018) echoed these findings, showing how initial investments and coordination could improve the efficiency of performance-based maintenance contracts. These results are consistent with the experimental study by Guajardo *et al.* (2012), which was based on data from the Rolls-Royce Company. Their findings indicated that under PBC, product reliability was 25%–40% higher than in traditional contracts. Randall *et al.* (2010) underscored the significance of knowledge generation in inter-firm supply chain relationships for successful PBC. Randall *et al.* (2012) also argued that the function of knowledge generation in a supply chain was to innovate on efforts to improve quality in PBC. Consistent with this discussion, Jin *et al.* (2015) found substantial evidence of willingness among suppliers to engage in reliability investment under longer PBC terms. These studies highlight the significance of quality improvement through the employment of mathematical modeling. These upfront investments translate into future savings when delivering outcomes by decreasing maintenance, repair and holding costs for spare parts (Kim *et al.*, 2007; Randall *et al.*, 2010). However, increasing the reliability of a system that provide desired outcomes requires the collaboration of key suppliers to create value offerings (Iyer, 2014). Furthermore, contracting features are of critical importance for motivating suppliers' actions. For instance, while suppliers may be more willing to improve after-sales support and logistics systems in the short term, they are more likely to make an upfront investment to increase the quality of products in the long term (Randall *et al.*, 2014). However, the PBC literature lacks experimental studies investigating how PBC features lead to quality investment. Therefore, in the present research, we examined the impact of PBC features (i.e. joint knowledge generation, incentive alignment and goal congruence) on quality investment and the mediating role of quality investment between PBC features and financial benefits.

Considering the importance of the life cycle support perspective in performance-based value offerings (Kindström *et al.*, 2012), finding innovative approaches and providing high impact solutions (Randall *et al.*, 2015) to delivering performance outcomes at a lower cost requires collaboration with key suppliers (Uvet *et al.*, 2020). The literature has shown that reliability investments are effective as long as they increase the quality of the product (Randall *et al.*, 2011). This quality enhancement can be achieved through team innovation that requires the exploration of new knowledge with suppliers (Randall *et al.*, 2015). Although numerous studies exist in literature with regard to PBC (Glas *et al.*, 2013; Hypko *et al.*, 2010a; Selviaridis and Wynstra, 2015), there is still limited empirical work investigating the impact of PBC features that lead to highly reliable products. This study, drawing on the findings of previous research, fills this gap and investigates PBC features' impact on financial benefits through quality investment.

3. Theoretical development and research model

The theoretical basis of this study was the relational view (RV) perspective because of the importance of supplier collaboration

under PBC (Uvet *et al.*, 2020). Such collaboration promotes early involvement in product development (Kleemann and Essig, 2013; Melander and Tell, 2019) and motivates the creation of more reliable and high-quality products/systems and innovative solutions (Sumo *et al.*, 2016) for delivering performance objectives. Studies examining the effectiveness of PBC (Randall *et al.*, 2011; Mouzas, 2016) and significance of quality investment (Bakshi *et al.*, 2015; Kim *et al.*, 2017) have emphasized the importance of RV to the development of innovative solutions (Ligthart *et al.*, 2016). RV highlights four constructs for effective inter-organizational relationships: effective governance, knowledge and information sharing, coordination mechanisms and investment in complementary assets (Dyer and Singh, 1998). RV argues that critical resources can be attained through collaborative partners (Dyer and Singh, 1998; Dyer *et al.*, 2018). Based on RV, investment in relations-based resources, the sharing of knowledge and capabilities and establishment of useful governance can lead to the attainment of relational rents to increase value offerings for customers (Crick, 2020; Dyer and Singh, 1998; Lavie, 2006). The features of PBC presented in the above literature review, including an upfront investment in quality (Ulloa *et al.*, 2018), innovative solutions (Essig *et al.*, 2016), the sharing of knowledge and skills (Nowicki *et al.*, 2018) and the collaboration of suppliers (Uvet *et al.*, 2020) all lie within the central concepts of RV. In the PBC context, suppliers can achieve a reliable improvement in their products/systems only if they have the core competency, knowledge base and skills needed for product development. Considering the necessity of complementary resources, capabilities and knowledge (Lockett *et al.*, 2009) when making upfront investments in more reliable high-quality products/systems, RV provides a means of explaining how suppliers' relationships will be shaped based on their collaboration in the delivery of performance objectives (Crick, 2020). Additionally, RV supports information and knowledge exchange between suppliers, engendering innovative outcomes (Fisher and Qualls, 2018; Patrucco *et al.*, 2022). It is the process of comprehending and retaining information, experience and know-how that leads to the creation of knowledge (Cortez and Johnston, 2019).

As in RV, PBC arrangements encouraging interactions among suppliers through collaborative communication and information sharing enable knowledge generation that leads to innovative solutions. Aligning the goals of suppliers toward performance objectives motivates them to collaborate on and invest in value-added activities such as quality investment, resulting in financial benefits. Value propositions for achieving targeted outcomes require collaborative efforts along the supply chain (Uvet *et al.*, 2020). This collaboration enables access to vital sources of knowledge and skill (Liinamaa *et al.*, 2016) for product development (Sundquist and Melander, 2021). The coordination of processes along the supply chain and around similar goals is critical for making investment decisions that will secure a competitive advantage (Cao and Zhang, 2011). Despite the claim that successful implementation of PBC leads to highly reliable quality products/systems, empirical research on the features of PBC has been limited, especially with regard to supplier-led quality investment. We characterize the various PBC features: joint knowledge generation, incentive alignment and goal congruence. All are strongly linked to upfront investment for quality improvement. These characteristics specifically urge suppliers to integrate with one another and innovate for better solutions. We also argue that information sharing and collaborative communication among suppliers are significant drivers of knowledge generation, as has been discussed in the literature addressing supply chain collaboration and integration (Cao and Zhang, 2010; Chen *et al.*, 2013; Glas and Kleemann, 2017; Haensel and Hofmann, 2018; Li *et al.*, 2019; Shu-Hsien *et al.*, 2022).

