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DOES COOPETITION FOSTER VALUE CREATION? AN EMPIRICAL ANALYSIS OF DYADIC AND MULTIPLE COOPETITORS

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Abstract

This study intends to examine the coopetition effects on firm value creation from dyadic as well as from multiple relationship perspective. This phenomenon further raises the questions, i.e., whether the mediation of knowledge sharing helps nurture the process of value creation, do resource relevance and organizational trust moderate the relationships contrastingly, and does cultural fit moderates the relationship between coopetition and value creation? These questions have been executed to answer both dyadic as well as multiple level relationships. After a brief literature review, and hypotheses development, data was collected from software industry through a questionnaire for which two step approach entitled measurement model and structural model has been applied using the Smart PLS. The initial findings reveal the presence of reliability and validity of the latent constructs both at dyadic and multiple levels. Moreover, the findings through structural equation modelling technique reveals the presence of the significance relationship between coopetition and value creation, coopetition, and knowledge sharing, along with the moderating role of resource relevance.

Keywords: Coopetition; value creation; knowledge sharing; trust; resource relevance; dyadic-firm; multiple-firm

1. Introduction

Coopetition strategy is a simultaneous and paradoxical relationship between competing firms (Bengtsson & Raza-Ullah, 2016; Gnyawali, Madhavan & Bengtsson, 2016). The trend towards collaboration with competitor is being increased for the sake of firms' value creation that cannot be attained working alone (Ritala and Tidstrom 2014). Coopetition does not only lead to better performance but also permit earlier accomplishments toward higher performance (Peng,

Pike, Yang, & Roos, 2012). The development of such relationship can influence the competitive advantage (Dyer and Singh, 1998), innovation (Munten, Vanhamme, Maon, Swaen, & Lindgreen, 2021; Park, Srivastava & Gnyawali, 2014), and profitability (Estrada, & Dong, 2020), which are the potential outcomes of value creation (Jayaraman, & Luo, 2007; Porter, 1985).

Value creation refers to the benefits created by firms i.e. innovation and product development (Mizik & Jacobson, 2003). Coopetition for value creation has been discussed increasingly during past decade (e.g. Ritala & Hurmelinna-Laukkanen, 2009; Gnyawali & Park 2011; Ritala & Tidström, 2014; Akpinar & Vincze, 2016; Bengtsson & Raza-Ullah, 2016; Gnyawali, et al 2016; Rai 2016; Chou & Zolkiewski, 2018; Gnyawali and Charleton, 2018; Charleton, & Gnyawali, 2021, Crick, Karami and crick, 2022) and the focus of these studies have been to provide theoretical evidence of how and when simultaneous and paradoxical relationship of firms affect value creation. Thus, limitation in previous research is that the nature of their data is mostly qualitative and less representative, which inhibits the generalizability of their results. Then, a few researches that could empirically test the coopetition effects (e.g. Park, Srivastava, & Gnyawali, 2014; Park, Srivastava, & Gnyawali, 2014-b; Navío-Marco, Bujidos-Casado, & Rodrigo-Moya, 2019) reveal a blur understanding in coopetition-value creation research. Past research demonstrates that value hinges both on positive and negative, i.e. value creation and value destruction, which depends on coopetition mechanism (Gnyawali and Charleton, 2018). Bouncken, Fredricha, Krausb, & Ritala (2020), and Charleton, & Gnyawali, (2021) also determine that there are negative as well as positive effects of coopetition depends on the nature and preferences of coopetition, which demonstrate a blur picture of comparative consequences of coopetition effects and both dyadic and multiple coopetition might have different outcomes, which are rarely researched in empirical settings.

Furthermore, several researches have examined the relationship between coopetition and value creation at dyadic level, however, little research has tested it at multiple level (Hoffmann, Lavie, Reuer & Shipilov, 2018). According to Dagnino & Padula (2002), multiple firm coopetition is more complex than dyadic coopetition. It might be the case because the pressure of different firms in terms of trust among several parties, knowledge sharing process, joint and dispersion of potentially different resources and different cultures make the relationship more convoluted. Thus it can be quite different from dyadic coopetition. thus,, as suggested by Yami and Nemeh (2014), further research is needed to carry out the analysis both at dyadic and multiple level.

In this study, we build on the theoretical basis of Gnyawali and Charleton (2018) to empirically extract the coopetition effects on value creation, which occurs through knowledge sharing (Schoenberg, 2001; Park, Srivastava, & Gnyawali, 2014), resource sharing (Taminiau, Smit, & De Lange, 2009; Ritala, Olander, Michailova, & Husted, 2015) and results in value capture and competitive advantage (Adner and Kapoor, 2010; Porter, 1985) i.e. firm value creation. In doing so, this research raises the question that "Do dyadic- versus multi-firm coopetition keep diverse effects on firm value creation?".

Importantly, our research extends the coopetition literature by elucidating the boundary condition by which coopetition influence value creation. Contributing to the literature, we suggest that knowledge sharing plays an important role between coopetition and value creation. Firms can transfer and access valuable knowledge and expertise (Cross, Borgatti, and Parker, 2002),

however, it can lead towards value creation in specific conditions and otherwise its effects are limited towards value creation (Allen, James, & Gamlen, 2007), which indicate that the effects of knowledge sharing are quite opaque. Although several researches (e.g. Estrada, Faems and Faria, 2016; Gast, Gundolf, Harms, & Collado, 2019; Loebbecke, Fenema, & Powell, 2016) have examined the knowledge sharing mechanism between firms. The focus of these studies were to test the mechanism of knowledge sharing and knowledge protection, and the dimensions of knowledge sharing (e.g. Park et. al., 2014). Rarely any study has focused on the mediating effects of knowledge sharing in coopetition literature.

This research utilizes the knowledge sharing framework to theorize that trust and resource relevance between (among) firms serve as boundary condition that can nurture or impede the value creation. Despite, the discussion about the link of coopetition and knowledge sharing, there are only a few empirical studies that have discussed phenomenon of trust from the perspective of knowledge sharing. Trust is crucial for collaboration among competitors, because it moulds individual thinking whether they should focus to cooperate or compete in coopetition (Coletti, Sedatole, & Towry, 2005). The concept of trust is complex and vague from past studies due to lack of empirical research of how inter-organizational trust can affect the relationship between coopetition and knowledge sharing. The other boundary condition, the resource relevance is also crucial for coopetition relationship. Firms coopete for the sake of value creation, which potentially be viable through resource relevance (Gnyawali and Charleton, 2018). As the knowledge sharing retains diverse effects to value creation, moderating effects of resource relevance in this perspective can further change the level of value creation. Although past research has taken resource relevance from different perspectives, but according to best of our investigation, no empirical study in comparative analyses investigate the moderating role of resource relevance in coopetition literature.

This research also aims to investigate the relationship between coopetition and value creations with two lenses i.e. dyadic-firm relationship and multiple-firm relationship. Dyadic and multiple coopetition possess different relational pattern, which can consequence into different level of value creation (Yami and Nemeh, 2014). Bengtsson & Kock, (2014) also suggest the need to develop multiple coopetition and assess its varying effects with dyadic coopetition. Dyadic level coopetition is more useful in incremental innovation as well as for individual (firm) motives, and on the other hand multiple coopetition is handier for radical innovation as well as for collective development. From another perspective, dyadic level coopetition is more suitable for, whereas, multiple level coopetition is more appropriate for collective (whole industry) development (Czakon, Mucha-Kuś, & Sołtysik, 2016).

In proposing our conceptual model (see Figure 1), we determine our study can provide important insights from the relationship between coopetition and firm value creation. First, this research investigates the firm value creation by taking knowledge sharing between (among) firms, which extends, the prior research to contend, through the social network theory (Granovetter, 1973), that (i) the relationship between coopetition value creation depends on knowledge sharing, and furthermore (ii) knowledge sharing contributes variably in dyadic- versus multi-firm relationship (Yami, & Nemeh, 2014). Although past research has concluded (Czakon & Czernek 2016; Klimas, 2016; Park, Srivastava, & Gnyawali, 2014-b) that coopetition effects are quite

different at both levels. However, most of the research is theoretical as well as did not focus to dyadic and multiple phenomena comparatively.

Second, this study contributes to the coopetition research by integrating trust with knowledge sharing. Although several studies have settled that coopetition is formed to share knowledge between (among) them, yet trust between (among) these firms can be a valuable predictor (Coletti, Sedatole, & Towry, 2005) to share knowledge. Furthermore the chemistry of knowledge sharing can be quite different in dyadic- versus multi-firm relationship.