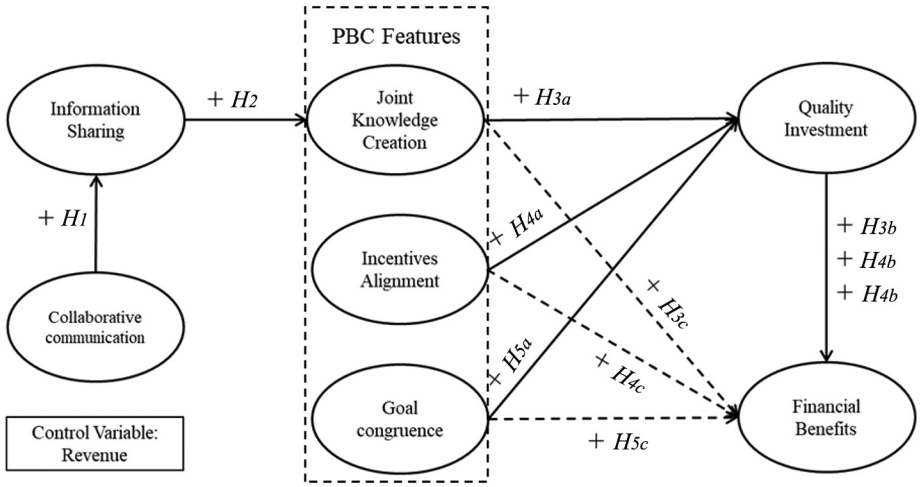
Considering the studies addressing supply chain collaboration and the advantages offered by such efforts (Cao and Zhang, 2011), we emphasize the PBC features requiring alliances among suppliers to ensure quality improvement for financial benefits. Cao and Zhang (2010) explored quality as a collaborative advantage along the supply chain, which is considered a major success factor in PBC arrangements. A PBC incentive structure with a reward mechanism and the achievement of a particular goal to obtain a reward (Sols *et al.*, 2007) motivate suppliers to collaborate under a successful PBC. Also, as knowledge transformation for innovation is important in PBC (Randall *et al.*, 2010), we added knowledge generation to our model as a critical PBC feature leading to financial benefits through quality investment. Through our research model, we examined the mediation impact of quality investment between three key PBC features (joint knowledge generation, goal congruence and incentive alignment) and the consequent financial benefits (Figure 1). Additionally, we identified the impact of collaborative communication on joint knowledge generation through information sharing among suppliers. Thereafter, by specifically examining these three features, we were able to determine how they can lead to quality investment and how that investment creates financial benefits under PBC.

Collaborative communication is the conveyance of messages through communication channels established between suppliers (Cao and Zhang, 2011). The existence and effectiveness of communication channels among suppliers form the fundamental basis of collaborative communication through the supply chain, enabling information sharing. Collaborative communication efforts among suppliers facilitate information sharing, which leads to knowledge exploration throughout the supply chain (Gesell *et al.*, 2022). We, therefore, propose the following:

H1. Collaborative communication is positively associated with information sharing.

Information sharing entails the sharing of timely, relevant and correct information among suppliers (Cao and Zhang, 2011; Sheu *et al.*, 2006; Uvet *et al.*, 2020). Throughout the supply chain, *information sharing* is critical to improving responsiveness and generating new knowledge for use in efficiently delivering performance objectives and avoiding future costs. Thus, information sharing among suppliers is a vital requirement for joint knowledge generation (Fisher and Qualls, 2018; Kleemann and Essig, 2013). It includes suppliers' efforts to explore new knowledge along the supply chain (Bhatt and Grover, 2005; Cao and Zhang, 2011). Shared information is a key factor in PBC for mitigating challenges and risks (Ng and Nudurupati, 2010), and the sharing and alignment of information are critical to achieving desired outcomes

Figure 1 Research model and hypotheses



(Ng *et al.*, 2013) and finding innovative solutions (Preikschas *et al.*, 2017). Essentially, information sharing among key suppliers is necessary for knowledge generation to achieve performance objectives. We, therefore, propose the following:

H2. Information sharing is positively associated with joint knowledge generation.

In this study, PBC benefits were investigated from the viewpoint of the suppliers. Financial benefits constitute how suppliers increase their profits by avoiding future costs associated with delivering performance objectives. The pay-for-performance scheme in PBC prompts suppliers to find innovative solutions to reduce their sustainment costs for products/systems, leading to increased profits. Studies based on cases in the defense industry have shown cost savings for after-sales support services and operating costs (Boyce and Baghart, 2012). These operations and maintenance savings can be found in a variety of industries, such as energy (Wang *et al.*, 2020), defense (Boyce and Baghart, 2012), transportation and health care (Nowicki *et al.*, 2018). Furthermore, Randall *et al.* (2010) proposed that knowledge-based value creation is a driver of financial performance. The reflection of this value creation can be seen in process improvements in short-term arrangements and quality improvements in long-term arrangements (Nowicki *et al.*, 2018; Randall *et al.*, 2012).

Quality investment refers to suppliers' investment in long-lasting, reliable, and high-quality products. Having highly reliable products has been discussed in the PBC literature as being a significant factor in avoiding expenses related to after-sales support services and spare parts inventory (Jin and Wang, 2012; Kim *et al.*, 2017; Uvet *et al.*, 2020). Suppliers can avoid these costs by investing in the reliability of products/systems. Additionally, this upfront investment will ensure the high availability of products/systems, which is a commonly agreed-upon performance metric (Patra *et al.*, 2019) used in PBC. In long-term contracts, suppliers are eager to make upfront investments by translating knowledge into innovation (Randall *et al.*, 2012), maximizing quality and minimizing the corresponding total support cost needed to achieve performance objectives. Therefore, *H3*, *H4* and *H5* examine the mediation effect of quality investment among the joint knowledge generation, incentive alignment and goal congruence features of PBC, and the resulting financial benefits.

Joint knowledge generation refers to the efforts of suppliers to explore new knowledge along the supply chain (Bhatt and Grover, 2005; Cao and Zhang, 2011). Value creation depends on the knowledge attained from inter-firm supply chain relationships (Fisher and Qualls, 2018; Ng *et al.*, 2009; Randall *et al.*, 2010; Randall *et al.*, 2012). The success of suppliers in achieving desired performance targets is directly associated with the knowledge and skills of all supply chain partners. Innovative solutions highlighted in the PBC literature (Randall *et al.*, 2015; Selviaridis and Wynstra, 2015; Sumo *et al.*, 2016) for delivering performance requirements were derived from knowledge exploration and the application of new knowledge by supply chain partners. Therefore, knowledge generation has become a necessary condition for innovative solutions (Randall *et al.*, 2012) and investment decisions within the PBC context. In PBC, suppliers can avoid the future cost of maintaining the system for buyers by investing in the quality and reliability of their products (Kim *et al.*, 2007). According to the PBC literature using mathematical models (Bakshi *et al.*, 2015; Kim *et al.*, 2010), there has been a 25%–40% increase in the reliability of products (Guajardo *et al.*, 2012) as well as a significantly positive impact from this increase on financial benefits. Therefore, we propose the following:

H3. Quality investment mediates the positive effect of joint knowledge generation on the financial benefits of PBC.

Incentive alignment refers to suppliers having the same motives for benefits and awards (Cao *et al.*, 2010; Cao and Zhang, 2011). The design of PBC monetary incentives, which are created by the pay-for-performance link (Glas *et al.*, 2018) and impact of these incentives on suppliers' decisions regarding ways to achieve their performance objectives are the most critical aspects of PBC design (Mouzas, 2016; Selviaridis and Wynstra, 2015). PBC creates a powerful incentive among suppliers to invest in enhancing reliability (Kim *et al.*, 2017) and fostering innovation (Essig *et al.*, 2016). Furthermore,

while suppliers seek to achieve performance objectives and minimize their total support costs, they also have a powerful incentive to build long-lasting and durable products/systems that require minimal after-sales support, thus, minimizing or even eliminating future costs. Considering the incentive structure of the PBC reward mechanism associated with the achievement of targeted outcomes, incentive alignment appears to be a major enabler of quality investment decisions in PBC. This upfront investment in quality enables suppliers to avoid future costs, thus, increasing their revenue. Essentially, because of the PBC payment regime, there is incentive alignment among key suppliers, which is a major driver of upfront investment in increasing the reliability of their products/systems to achieve PBC performance objectives. The result is an increase in revenue from receiving rewards and avoiding future after-sales support costs. We therefore propose the following:

H4. Quality investment mediates the positive effect of incentive alignment on the financial benefits of PBC.

Goal congruence refers to the perception of each supplier regarding attaining goals through the achievement of performance objectives (Cao and Zhang, 2011; Selviaridis and Wynstra, 2015). The PBC incentive structure for the desired performance objectives leads suppliers to aim at the same target. This structure creates an environment in which all benefit from collaboration with one another. Today, increasing the quality of any system requires collaborative efforts along the supply chain. Considering the necessity of this collaborative effort to improving the reliability and durability of any product/system, aligning the goals of suppliers is especially critical in PBC. The incentive structure of PBC enables alignment of such goals to achieve performance objectives, also encouraging suppliers to make upfront investments. The importance of this initial investment and criticality of coordination for successful PBC were evident in the recent study by Ulloa *et al.* (2018). Based on the above discussion, we argue that goal congruence among key suppliers positively influences the financial benefits from quality investment by facilitating the integration of resources, knowledge and capabilities throughout the supply chain. Hence, we propose the following:

H5. Quality investment mediates the positive effect of goal congruence on the financial benefits of PBC.

Although various aspects of PBC have been examined in many studies, based on the above arguments, this study hypothesizes a positive impact of the PBC features of joint knowledge generation, incentive alignment and goal congruence on the financial benefits from PBC through quality investment. Moreover, we examine the impact of collaborative communication among suppliers on information sharing and information sharing on joint knowledge generation (Figure 1).

4. Research design and methods

We used an online survey to empirically test the hypotheses of interest. The details of the survey instrument, sampling, data analysis for instrument validity and reliability and hypothesis testing are discussed in the following sections.

4.1 Survey design

The survey consisted of two parts. First, we collected background and demographic information (i.e. participants' age, gender, job function, job title and industry) (Table 2). Screening questions were used to limit participation to only those whose job functions include operations management, supply chain management and logistics management in manufacturing companies. Screening questions were also used to limit

Table 2 Demographics

Demographics	N (381)	%
Job function		
Operations management	164	43
Supply chain management	143	37.5
Logistics management	74	19.5
Job position		
Member of management/executive board	25	7
Senior director/director	21	6
Senior manager	121	32
Supervisor	65	17
Manager	149	39
Experience (years)		
1–5	172	45
6–10	138	36
11–15	47	12
16+	23	6
Age		
18–25	45	12
26–32	149	39
33–40	120	31
41–47	32	8
48+	35	9
Education		
High school graduate, diploma or the equivalent	29	7.6
Some college credit, no degree	98	25.7
Bachelor's degree	186	48.8
Master's degree	60	15.8
Doctorate degree	8	2.1
Firm size		
Less than 250 employees	123	32
Between 251 and 500 employees	107	28
Between 501 and 750 employees	30	8
Between 751 and 1000 employees	58	15
Greater than 1001 employees	63	17
Industry		
Automotive	114	30
Aviation/Defense	103	27
Electronic/optical devices	72	19
Metalworking	50	13
Consumer goods	22	6
Chemicals	14	4
Oil/gas/minerals	3	1

participation to managers and those of higher employment level. In the second part, we collected data for the constructs. To increase the reliability of the responses, we used attention check questions throughout the survey that detected whether respondents were answering without reading the questions.