Finally, this study adds to the coopetition literature by arguing, that resource relevance between (among) firms play an important role between the shared knowledge and value creation (Gnyawali & Charleton, 2018). We argue this notion on the base of Resource Based View (Barney, 1991), which postulates that resources enhance the firm performance (Aragón-Correa & Sharma, 2003). Furthermore, to the vague understanding, it is anticipated that resource relevance plays a boosting role for value creation in both dyadic- and multiple-firm coopetition relationships.

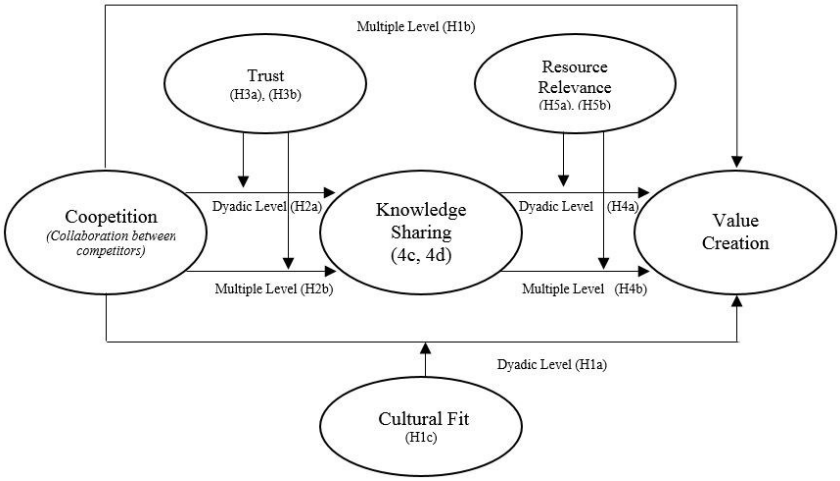

Figure 1: Conceptual model of the Study

2. Literature Review

2.1 Coopetition

A simultaneous competition and cooperation between (among) firms for the sake of value creation is referred to coopetition, in which simultaneity and value creation intent are prerequisites. According to Gnyawali and & Ryan Charleton, (2018), "simultaneity refers to the concurrent presence of competition and cooperation, while value creation intent refers to firms' primary ambition to generate new, additional benefits". Coopetition is not only the balance between competition and cooperation but it is a "paradoxical relationship" of competition and cooperation between (among) two or more firms. Paradox presumes tensions between contradictory yet interrelated elements that exist simultaneously and persist over time (Smith & Lewis, 2011, p. 382). This paradox varies from weak to strong in coopetition relationship (Park, Srivastava &

Gnyawali, 2014), and results in joint value creation, firm value creation and value destruction (Gnyawali and & Ryan Charleton, 2018).

Distinguish between dyadic- and multiple-firm coopetition is based on the number of players (see figure 2) in the relationship (Gnyawali, He, and Madhavan, 2008). Two simultaneously competing and cooperating firms' relationship is dyadic-firm coopetition (Dagnino, 2009), which is a simple form of coopetition. However, more complex form of coopetition is multiple-firm coopetition in which the relationship among multiple (three or more) firms is established that are simultaneously competing and cooperating. Multiple coopetition possesses several firms in the same value chain (Ritala et al 2014) that aim to create collective values that each firm can use (Dagnino & Padula, 2002). Czakon, et al., (2016) argue that dyadic and multi-firm coopetition are different, i.e., dyadic coopetition involves more individual motives but multiple firm coopetition means towards more collective outcomes. However, coopetition either at dyadic or multiple level is always paradoxical (Yami, Castaldo, Dagnino, & Roy, 2010).

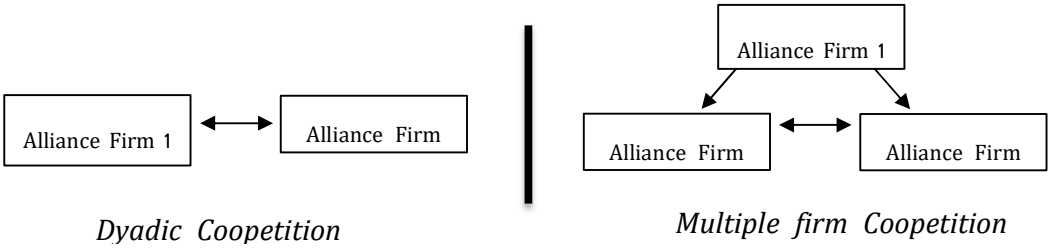

Figure 2:

Distinguish between dyadic- versus multiple-firm Coopetition

2.2 Coopetition and value creation

Coopetition literature suggests that technological development and innovation can be achieved with coopetition (Ansari, Garud & Kumaraswamy, 2016). It has been generally considered that the resources of coopeting firms create synergy to boost up value creation. It is because they possess similar knowledge and technology, which nurture the efficiency (Ritala & Tidström, 2014). However, Coopetition from value creation perspective can also perilous sometimes, which depends on the nature of market rivalry and the shared and individual knowledge (Ritala, 2009). Competitors collaborate when they perceive that common interests are greater than risks (Liu 2013). Gulati, Nohria & Zaheer (2000) argue that coopeting partners generate common benefits that can be shared to foster value creation. These empirical and qualitative evidences demonstrate that while there are benefits of coopetition, on the other side there can be some disadvantages of coopetition.

From the dyadic side of coopetition, pressure of competition along with cooperation pushes firms to foster innovation, which can lead to value creation (Bengtsson and Kock, 2000). According to Park, Srivastava Gnyawali (2014), dyadic coopetition relationship impacts positively to value creation. However, the previous study of Gnyawali, He, Madhavan and Bengtsson (2012), reveals that conflicting demands promotes opportunistic behavior, which hinges value creation.

According to Crick (2019), if the firms involve in intense coopetition, several factors (e.g. tension among the rival partners) can negatively affect the performance of firms; however, negative effects can be diminished involving more partners. According to Chen & Miller (2012), coopetition is not significantly related to value creation but in specific circumstances, e.g., strategic competitiveness. Coopetition related value creation hinges on learning capacity from the alliance firm and beyond (Park, Srivastava, & Gnyawali, 2014-b).

Bereskin, Byun, Officer, & Oh (2018) argues that although several human resource problems arise during dyadic coopetition; however value creation can be achieved if both firms provides optimum performance,. Investigating the case of *Samsung electronics* and *Sony corporation*, Gnyawali & Park (2011) suggest that firm foster innovation and value creation only when it coopetes with appropriate partners and defined technological standards. Organizational culture not only develops the collaboration between competitors but also enables the coopeting firms to collaborate for long-term (Klimas, 2016). Laskowska-Rutkowska, & Warszawie, (2009) illustrates that coopetition at dyadic level positively relates to firm performance, however the chances of success augment at multiple level (forgoing discussed). The general consensus is that inter-organizational coopetition is positively related to value creation because coopeting partners can get extra resources and market share.

2.3 Multiple Level Coopetition

A further closely related issue in coopetition research is that prior studies on coopetition are mostly done examining the effects of two organizations that affect each other dynamically. Multiple firm coopetition literature is lacking, which pushed us to analyse the coopetition effects on value creation. In this regard, Bengtsson and Kock (2000) argue that sometimes two firms cannot cooperate and compete simultaneously. In this situation, conflict can be minimised and controlled by third firm (which can be coopetative partner). Firms working in multiple coopetition increase the value creation process because these firms use resources of the whole network to create value (Cohen and Levinthal, 1990. P.134). Czakon & Czernek (2016) found that instead of alliance between two firms, the multiple firm coopetition is more useful to firms' development. Firms in multiple coopetition can create value if they identify shared problems or opportunities that is collectively workable (Wang, 2008). According to Fernandez, Roy and Gnyawali (2016), if the areas in which competitive firms are doing cooperation are well defined and the appropriate activities are well divided among network individuals can lead towards value creation.

Several researches have different but interlinked opinion about coopetition and its effects on value creation. Moreover, some of the researchers postulate different outcomes of coopetition from dyadic and multiple perspective. Some researchers suggest that coopetition nurture value creation, while some studies posit that coopetition effect value creation in specific conditions especially in dyadic relationship. Prior to empirical studies, and social network theory suggests that coopetition enhance value creation process, however, in some conditions coopetition effects insignificantly or negatively. So, according to aggregate evidence, this study argues that coopetition positively relates to value creation.