In this study, the scale items of the constructs were adapted from the existing literature on supply chain collaboration and PBC. The scale items for incentive alignment, joint knowledge generation, quality investment, goal congruence, information sharing and collaborative communication were adapted from Cao *et al.* (2010), Cao and Zhang (2011) and Uvet *et al.* (2020). The 29 scale items shown in Table 3 were used in this study. There were three items for the construct of goal congruence, three items for incentive alignment, six items for joint knowledge generation, five items for quality investment, four items for collaborative communication, three items for information sharing and five items for financial benefits of PBC. The study used a five-point Likert-type scale, with "1" indicating "strongly disagree" and "5" indicating "strongly agree."

4.2 Sampling

We used Amazon Mechanical Turk (MTurk) to conduct the Qualtrics survey. The use of the MTurk platform has been validated (Buhrmester *et al.*, 2011) and also considered an appropriate platform for reaching professionals with work experience in operations management, logistics and supply chain management (Knemeyer and Naylor, 2011). Furthermore, the quality of MTurk data has been evaluated as better or equal to that of other survey platforms (Duan *et al.*, 2021; Kees *et al.*, 2017). Many impactful studies have accessed their participants through MTurk (Chernev and Blair, 2015; Oakley *et al.*, 2021; Sussman and Olivola, 2011; Ta *et al.*, 2018; Zhu *et al.*, 2018). The screening question was used to limit participation to specific job functions related to supply chain, logistics and operations management. Also, to increase the quality of responses, we used attention-check questions (Schoenherr *et al.*, 2015). As an attention check question, we asked participants the question "For an attention check, please select somewhat disagree". If a participant failed to answer this question, the survey terminated immediately. In the data collection process, 141 participants failed to pass the attention check question out of 548 participants, and only 407 participants completed the survey. Also, we removed 26 responses (6%) from the analysis during the data cleaning process because of completion times and straight-line responses. The responses that had a short completion time (less than 2 min) to fully read and answer the survey questions were removed from the analysis. Also, these responses had a straight-line response that raised a red flag for these participants. So, we removed them from the final analysis and used only 381 responses.

Regarding the job function of the participants, operations management represented 43%, supply chain management 38% and logistics management 19% of the total 381 participants. Moreover, 71% of participants held the job title of manager (39%) or senior manager (32%). The proportions of other job titles were: supervisor (17%), senior director (6%) and member of management/executive board (6%). Based on the participants' experience level with supply chain management, out of 381 participants, 6% had more than 16 years, 12% between 11 and 15 years, 36% between 6 and 10 years and 45% between one and five years. Most respondents worked in the automotive or aviation/defense industries, accounting for 30% and 27%, respectively. Other industries represented in this study included: electronic/optical devices (19%), metalworking (13%), consumer goods (6%), chemicals (4%) and oil/gas/minerals (1%). Regarding the academic backgrounds of participants, the majority (49%) had bachelor's degrees, 34% had high school diplomas with some college credits, 16% had master's degrees and only 2% had PhDs. Moreover, 56% of respondents were male, and 44% female.

5. Data analysis

The common method bias (CMB) was checked by using Harman's single-factor test (Podsakoff *et al.*, 2003) and common latent factor (CLF). For the convergent validity, construct reliability (CR) and discriminant validity of the instruments, the confirmatory factor analysis (CFA) was used. As covariance-based structural equation models (CB-SEM) provide simultaneous analysis of observed and latent variables and enable the simultaneous testing of multiple mediation relationships (Zhang *et al.*, 2021), we conducted a CB-SEM using IBM AMOS 27 for inferential analysis. The comparative fit index (CFI), root mean square error of approximation (RMSEA), normed fit index (NFI), non-NFI, goodness-of-fit index (GFI), adjusted GFI (AGFI) and normed Chi-squared value were used to assess the overall model fit (Bentler, 1990; Byrne, 2001; Hair *et al.*, 2010; Jöreskog and Sörbom, 1986).

5.1 Common method bias

For examining CMB, Harman's single-factor method was applied via exploratory factor analysis (Zhao *et al.*, 2011). The results of Harman's single-factor test of CMB (Podsakoff *et al.*, 2003) indicated that seven distinct factors with eigenvalues above 1.0 account for 69% of the total variance. Less than half of the total variance was explained by the first factor, which represented only 37%. Because the major portion of the variance was not explained by any single factor, there was no significant CMB in these data. In addition to Harman's single factor method, we also used CLF to test for CMB. The calculated common method variance was 23%, which is considerably below the threshold of 50% (Eichhorn, 2014). Therefore, just as Harman's single-factor method suggested, the CLF technique also indicated that there was no significant CMB in these data.

5.2 Convergent validity and reliability

To test for internal consistency, we calculated Cronbach's α for each construct. All values for Cronbach's α were above the suggested threshold of 0.70 (Fornell and Larcker, 1981). These results support the reliability of the constructs. In addition to the Cronbach's alpha, we computed the CR using the CFA model (Fornell and Larcker, 1981; O'Leary-Kelly and Flores, 2002). The indicators for the measurement model (i.e. CFI: 0.961, GFI: 0.908, AGFI: 0.884, RMSEA: 0.042, NFI: 0.907, IFI: 0.954 and normed Chi-squared: 1.655) demonstrated a satisfactory model fit (Table 3) (Anderson and Gerbing, 1988; Bagozzi and Yi, 1988). Accordingly, reliability was determined