Hypothesis 1a: *Coopetition positively relates to value creation at dyadic level.*

Hypothesis 1b: *Coopetition positively relates to value creation at multiple level.*

2.4 Moderating role of Cultural Fit

The concept of organizational culture is vast and complex phenomenon and used in variety of ways in management research (Alvesson, 2012, p143). Cultural fit is similarity between two firms (Klimas, 2016). This research defines cultural fit as similarity between two firms based on organizational norms, way of working and technical communication. Cross cultures and cultural fit between organizations and its impacts are being studied from 1970's (c.f. Peterson & Shimada, 1978; Gudykunst, 1985; Kanter, 1994; Laskowska-Rutkowska & Warszawie, 2009; Klimas, 2016;). Although some coopetition literature has also studied cultural aspects (Wang and Zajac, 2007; Chin, 2008; Klimas, 2016; Knein, Greven, Bendig, & Brettel, 2020), however past coopetition research has not argued whether cultural fit impacts value creation. Coopetition research in empirical setting is still unable to emphasis this phenomenon. However, done research validates that organizational cultural fit is the key to value creation at dyadic level.

Past research suggests that firms alliance is much successful in which both the firms have similar cultures. E.g. Kim, J., & Parkhe (2009) test several types of cultural similarities and coopeting firms and determine that cultural similarity mostly cultivates positive synergy. Dyadic coopetition is mostly risky in terms of technical human resources, but the threat is curtailed, and the relationship provides optimum performance when both partners have similar cultures (Bereskin, et. a., 2018). As discussed above (coopetition and value creation 2.4) that firm foster innovation and value creation only when it coopetes with appropriate partners and defined technological standards (Gnyawali & Park, 2011), which implies that cultural similarity is a major factor that makes the coopeting partners appropriate for one another. Organizational culture not only develops the collaboration between competitors but also enables the coopeting firms to collaborate for long-term (Klimas, 2016). Investigating the dyadic firm relationship, Peterson & Shimada, (1978) and Broek, Boselie, and Paauwe (2018) find that cultural difference is the main reason of joint venture failure. Wang and Zajac (2007) argue that cultural similarity lead dyadic relationship better toward alliance otherwise acquisition can be the result of coopetition by either firm. Firms try to coopete with such firm that have attuned culture, so the transmission of resources become smooth (Laskowska-Rutkowska, & Warszawie, 2009).

Hypothesis 1c: *Cultural fit moderates the relationship between coopetition and value creation at dyadic level.*

2.5 Coopetition and Knowledge Sharing

The process of knowledge sharing in coopetition relationship is driven by lateral relations as well as through formal hierarchical structure (Tsai, 2002), in which lateral relation is recognised as an important tool to transfer personal technical and scientific (Allen, James, & Gamlen, 2007) and cultural knowledge (Taminiau, Smit, and Lange, 2009). Coopetition mechanism develops a culture in which, new projects and new opportunities are conveyed by learning and knowledge sharing (Park et al., 2014). Sharing, obtaining and integrating knowledge is indispensable in coopetition relationship (Enberg, 2012). But on the other hand, knowledge sharing between firms

become risky (Gast, Filser, Gundolf, & Kraus, 2015) because of opportunistic behavior (Bouncken & Kraus, 2013) and knowledge leakage (Estrada et al., 2016), yet the employees are encouraged to knowledge sharing for the sake of potential intangible rewards to both (all) the firms. (Connelly & Kelloway, 2003).

As each firm in coopetition relationship does not possess adequate knowledge (Enberg, 2012), so the knowledge sharing becomes essential in coopetition relationship. This research adopts both perspectives (dyadic and multiple) for knowledge sharing through coopetition. A tie between members of two organizations form a dyadic relationship and a multiple relationship is established when the third (and so on) organization enters the coopetition relationship, which change the nature of tie as well (Krackhardt, 1999). Knowledge sharing has hierarchical mechanism and must be shared in coopetition.

The extent of coopetition impacts knowledge sharing. According to Park et al., (2014) a moderate level of coopetition develops a situation in which more knowledge is shared. Schuler, Jackson, & Luo (2004) suggest that cooperation based coopetition foster more knowledge sharing. They further argue that competition based coopetition raise more tension that subsequently decrease knowledge sharing between firms.

*Hypothesis **2a:** Coopetition positively relates to knowledge sharing at dyadic level.*

*Hypothesis **2b:** Coopetition positively relates to knowledge sharing multiple level.*

2.6 Moderating mechanism of Inter-organizational Trust

A pivotal term in strategic and social relations (Cook, 2005), trust, is defined as "a psychological state comprising the intention to accept vulnerability based on positive expectations of the intentions or behavior of another" (Rousseau, Burt, Sitkin, & Camerer, 1998, pp.395). In coopetition literature, according to Castaldo & Dagnino (2009, pp.95) trust is "expectation that coopetitor's future actions will produce favorable results in a situation of risk and vulnerability". Pavlou, (2002, pp.218) defines trust as "the subjective belief with which organizational members collectively assess that a population of organizations will perform potential transactions according to their confident expectations, irrespective of their ability to fully monitor them". Trust have got significant attention in coopetition qualitative literature. Despite, the active discussion about the link of coopetition and knowledge sharing, there are only a few empirical studies have discussed phenomenon of trust. Recent research focus on how trust affects knowledge sharing at formal level (e.g. Crick, 2019). Trust is crucial for collaboration among competitors, because it moulds individual thinking whether they should focus to cooperate or compete in coopetition (Coletti, Sedatole, & Towry, 2005). The concept of trust is complex and vague from past studies of coopetition and knowledge sharing. Thus, there is a lack of empirical research of how inter-organizational trust can affect the relationship between coopetition and knowledge sharing.

Czakon & Czernek, (2016) in their multiple network study reveal that trust at multiple level is quite different from dyadic level coopetition. Partner selection, the formation of network, the procedure of partner entry into network, partner role and the nature of combine projects is quite different at multiple level. It demonstrates that opportunism threats and knowledge access also varies in dyadic and multiple coopetition. So, the level of trust and its consequences between the

relationship of coopetition and knowledge sharing also varies. But it is obvious that trust plays a role of catalyst in coopetition relationship, for knowledge sharing (Tidström, 2014). So, it is assumed that:

*Hypothesis **3a:** Organizational Trust strengthens the relationship between coopetition and knowledge sharing at multiple level.*

*Hypothesis **3b:** The relationship between coopetition and knowledge sharing at dyadic level is stronger under intermediate level of organizational trust, but weaker when trust is lower or higher.*

2.7 Knowledge Sharing and Value Creation

Sharing of knowledge is acknowledged crucial in coopetition relationship (Ritala, et. al., 2015), and firms consider sharing and acquisition of knowledge as a strategic resource for their development and innovation (Sing, et. al., 2016). Research demonstrates that knowledge sharing practices nurture the value creation process. However, this processes can vary in diverse situations. As discussed in the first section, knowledge sharing is an exchange the knowledge of resource and service activities but the exchange process is not designed for the specific knowledge sharing purpose. According to Taminiau, et al. (2009), knowledge sharing is the most appropriate way for value creation. However, it is a source of value creation only in the developing fields, otherwise, with the increased exchange of knowledge the process towards value creation becomes more complex (Du Plessis, 2007). Dynamic nature of the technology demands new knowledge for existence, sustainability and growth (Inigo, Ritala, & Albareda, 2020). Hence the knowledge and expertise is prerequisite to the firms' growth, so the knowledge sharing between (among) alliance firms becomes an easy way to transform expertise and propagate knowledge within coopetition networks (Cross, et. al., 2002), which can subsequently lead firms towards value creation (Cross and Parker 2004). Although firms do not explicitly foster the process of the knowledge sharing, to some extent top management supports knowledge sharing practise (Mueller, 2015) for the sake of value creation. (Burrows, Drummond & Martinsons, 2005). However, Allen, et. al., (2007), argue that many a times sharing of knowledge impacts value creation limitedly.

As discussed earlier, coopetition however foster new opportunities; knowledge sharing bring new ideas, which eventually cause value creation for individual partner as well as for all the firms in relationship (Park et al., 2014). In this way, knowledge sharing enhances the quality of focal firm and combine projects that subsequently increase value creation.

*Hypothesis **4a:** Knowledge sharing relates positively to value creation at dyadic level.*

*Hypothesis **4b:** Knowledge sharing relates positively to value creation at multiple level.*

Accordingly, this research also postulates that knowledge sharing possesses a critical role in firms' value creation. Knowledge sharing becomes more imperative when information exchange is a requisite part (Gebretsadik et al., 2014). Firms share their valuable knowledge to competitors in which both (multiple) firms recognise shared use of knowledge for mutual interests (i.e. value creation) (De Dreu, 2007). According to Park et al., (2014) high level competition and revelry between (among) coopeting firms impedes knowledge sharing, which fallouts in lower value creation. It depicts that knowledge sharing increase the process of value creation in coopetition relationship. Srivastava and Gnyawali (2011) confer that the aspect of cooperation in coopetition

relationship support knowledge sharing, which further enhance value creation. Akhavan, Ghojavand, & Abdali, (2012) demonstrate that cooperative relationship increase value creation when shared knowledge is practical and managers are skilled enough to use that knowledge. Their research further conclude that the knowledge sharing in the relationship nurture more value creation when employee have capabilities to use new knowledge are higher. Sa´enz, Aramburu, & Rivera (2009) also posit that the value creation can be increased through shared knowledge when the firm has capabilities to absorb the knowledge. Therefore, it is quite plausible, when coopeting firms coopete for value creation they need sufficient knowledge sharing. Thus, the following hypotheses are proposed:

*Hypothesis **4c:** Knowledge sharing mediates the relationship of coopetition and value creation at dyadic level.*

*Hypothesis **4d:** Knowledge sharing mediates the relationship of coopetition and value creation at multiple level.*

2.8 Moderating Mechanism of Resource Relevance

Transferable resources can fill the resource gap for coopeting firms, thus both (all) the firms can bring value creation and market success (Verbeke, 2013 p9). Verbeke, (2013 p35) further explains that some resources are not transferable to coopeting firms e.g. marketing knowledge and reputational resources etc (Verbeke, 2013, p25). Hence, one of the objectives of this study is to probe the need for resource relevance (Gnyawali and Charleton, 2018), so, this study discusses such resources that are transferable to coopeting partners.

Past researches have taken both types of resources i.e. tangible and intangible resources such as human resource skills, and intellectual capital (e.g. Sullivan, 2000), organizational culture (e.g., Howard-Grenville and Hoffman, 2003; Carmeli, 2004), structural resources (Patricia, 2004), physical artefacts (e.g., Schriber, & Löwstedt, 2015) etc. So far, at least to our knowledge, no empirical study in comparative analyses investigate the moderating role of resource relevance in coopetition literature. To address this gap, and to link resource relevance between knowledge sharing and value creation, this study rely on Resource Based View (RBV) of the firm. The theory asserts that firms' valuable resources and capabilities help boost value creation which eventually develops competitive advantage (Wernerfelt, 1984; Barney, 1991; Kessler, 2013). Essentially, RBV of the firm postulates that intangible resources enhance firm performance (Aragón-Correa & Sharma, 2003). Firm value creation mainly depends on intangible resources (Grant, 1996; Kramer, Marinelli, Iammarino, & Diez, 2011). Park et al (2014) argue that coopeting firms face similar challenges, hence the similar resources assist to overcome the challenges and increase the learning process but the continuous coopetition with similar resources cannot bring value creation. Seeking appropriate resources is one of the primary reasons to coopetition especially for new firms (Park and Steensma, 2012). The interfirm alliance relies not only on strategic needs of resources but also on whether those resources are relevant to fulfil the needs.

However, from the RBV lens, value creation is connected with valuable and inimitable resources (Barney 1991), which are unique and rare (Barney, 2001). Gulati (1999) also suggests

that firms enter into alliance relationship to acquire new and unique resources. Further, these novel resources develop value creation through knowledge sharing. Acquisition of various resources from the partner creates new knowledge, which supports innovation (Zhang, Shu, Jiang, & Malter, 2010). So, in between diverse aspects, it is conceded that knowledge sharing firm resource relevance increase value creation to a certain level.

Utilization and value creation through similar to diverse resources in multiple alliance is noteworthy (Jiang, Tao, and Santoro, 2010), the relationship is not fully investigated in coopetition research, however. At multiple level, firms possessing to some extent divergent resources provide them with novel insight and the integration of these resources helps all the firms in value creation process (Hoffmann et al., 2018). Cui, and O'Connor (2012) argue that diverse resources can strengthen value creation (resource similarity weakens the relationship). However, Cui and O'Connor are limiting value creation in resource diversity in two ways, i.e., when knowledge is shared sufficiently to all the alliance members, and when it is shared equally to all the members. Their study further argue that common resource sharing can facilitate the value creation process. However, according to Dyer and Nobeoka, (2000), when different firm share their heterogeneous knowledge, value creation process can weaken than those when various firms with similar resources share their knowledge. All the firm in coopetition relationship (multiple) get resources, which in condition of loyalty and commitment, help out in achieving cost effected new technology (Osarenkhoe, 2010). Smith & Lewis, (2011) further highlight that when the firms engage in multiple coopetition and achieve mutual commitment with common resources, they get able to achieve better achievements, otherwise with limited commitment and inappropriate resource allocation, firms in the multiple network remain in the tension, which hinder the value creation process.

Hypothesis 5a: Resource relevance moderates the relationship between knowledge sharing and value creation at dyadic level.

Hypothesis 5b: Resource relevance moderates the relationship between knowledge sharing and value creation at multiple level.

3. Research Methods

This study examines the nexus between variables of interest for which primary data has been collected with the help of questionnaire. The term coopetition has been measured through three items as taken from the research work of Bouncken, & Fredrich, (2012). Chen (1996) compares the resources of interfirm rivalry to predict the competitive relationship and the influence on market, which is quiet relevant to this research and the similar scale has been considered for the present study. To cover the complete scope of knowledge sharing according to Blacker (1995), this study adapts seven (7) items from Cumming, (2004), Hansen (1999), Kale et. al. (2000), and Ritala et. al. (2015). Following Matzler et al (2008), items will be measured by the means of a five-point scale (1 frequent, to 5 never). This research will use Trust as a moderator between coopetition and knowledge sharing. Three (3) items will be adapted from Norman (2002). this research takes value creation with dimensions like technology, competitive advantage, novel solutions, product and services R&D and manufacturing etc. for this purpose, thirteen (11) items have been adapted from Wang & Ahmed (2004) and Gnyawali, et al., (2018). From Denison, &

Neale, (2000), this study will use eleven items from Denison Organizational Culture Survey (DOCS) to measure the cultural fit between firms. A 5-point Likert scale will be developed. After the development of the questionnaire, the study collects the data while considering the dyadic and multiple levels. For dyadic level, researcher was able to collect a final sample of 374 respondents, whereas for the multiple levels, the final valid sample of consisted of 232 respondents, respectively. The data analysis has been conducted using the SPSS-26 and Smart PLS 4.0 for both of the levels.

4. Results and Discussion

4.1 Assessment of the Measurement Model (MM)

To verify the internal consistency, reliability, and validity of the constructs, the researchers carefully evaluated the measurement assessment model throughout the first stage of this study. They also carefully considered the potential problem of common technique biasness and carried out a thorough test to remedy it. Figure 3 (multiple level) and Figure 4 (dyadic level) depict the measurement models of the study.

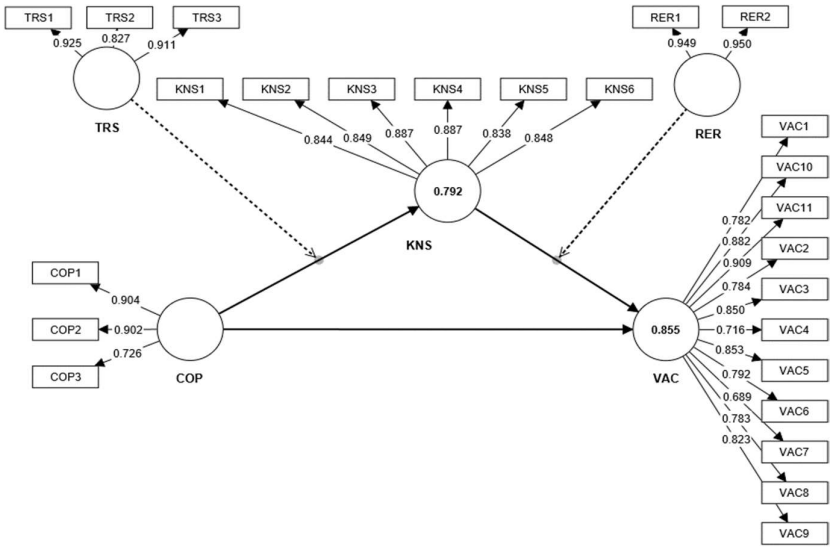

Figure 3: Measurement Model (Multiple Level)