Table 3 Confirmatory factor analysis results

Construct	Items	Loadings	*t*-value
Goal Congruence			
Our firm and supply chain partners agree that our goals can be achieved. . .			
. . . **through working toward the goals of the supply chain**	GC1	0.767	14.027
. . . **by getting the desired outcomes**	GC2	0.761	13.919
. . . **by getting the desired performance**	GC3	0.755	(set to 1.0)
Incentive Alignment			
Our firm and supply chain partners. . ..	IA1	0.725	9.348
. . . **share awards**			
. . . **share gains**	IA2	0.852	10.425
. . . **share rewards**	IA3	0.733	(set to 1.0)
Collaborative Communication			
Our firm and supply chain partners. . .			
. . . **have contact and message transmission**	CC1	0.667	13.260
. . . **have open and two-way communication**	CC2	0.792	15.043
. . . **use communication channels frequently**	CC3	0.780	(set to 1.0)
. . . **have frequent contacts on a regular basis**	CC4	0.809	15.504
Information Sharing			
Our firm and supply chain partners. . .			
. . . **exchange accurate information**	IS1	0.707	12.825
. . . **exchange relevant information**	IS2	0.778	(set to 1.0)
. . . **exchange convenient information**	IS3	0.727	13.257
Joint Knowledge Generation			
Our firm and supply chain partners. . .			
. . . **jointly search and acquire new knowledge**	JKG1	0.734	12.753
. . . **jointly search and acquire relevant knowledge**	JKG2	0.772	12.783
. . . **jointly assimilate and apply relevant knowledge**	JKG3	0.727	15.428
. . . **jointly assimilate and apply new knowledge**	JKG4	0.756	(set to 1.0)
. . . **jointly identify knowledge requirements**	JKG5	0.738	12.889
. . . **jointly research and develop contemporary knowledge**	JKG6	0.751	12.893
Quality Investment			
Our firm with supply chain partners. . .			
. . . **invests for highly reliable products**	QI1	0.759	15.174
. . . **invests for highly durable products**	QI2	0.814	16.394
. . . **invests for highly quality products**	QI3	0.783	(set to 1.0)
. . . **invests for long-lasting products**	QI4	0.713	15.414
. . . **invests for excellent products**	QI5	0.777	15.596
Financial benefits of PBC			
Performance-based contracting enables to reduce . . .. **that result in growth of profits**			
. . . **maintenance costs**. . .	FB1	0.648	12.447
. . . **repair costs**. . .	FB2	0.706	14.514
. . . **inventory costs**. . .	FB3	0.787	16.678
. . . **holding costs for spare parts**. . .	FB4	0.833	(set to 1.0)
. . . **post-product support costs**. . .	FB5	0.776	16.404

Notes: Model fit measures: Chi-square: 570.990; df: 345; normed Chi-square: 1.655; GFI: 0.908; AGFI: 0.884; NFI: 0.907; IFI: 0.954; CFI: 0.961; RMSEA: 0.042

based on the Cronbach's alpha and CR values. As shown in Table 4, all values for the Cronbach's alpha and CR were above the critical value of 0.70 (Hair *et al.*, 2010).

Convergent validity was also evaluated based on the significant factor loadings and average variance extracted (AVE) of the constructs. All factor loadings were found significant at $p < 0.01$ and standardized item loadings ranged from 0.648 to 0.852 (Hair *et al.*, 2010). Additionally, the AVE estimates for each factor were greater than the recommended threshold of 0.50 (Fornell and Larcker, 1981).

5.3 Discriminant validity

We assessed the discriminant validity using Fornell and Larcker's (1981) procedure and the Heterotrait–Monotrait ratio (HTMT) (Henseler *et al.*, 2015). As can be seen in Table 4, based on the Fornell and Larcker procedure, because

Table 4 Construct reliability, AVE and discriminant validity analysis

Construct	Cron-bach's α	CR	AVE	IA	JKG	FB	QI	GC	IS	CC
IA	0.781	0.822	0.607	*0.779*						
JKG	0.884	0.883	0.557	0.512	*0.746*					
FB	0.868	0.867	0.567	0.464	0.432	*0.753*				
QI	0.880	0.879	0.593	0.447	0.637	0.511	*0.770*			
GC	0.805	0.805	0.579	0.425	0.535	0.457	0.649	*0.761*		
IS	0.779	0.781	0.544	0.448	0.547	0.501	0.609	0.761	*0.738*	
CC	0.833	0.848	0.585	0.356	0.559	0.592	0.616	0.711	0.669	*0.765*

Notes: IA: incentive alignment; JKG: joint knowledge generation; FB: financial benefits; QI: quality investment; GC: goal congruence; IS: information sharing; CC: collaborative communication

the square root of each AVE (in diagonal) was greater than the correlation coefficients for each construct, discriminant validity was supported (Hair *et al.*, 2010). In addition to the Fornell and Larcker procedure, we conducted the HTMT of correlations test (Voorhees *et al.*, 2016). When HTMT values are greater than 0.90 (Henseler *et al.*, 2015), discriminant validity problems are present. Our results indicate that the values of all the constructs were well below 0.85 (Table 5), thereby satisfying the lowest HTMT criterion (Franke and Sarstedt, 2019).

5.4 Hypothesis testing

As CB-SEM provides simultaneous analysis for multiple mediation relationships (Zhang *et al.*, 2021), we used the CB-SEM procedure by using IBM SPSS AMOS 27 to test the hypothesized relationships (Anderson and Gerbing, 1988; Bagozzi and Yi, 1988; Jöreskog and Sörbom, 1986). The bootstrap technique was also applied to measure the statistical significance of the indirect mediation relationships (Preacher and Hayes, 2008).

Tables 6 and 7 and Figure 2 present the results of the SEM analysis. The global fit indices of the model (Anderson and Gerbing, 1988; Bagozzi and Yi, 1988; Bentler, 1990) were within acceptable limits (i.e. Chi-squared = 754.914, df = 379, CMIN/DF= 1.968; GFI = 0.886, AGFI = 0.860, IFI = 0.927, CFI = 0.936 and RMSEA = 0.050). We also conducted a Bollen–Stine bootstrap to test the model fit. If the Bollen–Stne bootstrap p-value < 0.05, the model is rejected (Bollen and Stine, 1992; Byrne, 2001). The Bollen–Stine bootstrap analysis provided a p-value of 0.226, indicating that the model fit the data well. In the SEM model, we controlled the revenue of the companies, a variable that has an influence on financial benefits; no discernable effects were observed.