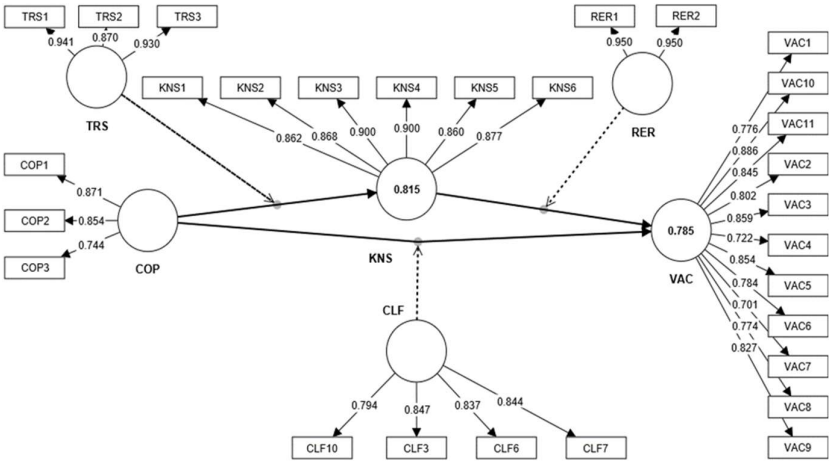

Figure 4: Measurement Model (Dyadic Level)

The Cornbach's Alpha (α) and composite reliability (CR) were used to determine the internal consistency and reliability of the data. The scores must be higher than 0.70 (Hair et al., 2014). The researchers then focused on convergent validity, which evaluates how well each latent variable's indications connect to one another based on previous research's theoretical underpinnings (Memon et al., 2021). Two metrics were used to determine convergent validity: factor loadings and average variance extracted (AVE) (Hair et al., 2021). The factor loadings of each item were looked at by the researchers to assess the constructs' internal consistency. Factor loadings above 0.7 suggest strong internal consistency, with each item accurately expressing its corresponding latent variable (Hair et al., 2019). According to the recommendations made by Hair et al. (2021), constructs should have AVE values that are equivalent to or higher than 0.5. The researchers then looked at discriminant validity, trying to determine how distinct each concept was from the others in the model. They aimed to prevent strong correlations between valid assessments of one construct and other constructs. The criteria for assessing discriminant validity were presented by Fornell and Larcker (1981), who said that the square root of AVE for each construct should be greater than the correlation of that construct with other constructs. Similarly, HTMT ratios are also considered for checking discriminant validity.

4.2 Reliability and Internal Consistency

As it relates to the accuracy and precision of a measurement scale, instrument reliability is an important part of data analysis. It is critical to ensure instrument reliability in order to ensure that the indicators used to measure a construct are accurate and genuine. A research instrument is considered reliable if it regularly gives the same results under the same conditions (Hair et al., 2021). Another criterion for reliability is that all measurements should capture the same idea and accurately represent the underlying constructs. A scale with a higher reliability signifies more precision and accuracy in measurements. Furthermore, high reliability indicates that the indicators capture the essential concept in the corresponding field of research effectively. In practice, two indicators are usually used to assess the reliability of a scale: α and CR (Hair and Sarstedt, 2019).

Alpha (α) is a rigorous approach for determining data reliability. Alpha (α) was determined for each latent variable in this study to determine its reliability. Alpha (α) must be greater than 0.70 to

be regarded credible (Memon et al., 2021). As shown in Table 1 (multiple level) and Table 2 (dyadic level, all latent variables in the investigation had strong internal consistency reliability, with alpha values more than 0.70. The variable "VC" had the greatest alpha value of 0.946, while "COP" had the lowest value of alpha 0.798 at multiple level (see Table 1), indicating that it covered about 80% of the assessed phenomena. The variable "VC" had the greatest alpha value of 0.945, while "COP" had the lowest value of alpha 0.764 at dyadic level (see Table 2), indicating that it covered about 76% of the assessed phenomena.

Table 1: Measurement Model Assessment: Multiple Level

Constructs	Items	Factor Loadings	VIF	α	CR	rho_A	AVE
Coopetition	COP1	0.904	2.665	0.798	0.884	0.796	0.719
	COP2	0.902	1.650				
	COP3	0.726	1.217				
Trust	TRS1	0.925	2.894	0.867	0.918	0.886	0.790
	TRS2	0.827	1.844				
	TRS3	0.911	2.715				
Knowledge Sharing	KNS1	0.844	2.752	0.929	0.944	0.930	0.738
	KNS2	0.849	2.963				
	KNS3	0.887	2.655				
	KNS4	0.887	1.993				
	KNS5	0.838	1.532				
	KNS6	0.848	1.443				
Resource Relevance	RER1	0.949	2.811	0.891	0.948	0.891	0.901
	RER2	0.950	2.811				
Value Creation	VAC1	0.782	2.744	0.946	0.954	0.949	0.653
	VAC2	0.882	2.976				
	VAC3	0.909	1.857				
	VAC4	0.784	2.412				
	VAC5	0.850	1.353				
	VAC6	0.716	2.498				
	VAC7	0.853	1.646				
	VAC8	0.792	1.718				
	VAC9	0.689	1.830				

	VAC10	0.783	2.021				
	VAC11	0.823	1.176				

Note: "COP: Coopetition, TRS: Trust, KNS: Knowledge Sharing, RER: Resource Relevance, VAC: Value Creation, CR: Composite Reliability, α: Cronbach's Alpha."

CR is another way for assessing the internal reliability of latent variables. Hair et al. (2019) and Hair et al. (2021) state that the CR must be greater than 0.70 in order to demonstrate internal reliability. All of the CR values in Table 1 (multiple level) and Table 2 (dyadic level) were greater than 0.70. The highest CR value was assigned to VAC (both at multiple and dyadic levels), while the lowest value was assigned to COP (both at multiple and dyadic levels). Moreover, rho_A scores are also greater than 0.70 (Hair et al., 2014) which further confirms the internal consistency (See Table 1 and 2).

Table 2: Measurement Model Assessment: Dyadic Level

Constructs	Items	Factor Loadings	VIF	α	CR	rho_A	AVE
Coopetition	COP1	0.871	2.696	0.764	0.864	0.764	0.681
	COP2	0.854	2.698				
	COP3	0.744	1.198				
Trust	TRS1	0.941	1.751	0.901	0.938	0.913	0.835
	TRS2	0.870	2.257				
	TRS3	0.930	2.464				
Knowledge Sharing	KNS1	0.862	2.073	0.941	0.953	0.941	0.771
	KNS2	0.868	2.357				
	KNS3	0.900	1.298				
	KNS4	0.900	1.926				
	KNS5	0.860	1.068				
	KNS6	0.877	1.576				
Cultural Fit	CLF3	0.847	2.105	0.856	0.899	0.892	0.690
	CLF6	0.837	1.776				
	CLF7	0.844	2.930				
	CLF10	0.794	2.908				
Resource Relevance	RER1	0.950	2.854	0.893	0.949	0.893	0.903
	RER2	0.950	2.854				

Value Creation	VAC1	0.776	2.750	0.945	0.953	0.950	0.648
	VAC2	0.802	2.162				
	VAC3	0.859	1.161				
	VAC4	0.722	2.509				
	VAC5	0.854	1.972				
	VAC6	0.784	2.791				
	VAC7	0.701	2.362				
	VAC8	0.774	2.597				
	VAC9	0.827	1.738				
	VAC10	0.886	1.936				
	VAC11	0.845	1.822				

Note: "COP: Coopetition, TRS: Trust, KNS: Knowledge Sharing, CLF: Cultural Fit; RER: Resource Relevance, VC: Value Creation, CR: Composite Reliability, α: Cronbach's Alpha. Items having lower factor loadings have been removed from the model and given results.

Thus, establishing instrument reliability is critical in data analysis to ensure measurement reliability. Various indicators, such as α, CR, and rho_A, are used by researchers to evaluate and confirm the reliability of the measurement scale, thereby improving the overall quality and credibility of their research.

4.3 Validity Analysis

Validity refers to the extent to which an instrument measures what it is intended to measure. It can also be described as the precision, fitness, relevance, and efficacy of the research instrument and the data collected from it. In SEM, there are two types of validity: "*convergent validity and discriminant validity*." This study has assessed both types of validity for the proposed research framework. Each construct must have an AVE value larger than 0.50 in order to be considered convergent. In the analysis, AVE is used to determine convergent validity. Discriminant validity, on the other hand, is assessed using two criteria: *"Fornell-Larcker Criterion and the HTMT ratio"*.

4.3.1 Convergent Validity

Convergent validity of the constructs was tested in this research study to guarantee that each construct effectively converges to explain the variance of its indicators. It is critical that two or more indicators used to quantify a latent variable in a research study be connected to each other. The SEM technique with SMARTPLS was used in this investigation.

The AVE was used to determine convergent validity. Acceptable AVE values are 0.50 or higher (Hair et al., 2019). Table 1 and 2 show that the AVE values for all constructions are more than the minimum criteria of 0.50. The highest AVE value of 0.901 is observed for RER (Table 1), while the lowest AVE value of 0.648 is found for VLC (Table 2). As all the AVE values exceed the minimum threshold, it is established that all the indicators used to measure each latent variable are

indeed related to each other. Thus, the study successfully establishes convergent validity, as shown in Table 1 (multiple level) and Table 2 (dyadic level).

Factor loadings or outer loadings were also used to evaluate the convergent validity of the indicators. The individual validity of each indicator relating to latent variables was assessed using outer loadings. If the outside loadings are more than 0.70, indication validity is deemed adequate by Hair and Sarstedt (2019). The factor loadings for each construct are shown in Table 1 (multiple level) and Table 2 (dyadic level), along with the item or indicator names that they correspond to in the code column. After careful consideration, all the indicators outer loadings were higher than 0.70. Thus, confirming the convergent validity. Conclusively, choosing the proper indicators for the measurement model required careful consideration of how factor loadings, particularly outer loadings, assessed the validity of the indicators. Without adding more words, the researchers improved the validity and robustness of their study by keeping dependable indicators and making sure that high-quality data were used.

4.3.2 Discriminant Validity

Discriminant validity refers to the empirical distinction of one construct from another (Hair et al., 2021). Discriminant validity examines how one latent variable differs from other variables. In Smart PLS, there are two ways for determining discriminant validity: "*Fornel and Lacker Criteria and HTMT ratios*". Each method has its own set of rules or criteria for determining construct discriminant validity. Fornell and Larker (1981) devised the Fornell Lacker criteria. This criterion thoroughly assesses the discriminant validity. The square root of the AVE of each variable in the study model must be greater than the correlation of the same variable with others in this procedure. The Fornell Lacker Criterion results are presented as a matrix (see Table 3 and Table 4, Panel A). The values at the top of diagonals must be greater than the values at the bottom. The values on the top of the diagonals in the Table 3 and Table 4 (Panel A) are higher than the values below, indicating that discriminant validity has been established.

Table 3: Discriminant Validity: Multiple Level

Panel A: Fornell Larker Criteria					
Construct	**CP**	**KS**	**RR**	**TR**	**VC**
CP	**0.848**				
KS	0.589	**0.859**			
RR	0.779	0.456	**0.949**		
TR	0.356	0.731	0.242	**0.889**	
VC	0.614	0.520	0.477	0.724	**0.808**
Panel B: Heterotrait-Monotrait (HTMT) Ratio					
Construct	**CP**	**KS**	**RR**	**TR**	**VC**
CP					
KS	0.683				

RR	0.528	0.502			
TR	0.421	0.416	0.275		
VC	0.604	0.679	0.517	0.494	

Note: "CP: Coopetition, TR: Trust, KS: Knowledge Sharing, RR: Resource Relevance, VC: Value Creation."

HTMT is an estimate of the constructs' correlation. It is known as a new criterion for evaluating discriminant validity in SEM. The interpretation of HTMT analysis has become simpler. The HTMT estimate required comparing mechanism with a predefined threshold to determine discriminant validity. The previously discussed and supported threshold value has already been explored and supported in the literature. For example, Henseler et al. (2015) claimed that to verify for discriminant validity, the HTMT value of effect should be less than 0.90. If the HTMT value is greater than this threshold, there is a lack of discriminant validity. All HTMT values in Table 3 and 4 (Panel B) are less than 0.90, indicating that the discriminant validity of constructs has been demonstrated.

Table 4: Discriminant Validity: Dyadic Level

Panel A: Fornell Larker Criteria						
Construct	**CF**	**CP**	**KS**	**RR**	**TR**	**VC**
CF	**0.831**					
CP	0.439	**0.825**				
KS	0.513	0.477	**0.878**			
RR	0.476	0.542	0.423	**0.950**		
TR	0.692	0.266	0.666	0.238	**0.914**	
VC	0.514	0.664	0.765	0.478	0.642	**0.805**
Panel B: Heterotrait-Monotrait (HTMT) Ratio						
Construct	**CF**	**CP**	**KS**	**RR**	**TR**	**VC**
CF						
CP	0.535					
KS	0.659	0.544				
RR	0.561	0.611	0.463			
TR	0.635	0.303	0.535	0.266		
VC	0.527	0.680	0.696	0.522	0.671	

Note: "CP: Coopetition, TR: Trust, KS: Knowledge Sharing, CF: Cultural Fit; RR: Resource Relevance, VC: Value Creation."

4.4 Assessment of Structural Model (SM)

A SM is important in research since it assists in understanding the linkages and interactions between variables (Hair and Sarstedt, 2019). SM helps researchers to test hypotheses and evaluate theoretical frameworks by sketching causal pathways and directional links between latent constructs (Hair and Sarstedt, 2019). Through SEM analysis, it measures the strength and relevance of linkages across constructs, providing insights into the fundamental mechanisms driving the events under research (Hair et al., 2020). SM also facilitates model evaluation and fit assessment, ensuring that the model effectively captures data and expresses theoretical constructs (Purwanto, 2021). It also helps with hypothesis testing, theory confirmation, and comparing various models, all of which contribute to the advancement of knowledge in the subject (Shmueli et al., 2019). SM not only improves reliability and validity, but it also gives a graphical depiction of variable interactions, making it easier to communicate research findings to the scientific profession and stakeholders (Shmueli et al., 2019). Figure 5 (multiple level) and Figure 6 (dyadic level) depict the structural models of the study.

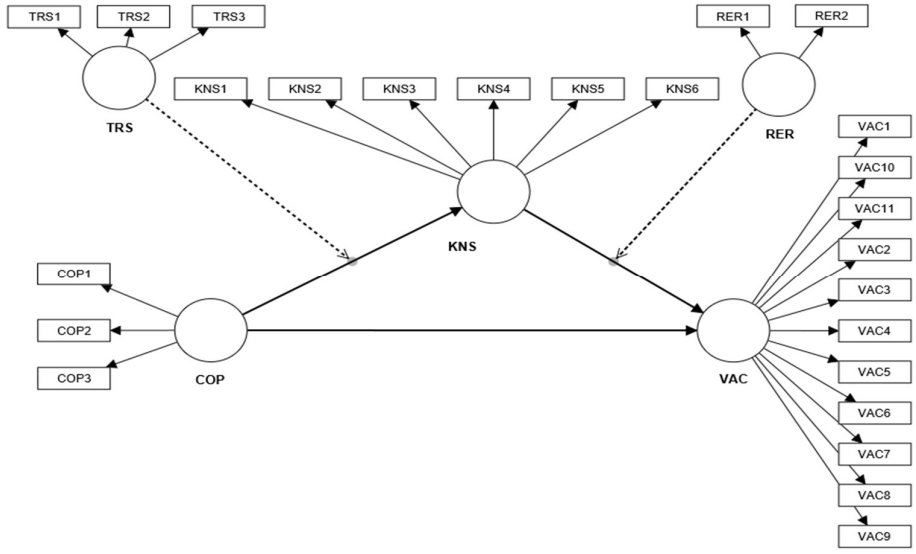

Figure 5: Structural Model (Multiple Level)

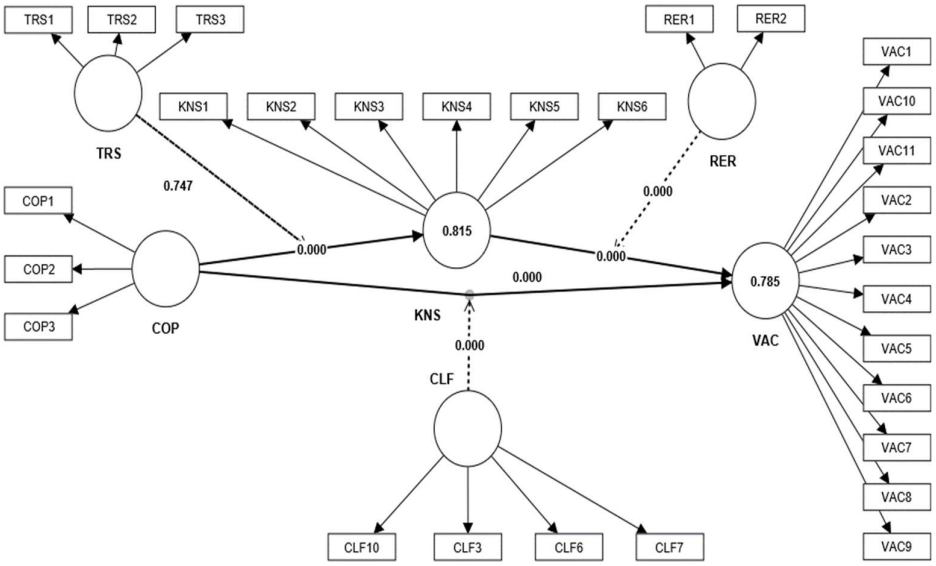

Figure 6: Structural Model (Dyadic Level)