Table 5 Heterotrait-Monotrait Ratio (HTMT)

Construct	CC	FB	GC	IA	IS	JKG	QI
CC							
FB	0.608						
GC	0.728	0.467					
IA	0.387	0.476	0.458				
IS	0.700	0.510	0.756	0.476			
JKG	0.588	0.437	0.539	0.545	0.549		
QI	0.637	0.529	0.644	0.476	0.604	0.636	

Notes: CC: collaborative communication; IA: incentive alignment; JKG: joint knowledge generation; FB: financial benefits; QI: quality investment; GC: goal congruence; IS: information sharing

The impact of collaborative communication ($\beta = 0.758$; $t = 22.626$; $p < 0.001$) on information sharing was positive and significant, supporting *H1*. The impact of information sharing ($\beta = 0.627$; $t = 15.695$; $p < 0.01$) on joint knowledge generation was also positive and significant, thereby supporting *H2*. This finding suggests that existing communication tools and frequent contacts among suppliers led to information sharing and sharing information within the supply chain, enabling new knowledge generation. Moreover, the indirect relationships between collaborative communication and knowledge generation through information sharing were examined and found to be significant ($\beta = 0.475$; $p < 0.001$). *H3*, *H4* and *H5* proposed that quality investment would mediate the relationships among joint knowledge generation, incentive alignment and goal congruence, respectively, along with the financial benefits of PBC.

The mediated relationship was investigated using the bootstrapping test (Preacher and Hayes, 2008). The mediation effect was tested in AMOS 27 using 2,000 bias-corrected bootstrapping resamples. The results related to the mediating effect of quality investment are provided in Table 7. The mediating effect of quality investment between joint knowledge generation and the financial benefits of PBC was positive and significant ($\beta = 0.119$; $p < 0.001$), supporting *H3*. The direct effect of knowledge generation on financial benefits without the mediator of quality investment was also found to be significant ($\beta = 0.138$; $p < 0.001$), but the direct effect of knowledge generation on financial benefits with a mediator ($\beta = 0.019$, $p = 0.781$) was not. The statistically significant positive indirect effect of joint knowledge generation on financial benefits indicated that the impact of the former on the latter was fully mediated by quality investment. This result empirically confirmed the PBC literature on how new knowledge can lead to highly reliable products (Randall *et al.*, 2015) and, consequently, to financial benefits by avoiding future after-sales support costs (Sols *et al.*, 2008).

The indirect impact of incentive alignment on financial benefits through quality investment was found to be insignificant ($\beta = 0.016$; p =0.215), and thus, *H4*, the mediation effect of quality investment between incentive alignment and financial benefits, was not supported. Therefore, quality investment does not mediate the impact of incentive alignment on financial benefits. However, the direct impact of

Table 6 Results of structural equation models

Test of hypotheses	Standard estimate	Standard error	*t*-value
Collaborative Communication to Information Sharing	0.758	0.030	22.626
Information Sharing to *Joint Knowledge Generation*	0.627	0.046	15.695
Joint Knowledge Generation to *Quality Investment*	0.408	0.031	11.655
Incentive Alignment to *Quality Investment*	0.055	0.031	1.482
Goal Congruence to *Quality Investment*	0.495	0.041	12.655
Joint Knowledge Generation to *Financial Benefits*	0.019	0.051	0.379
Incentive Alignment to *Financial Benefits*	0.281	0.045	6.084
Goal Congruence to *Financial Benefits*	0.171	0.071	2.936
Quality Investment to *Financial Benefits*	0.291	0.074	4.540

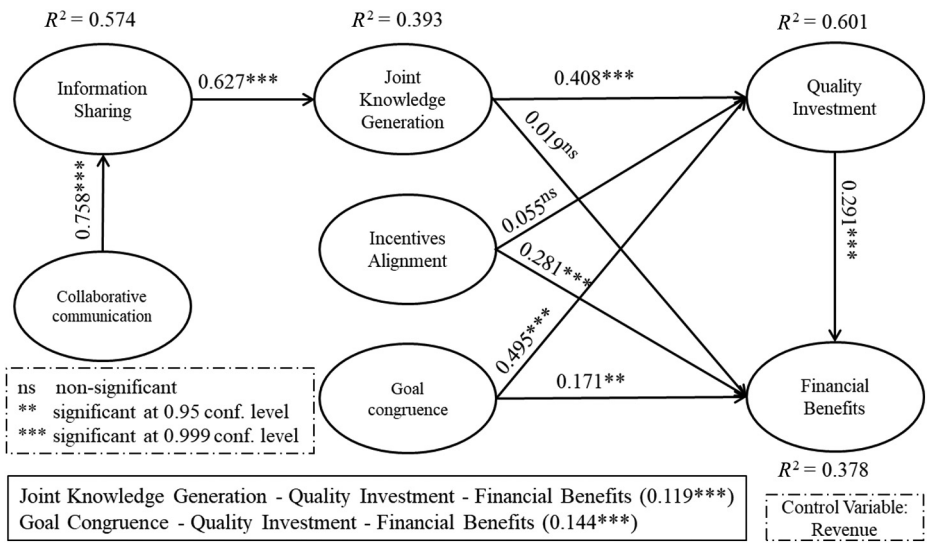
Notes: Model fit measures: Chi-square: 754.914; df: 379; normed Chi-square: 1.968; GFI: 0.886; AGFI: 0.860; NFI: 0.879; IFI: 0.927; CFI: 0.936; RMSEA: 0.050

Table 7 Testing results of mediating effects of quality investment

Hypothesis	Direct Beta w/o Med	Direct Beta w/Med	Indirect Beta	Mediation type observed
Mediation JKG-QI-FB	0.138***	0.019^{ns}	0.119***	Full mediation
Mediation IA-QI-FB	0.297***	0.281***	0.016^{ns}	No mediation
Mediation GC-QI-FB	0.315***	0.171**	0.144***	Partial mediation

Notes: **p-value is significant at 0.95 confidence level; ***p-value is significant at 0.999 confidence level

Figure 2 Results of SEM analysis (IBM AMOS 27)



incentive alignment on financial benefits was found to be significant ($\beta = 0.281$; $p < 0.001$). That being the case, we can still see a positive impact of the reward mechanism in PBC arrangements on financial benefits. As discussed in the literature, this incentive structure can motivate suppliers to achieve performance goals, and thus, increase their revenue.