Using SM to analyse primary data increases the general accuracy and validity of the research project. SMs are extensively used by researchers to test hypotheses and investigate intricate connections between variables (Hair and Sarstedt, 2019). The model provides for the control of confounding variables as well as the identification of critical elements that influence the desired outcome. SMs are useful tools in empirical research, assisting researchers in confirming hypotheses and addressing collinearity difficulties. Thus, SMs are critical for comprehending variable relationships, testing hypotheses, assessing model fit, and interpreting research outcomes. Their use adds rigor and depth to the analysis, improving the overall quality of the study.

4.4.1 Hypotheses Testing

In this section, the testing of direct, indirect (mediation) and moderation hypotheses are presented. These are shown in Table 5 and Table 6.

Hypothesis 1a: **Coopetition positively relates to value creation at dyadic level.**

Table 5 and 6 display the SEM results for the model's variables. The first column lists the paths that were examined in the analysis. The estimated coefficients for each variable are shown in the second column, and the standard errors are shown in the third column. The fourth column displays the calculated t-values, and the fifth column displays the corresponding p-values. The statistical significance of the coefficients is determined using the t-values and p-values. The dyadic coopetition coefficient (as shown in Table 5, path 1) has very low p-values (0.000), indicating that they are statistically significant. Based on the calculated values and standard errors, these intervals provide a range of feasible coefficient values. According to the findings, dyadic cooperation has a strong positive impact on value creation, as indicated by the statistically significant coefficient and related p-value. As a result, H_{1a} is supported.

Table 5: Hypotheses Testing (Dyadic Level)

Paths		Coefficient	Std. Dev.	T-Statistics	P-Values	Remarks
1	COP → VC	0.381	0.078	4.861	0.000^{***}	H_{1a}

2	CLF x COP → VLC	0.021	0.068	0.312	0.755	H_{1c}
3	COP → KNS	0.248	0.071	3.505	0.000***	H_{2a}
4	TR x COP → KNS	0.014	0.044	0.322	0.747	H_{3b}
5	KNS → VLC	0.768	0.093	8.239	0.000***	H_{4a}
6	COP → KNS → VLC	0.190	0.049	3.898	0.000***	H_{4c}
7	RRR x KNS → VLC	0.255	0.073	3.512	0.000***	H_{5a}

Note: "***: p≤0.01. CP: coopetition, VC: value creation, KS: knowledge sharing, TR: trust, RR: resource relevance."

Table 6: Hypotheses Testing (Multiple Level)

Paths		Coefficient	Std. Dev.	T-Statistics	P-Values	Remarks
1	COP → VLC	0.709	0.052	13.628	0.000***	H_{1b}
2	COP → KNS	0.281	0.068	4.133	0.000***	H_{2b}
3	TR x CP → KS	0.249	0.060	4.122	0.000***	H_{3a}
4	KS → VC	0.853	0.048	17.923	0.000***	H_{4b}
5	CP → KS → VC	0.240	0.056	4.312	0.000***	H_{4d}
6	RR x KS → VC	0.796	0.039	20.247	0.000***	H_{5b}

Note: "***: p≤0.01. CP: coopetition, VC: value creation, KS: knowledge sharing, TR: trust, RR: resource relevance."

Hypothesis 1b: **Coopetition positively relates to value creation at multiple level.**

Table 6 (path 1) provides results for the impact of multiple coopetition on value creation. The coefficient for the multiple coopetition variable is estimated to be 0.709, with a standard error of 0.052. The t-value is 13.628, and the p-value is 0.000, suggesting that the coefficient is statistically significant. These results support H_{1b} of a positive relationship between multiple coopetition and value creation. The coefficient of 0.709 suggests that, on average, a one-unit increase in multiple coopetition is associated with an increase of approximately 0.71 units in value creation.

Hypothesis 1c: *Cultural fit moderates the relationship between coopetition and value creation at dyadic level.*

Table 5 (path 2) shows the results for cultural fit as a moderator between dyadic coopetition and value creation. The coefficient for cultural fit (CF×CP) is 0.021, (t-value is 0.312, and the p-value is 0.755), indicating that it is not statistically significant. The results indicate that cultural fit does not moderate between dyadic coopetition and value creation. Thus, H_{1c} is rejected.

Thus, the degree of the moderating effect of cultural fit on the relationship between dyadic coopetition and value creation in IT enterprises emphasizes the need of organizations focusing on other crucial factors impacting the effectiveness of coopetition partnerships. Understanding the distinct characteristics that drive value creation in cooperative collaborations can assist IT firms

in developing effective strategies and increasing their competitive edge in a rapidly changing industry (Knein et al., 2020).

Hypothesis 2a: *Coopetition positively relates to knowledge sharing at dyadic level.*

Table 5 (path 3) shows that dyadic cooperation has a positive connection with dyadic knowledge sharing (KNS). A one-unit increase in dyadic cooperation is connected with an increase in KNS of roughly 0.248 units. H_{2a} is accepted. In the ever-changing landscape of the IT business, KNS is critical to improving organizational performance and competitiveness. Dyadic coopetition, a strategy approach that incorporates both cooperative and competing contacts between enterprises, has emerged as a prominent driver of KNS in IT firms. This approach develops a collaborative and competitive atmosphere, encouraging businesses to exchange valuable expertise and resources for mutual gain (Vătămănescu et al., 2022).

Hypothesis 2b: *Coopetition positively relates to knowledge sharing at multiple level.*

Table 6 (path 2) displays how multiple coopetition affects KS. Multiple coopetition has a statistically significant positive influence on KNS, as shown by the coefficient for multiple coopetition, which is 0.281 and has a matching p-value of 0.000. These findings are consistent with H_{2b}, which holds that coopetition has a positive relationship with KS at multiple levels. KS increases by about 0.281 units for every unit that multiple cooperation increases by. Multiple coopetition, a strategy that involves concurrent competitive and collaborative interactions with numerous partners, has shown to have a considerable positive impact on KS in the context of IT firms. By encouraging the sharing of information, ideas, and resources among multiple businesses, this strategic approach produces a dynamic and interconnected ecosystem that enhances innovation and competitive advantage (Czakon et al., 2020).

Hypothesis 3a: *Organizational trust strengthens the relationship between coopetition and knowledge sharing at multiple level.*

Table 6 (path 3) illustrates how organizational trust influences the relationship between multiple cooperation and KNS. The coefficient for the interaction term (TR×CP) between multiple cooperation and organizational trust is 0.249, and the p-value of 0.000 indicates that the coefficient is statistically significant. As a result, H_{3a} is supported.

This finding emphasizes how important trust is to successful teamwork and KNS. Organizational trust acts as a fundamental component that boosts the efficiency of various coopetition arrangements by encouraging transparency, collaboration, and mutual reliance among partner companies (Bacon et al., 2020). The exchange of information and resources is facilitated by trust in the context of multiple coopetition, where businesses engage in both cooperative and antagonistic actions with different partners. Since partners have faith in one another's good intentions and skills, trust lowers uncertainty and risk. This feeling of trust motivates businesses to share their priceless expertise without worrying about being taken advantage of or betrayed, creating a more open and transparent knowledge-sharing environment (Virtanen and Kock, 2022).

Hypothesis 3b: *Organizational trust moderates the relationship between coopetition and knowledge sharing at dyadic level.*

Table 5 (path 4) exhibits that the coefficient for the interaction term between dyadic cooperation and organizational trust (TR×CP) at is calculated to be 0.014. The interaction is insignificant, as evidenced by the insignificant p-values. These findings do not support H_{3b}.