The mediation effect of quality investment between goal congruence and the financial benefits of PBC was positive and

significant ($\beta = 0.144$; $p < 0.001$), thereby supporting *H5*. Per the coefficients in the SEM model, we also found that goal congruence had a significant direct effect on financial benefits ($\beta = 0.171$, $p = 0.016$). Furthermore, the total direct and indirect effects of goal congruence on financial benefits were found to be positive and significant ($\beta = 0.315$, $p < 0.001$). The statistically significant positive direct effect of goal congruence on financial benefits indicated that the impact of the former on the latter was partially mediated by quality investment.

These results are empirically confirmed by the PBC literature, arguing that under PBC, collaboration among suppliers toward specified goals leads to financial benefits. The findings of this study empirically illustrate the critical dimensions of the PBC features that lead to financial benefits through investment in durable and reliable products; thus, *H3* and *H5* are supported. This also confirms the PBC literature highlighting that under PBC, suppliers are more willing to make upfront investments that enable them to avoid future costs associated with after-sales support. The coefficients of determination (R^2) and proportion of variation in the endogenous variables (R^2 of information sharing = 0.574, R^2 of joint knowledge generation = 0.393, R^2 of quality investment = 0.601 and R^2 of financial benefits = 0.378) were satisfactory.

6. Discussion of results

In this study, we examined the impact of major PBC features on financial benefits through quality investment. Based on a literature review, the PBC incentive structure creates three critical features – goal congruence, incentive alignment and joint knowledge generation – that facilitate quality investment and lead to financial benefits. Furthermore, we also investigated the impact of collaborative communication on information sharing and the effect of information sharing on knowledge generation. Collaborative communication and information sharing are major dimensions of supply chain collaboration, creating a collaborative advantage such as knowledge generation (Chao *et al.*, 2010). The benefits of PBC are realized when all key suppliers who contribute to quality cooperate. PBC facilitates this cooperation through the incentive structure, linking payment to performance and creating an environment in which all suppliers target the same objectives. Knowledge generation, which can be considered a major driver of innovative solutions in PBC, was also found to be essential for a quality investment. Upfront investment in increasing the durability and quality of products/systems can reduce holding and ordering costs for spare parts, as well as decrease maintenance and repair costs, thus, increasing the availability of the product/system. On the other hand, this upfront investment poses a dilemma by generating greater dependence on suppliers by causing a more intense relationship (Hypko *et al.*, 2010b; Lampón *et al.*, 2021) in PBC that reduces the control of buyers in future contracts. These research findings highlight the significant impact of PBC features on financial benefits and the mediation effect of quality investment between PBC features and financial benefits.

In this study, after building a research model that captured major PBC features leading to financial benefits through quality investment, we used covariance-based SEM analysis to explore the inferential relationship between variables. The results empirically confirmed that collaborative communication can lead to information sharing and information sharing increases joint knowledge generation along the supply chain. More open two-way communication and frequent contacts within the supply chain enable information sharing among partners. This leads to the creation of new knowledge, which is crucial for innovative PBC solutions (Randall *et al.*, 2012). Knowledge generation leading to innovative solutions to existing problems is essential for successful PBC. Thus, understanding the impact of information sharing on new knowledge will help practitioners recognize the significance of collaborative efforts to find innovative solutions. Considering the significantly positive impact of collaborative communication on information sharing as well as of information sharing on knowledge generation, we conclude that these are major success drivers leading to innovative solutions under PBC (Randall *et al.*, 2014). Therefore, for successful PBC practices, information sharing must be increased by enriching communication channels with and among suppliers, facilitating new knowledge creation. This empirical finding broadens the discussion in the PBC literature (Patra *et al.*, 2019; Randall *et al.*, 2010) by underscoring the impact on knowledge generation and emphasizing the criticality of new knowledge for innovative value offerings under PBC.

With regard to the mediation effect of quality investment between PBC features and financial benefits, our results support the claim that quality investment mediates the impact of knowledge generation and goal congruence on financial benefits. Considering the significant indirect impact of knowledge generation through quality investment and its insignificant direct impact on financial benefits (as evidenced by the results of the bootstrapping mediation test), we conclude that exploring and applying new knowledge enables better and more durable products/systems through complementary knowledge resources and the skills of suppliers. This leads to financial benefits under PBC arrangements. The highly positive and significant impact of knowledge generation on quality investment highlights the essential role of the generation of new knowledge among suppliers, leading to more reliable products and ensuring successful PBC. The significant positive mediation impact of quality investment operating between goal congruence and financial benefits suggests that a buyer can create for themselves a favorable environment that aligns the goals of suppliers and provides better and more reliable products for themselves. From the supplier's perspective, aligning goals with the desired performance objectives under PBC will reduce goal conflicts along the supply chain. Therefore, this finding supports the discussion in the PBC literature (Kleemann and Essig, 2013) regarding increasing cooperation among suppliers to achieve performance metrics leading to positive outcomes under PBC.