The findings offer insight on the complexities of cooperation and rivalry dynamics inside organizations. At an intermediate degree of trust, partner enterprises are more likely to achieve a balance between cooperative and competitive behaviours, establishing an atmosphere of mutual understanding and respect. This optimal level of trust fosters a climate conducive to productive KS, as organizations feel confident communicating important information without fear of abuse (Kochura et al., 2022).

Hypothesis 4a: *Knowledge sharing relates positively to value creation at dyadic level.*

Table 4.5 (path 5) depicts the relationship between KnS and VLC. The coefficient for KNS is 0.768, which is significant at the 0.01 level. This finding supports H_{4a}, which states that KNS has a positive impact on VLC at the dyadic level.

At the dyadic level in IT firms, KNS is critical to drive VLC through joint activities. Partner companies that effectively share knowledge improve their ability to work together while gaining access to important knowledge. They are able to build on each other's strengths through this KNS, which leads to the creation of innovative goods, services and solutions that meet the shifting demands of the market (Planko et al., 2019). KNS facilitates learning and continual improvement, which is one of the most significant ways it adds value. Businesses in the IT industry that share their knowledge promote a culture of flexibility and learning (Wang et al. 2023). They are better able to keep up with technology changes and adjust to shifting client expectations as a result. Resultantly, they can deliver top-notch goods and services that satisfy their customers' evolving demands, enhancing their clientele's contentment and loyalty (Wang et al. 2023).

Hypothesis 4b: *Knowledge sharing relates positively to value creation at multiple level.*

Table 4.6 (path 4) shows that the coefficient for KS is 0.853 (p-value; 0.000), which is statistically significant. As a result, H_{4b} is acknowledged. The study's findings reveal that there is a positive association between KS and VC in IT firms. This indicates that when partner firms engage in successful KS practices, it leads to an increase in VC for both individual enterprises and the collaborative efforts as a whole (Butt et al., 2022). This finding is consistent with earlier research that emphasizes the value of KS in encouraging innovation, boosting problem-solving abilities, and improving overall performance (Butt et al., 2022; Good, 2023).

Hypothesis 4c: *Knowledge sharing mediates the relationship of coopetition and value creation at dyadic level.*

Table 5 (path 6) depicts the role of KS as a mediator between dyadic cooperation and VC. The direct effect of dyadic cooperation on VC (path 1) has a coefficient of 0.381 and a significant p-value (0.000), indicating that the direct effect is statistically significant. The indirect effect of coopetition on VC through KS (path 6) has a coefficient of 0.190 and a significant p-value (0.000), indicating that the indirect effect is statistically significant. The total effect of coopetition on VC has a coefficient of 0.571 (0.381+ 0.190) and a significant p-value (0.000), indicating that the total

effect is statistically significant. The partial mediation level is determined as the indirect effect divided by the total effect. Thus, the mediation level is partial.

These findings show that at the dyadic level, KS mediates the relationship between cooperation and VC. The direct effect of coopetition on VC is statistically significant, demonstrating a positive relationship. Furthermore, the mediation effect implies that the mediating role of KS explains a considerable percentage of the relationship between coopetition and VC. As a result, H_{4c} is approved.

Hypothesis 4d: *Knowledge sharing mediates the relationship of coopetition and value creation at multiple level.*

Table 4.11 (path 5) depicts the role of KS as a mediator between multiple cooperation and VC. The direct effect of multiple cooperation on VC (path 1) has a significant coefficient of 0.709, indicating that the direct effect is statistically significant. The indirect effect of coopetition on VC through KS (path 5) has a significant coefficient of 0.240, indicating that the indirect effect is likewise substantial. The total effect of coopetition on VC has a significant coefficient of 0.949 (0.709+0.240), indicating that the total effect is considerable. The level of mediation is only partially effective. H_{4d} is sustained.

Hypothesis 5a: *Resource relevance moderates the relationship between knowledge sharing and value creation at dyadic level.*

Table 5 (path 7) depicts the moderating influence of resource relevance (RR) at the dyadic level. The coefficient for the interaction between RR and KS (RR×KS) is 0.255 and is significant. It indicates that RR significantly moderates between KS and dyadic coopetition. These findings lend credence to H_{5a}. The presence of a positive coefficient for the interaction term implies that the degree of RR influences the relationship between KS and VC. The study demonstrates that the degree of RR modifies the relationship between KS and VC at the dyadic level. This suggests that the influence of KS on VC varies depending on the level of RR in a given dyadic connection (Ganguly et al., 2019). When resources are highly relevant to the partnership, KS is predicted to have a more significant and beneficial impact on VC outcomes (Salamzadeh et al., 2023; Singh et al., 2021).

Hypothesis 5b: *Resource relevance moderates the relationship between knowledge sharing and value creation at multiple level.*

Table 6 (path 6) depicts the moderating influence of RR on KS-VC nexus at multiple level. The coefficient (0.796) for the interaction between KS and RR is positive and significant at the 0.01 level. These findings confirm H_{5b}'s contention that RR moderates the relationship between KS and VC at several levels. The presence of a positive coefficient for the interaction component implies that the degree of RR influences the link between KS and VC.

The findings suggest that the extent to which KS effects VC outcomes in multiple collaboration partnerships is dependent on the level of RR present in the collaborative context. The findings imply that when resources are highly relevant and linked with cooperative efforts, KS has a more substantial and beneficial effect on VC (Goh et al., 2020). In such cases, sharing important

knowledge and skills among partner enterprises leads to higher synergy and effective resource utilization, resulting in increased VC.

5. Conclusion

The worldwide nature of the software industry and the application of innovative knowledge in producing new software have contributed to the software industry's transformation into a technology-oriented sector (Binuyo et al., 2015). The software industry is undergoing tremendous change and transition (Bianchi et al., 2020), necessitating cutting-edge technologies in software development and practices (Schneckenberg et al., 2021). Due to limited technological resources, a single firm cannot undertake this technological transition of software products. As a result, organizations look for external resources and opportunities to supplement their software development capabilities (Nguyen-Duc et al., 2018). As a result, most software companies build their products in conjunction with other software companies (Jansen et al., 2009) with whom they compete. This subject motivates corporations to collaborate with competitors, a practice known as coopetition. This paper empirically explains the value-creation mechanism in the software business in Pakistan.

The study investigated the impact of collaboration on value creation in the IT sector, considering both dyadic and multiple connections. It also looked into the roles of knowledge sharing, cultural fit, organizational trust, and resource relevance in moderating and mediating these interactions. The findings provide valuable insights with practical and societal ramifications.

The study found that cooperation favorably impacted value creation at both the dyadic and multiple levels. This conclusion emphasizes the need to embrace coopetition as a feasible strategy for enterprises in the volatile software industry. The industry's demands for collaboration with competitors imply that operating alone may not result in optimal value development. Embracing coopetition helps organizations to pool resources, share expertise, and cooperatively confront obstacles, resulting in increased innovation and overall value creation.

Furthermore, the favourable influence of cultural fit on value creation at the dyadic level emphasizes the importance of shared values, norms, and aims in successful cooperative endeavours. Firms that align culturally are better suited to interact effectively, resulting in higher levels of value generation through synergistic efforts.

The study also emphasizes the critical role of information sharing as a mediator in the relationship between coopetition and value creation, both at the dyadic and multiple levels. This highlights the importance of corporations actively fostering a knowledge-sharing culture, supporting the free flow of information and ideas among competitors. Firms may magnify the favourable impact of competition on value creation by utilizing collective intelligence and complementary strengths.

Furthermore, organizational trust was discovered to increase the relationship between coopetition and knowledge sharing at many levels. This emphasizes the importance of trust among cooperating enterprises, as it increases the desire to share essential knowledge and resources, resulting in more value creation.

The study also demonstrated an intriguing dyadic relationship between organizational trust, coopetition, and knowledge sharing and finds that a healthy level of trust is essential for successful

information sharing in dyadic collaboration interactions. Furthermore, the study found that resource relevance moderates the relationship between knowledge sharing and value creation at the dyadic and multiple levels.

Finally, the study sheds light on the complicated dynamics of competition and its impact on value creation in the IT sector. Embracing coopetition as a strategy can produce excellent results for organizations attempting to negotiate the demands of the software sector, where collaboration with competitors is crucial. To optimize collaboration and foster extensive value creation, cultural compatibility, knowledge sharing, and trust are pivotal factors. The research underscores the importance of establishing credibility among competitors and creating an environment conducive to knowledge sharing. To maximize the advantages of knowledge-sharing endeavours, the study emphasizes the need for comprehensive assessments of the relevance of available resources. These findings have significant implications for collaboration and the production of value across various industries and are helpful for IT firms.

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