Conversely, the indirect impact of incentive alignment through quality investment on financial benefits was found to be insignificant. However, the findings do show a significant direct impact of incentive alignment on financial benefits. Thus, we conclude that the incentive structure under PBC that is created by linking pay to performance (Essig *et al.*, 2016) and the convergence of goals through contracting governance creates a situation that is beneficial to all. From this standpoint,

we infer that contract governance that depends on outcomes has a positive impact by reducing opportunistic behavior among suppliers. This is achieved by enabling more information sharing and aligning suppliers' efforts toward a common goal to increase financial benefits. These findings are consistent with the extant PBC literature arguing how PBC enables highly reliable products through upfront investment (Bakshi *et al.*, 2015; Randall *et al.*, 2011). Considering the 25%–40% reliability growth seen under PBC (Guajardo *et al.*, 2012), these findings are critical for understanding the major features that lead to this outcome. These findings are also consistent with the existing PBC literature, which discusses how upfront investments for reliability growth result in avoiding costs related to maintenance, repair and spare parts for supporting the system throughout the contract term (Hypko *et al.*, 2010a; Kim *et al.*, 2017). From the buyer's perspective, there is also a decrease in total ownership cost under PBC (Straub, 2009; Uvet *et al.*, 2022).

7. Conclusions

7.1 Theoretical contributions

The findings of this study extend the applicability of RV in performance-based value offerings. This study shows that PBC governance strengthens the theory of RV by empowering collaborative efforts for value creation within downstream partners. Owing to the structure of the PBC, suppliers are more incentivized by the payment scheme to create overall benefits for all stakeholders in PBC. The findings support the incentive structure of PBC motivates suppliers to engage in more collaboration, generating common benefits by exploring innovative solutions for delivering outcomes. The positive significant impact of knowledge generation underscores the importance of inter-organizational interaction through collaborative communication and information sharing. Furthermore, performance-based governance will necessitate and facilitate enhanced information sharing among downstream partners. Therefore, we posit that PBC arrangements create a learning environment along the supply chain that facilitates the attainment of mutual goals. Consequently, PBC can be considered an enabler of knowledge generation at the inter-organizational level, leading to more innovative solutions. Therefore, we conclude that PBC governance strengthens the theory of RV by finding the significant impact of information sharing on knowledge generation that leads to quality improvement. Considering the necessity of complementary resources and knowledge generation through information sharing for quality investment, through the RV lens, we can see that any effort toward quality investment will contribute to achieving performance objectives, leading to financial benefits under PBC. Thus, we posit that PBC facilitates effective governance, knowledge and information sharing, coordination and collaboration mechanisms and investments in complementary assets, leading to the effective interorganizational relationships argued for in RV.

7.2 Managerial implications

Several managerial implications can be drawn from the findings. All findings are critical to establishing and building successful performance-based value offerings. This study illustrates that it is beneficial and practical for suppliers to be aware of and understand the major features of PBC to achieve performance targets. Furthermore, understanding the impact of these PBC features is critical for buyers seeking to ensure effective contracting, which incentivizes suppliers and creates a goal congruence among them. So, procurement managers can write effective contracting by understanding these features that will align incentives and goals. Considering the findings of this study that highlights the PBC features lead to quality investment, PBC should be preferred by buyers seeking to increase the improvement in the quality. Buyers also can leverage PBC to incentivize suppliers to behave in desirable ways. On the other hand, considering the positive impact of knowledge generation and goal congruence on quality investment, during the selection of a major system integrator, buyers should focus leadership skills of a major supplier. Collaboration between suppliers and shared information within the supply chain through electronic data interchange can facilitate this endeavor.

Based on the findings, we argue that PBC governance helps to mitigate suppliers' opportunistic behavior by aligning their goals to achieve performance objectives. However, because PBC provides autonomy and freedom to suppliers for delivering outcomes, buyers enter a relationship that creates an interdependency to suppliers. On the other hand, suppliers' actions that can cause moral hazard can be reduced by incentive alignment in PBC. So, procurement managers should be aware that performance targets need to be incentivized to align goals. Thus, any supplier who works as an integrator along the supply chain can leverage this outcome-based contracting relationship to ensure the cooperation of downstream partners. The findings of this study also highlight the importance of information sharing for knowledge exploration. Supply partners should consider extending channels for information sharing by building regular and informal mechanisms of communication among downstream suppliers. This will help increase the agility and flexibility of the value chain, which is critical to building resilient supply chains. On the other hand, considering suppliers' uncertainty related to investing for quality improvement, the findings will decrease the uncertainty of suppliers for upfront investments.

Furthermore, with the empirical support for PBC features, companies should leverage information sharing, joint knowledge creation and quality investment to mitigate the supply chain risks faced in PBC arrangements. The Covid-19 pandemic demonstrated how companies cannot survive without sharing information and joint planning with suppliers in the face of supply disruptions. The quality investment further contributes to this risk management approach by providing reliable products and services that can withstand contingencies in PBC arrangements. Finally, considering the significant positive impact of PBC features on quality investment and financial benefits, this governance offers a uniformly beneficial supplier-buyer relationship by creating a win–win situation for both sides.

7.3 Limitations and future research

An analysis of these PBC features by industry would be very beneficial in differentiating among and further understanding

the commonalities and differences across various sectors. Investigating changes across industries would help reveal any bias in PBC implementation. Moreover, by using the scale items used in this research, future work could test for factorial invariance across different industries (Jöreskog and Sörbom, 1986).

The CB-SEM analysis revealed R-squared values (i.e. the proportion of the variation in the dependent variable) of 57.4%, 39.3%, 60% and 37.8% for information sharing, joint knowledge creation, quality investment and the financial benefits of PBC, respectively. Considering the unexplored variances of these dependent variables, future studies should extend our model to explore other contract characteristics. In addition to quality investment, other variables such as process improvements should be studied to extend our understanding of PBC features and their impact on the success of PBC arrangements. Moreover, to incentivize suppliers to engage in quality investment, the optimal payment scheme that includes both awards and penalties should be determined. Furthermore, as in long-term contracting suppliers compensate for upfront quality improvements (Randall *et al.*, 2012), the contracting period should also be studied. Finally, as under PBC most of the responsibilities shift from the buyer to the supplier (Sols and Johannesen, 2013) and suppliers become more accountable and gain greater freedom in their value offerings, future work should extend the research model to investigate the impact of these features. This will provide more in-depth insights to both researchers and practitioners.

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