



Linking relation-specific investments and sustainability performance: The mediating role of supply chain learning

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Linking relation-specific investments and sustainability performance: The mediating role of supply chain learning

Abstract

Purpose – Despite the growing interest in the role of relation-specific investments (RSIs) in superior firm performance, their impact on sustainability performance remains unexplored, as do the underlying mechanisms of such effects. Drawing on the relational view and resource orchestration theory (ROT), we propose that supply chain learning (SCL) mediates the link between RSIs and sustainability performance.

Design/methodology/approach – A multi-method approach was adopted, combining a case study and survey. An exploratory case study of four Chinese manufacturing firms was first conducted to develop research hypotheses. A quantitative survey of data collected from 269 firms was then undertaken to test hypotheses.

Findings – Property-based, knowledge-based, and personal-based RSIs positively impact firm sustainability performance and SCL. SCL fully mediates the relationship between knowledge-based as well as personal-based RSIs and sustainability performance, and partially mediates the relationship between property-based RSIs and sustainability performance.

Originality – The study extends the RSIs literature by linking RSIs and sustainability performance and differentiating the effects of different types of RSIs on sustainability performance. The theorized underlying mechanism advances the understanding of SCL in the link between RSIs and sustainability performance.

Practical implications – The study unveils important practical insights and approaches for firms endeavouring to achieve sustainability performance through RSIs and SCL.

Keywords Relation-specific investments, Sustainability performance, Supply chain learning, Multi-method research, Relational view, Resource orchestration theory

1 Introduction

As an increasingly important issue on the global corporate agenda, sustainability has received considerable attention from scholars and practitioners for decades (He and Harris, 2020). To achieve sustainability, firms are increasingly building collaborative relationships with their supply chain (SC) partners (Kumar *et al.*, 2018). Successful interfirm collaboration entails substantial relation-specific investments (RSIs) (Dyer and Singh, 1998; Luo *et al.*, 2009).

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3 These are tangible and intangible investments made by partnering firms that provide
4 idiosyncratic assets for a particular relationship (Williamson, 1985; Heide and John, 1988).
5 From the relational view, RSIs are a critical source of relational rents for superior firm
6 performance (Dyer and Singh, 1998). RSIs enable the firms in the relationship to obtain higher
7 returns and sustainable competitive advantages (Nyaga *et al.*, 2010). A number of studies have
8 demonstrated the significant connections between RSIs and improved performance of the firms
9 in the SC (e.g. Nyaga *et al.*, 2010; Wang *et al.*, 2014; Vázquez-Casielles *et al.*, 2017). However,
10 these studies focus primarily on the conventional economic performance generated by RSIs.
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13 The SC literature indicates that, over time, the focus of firm performance in SCs has
14 advanced from economic aspects to environmental and social aspects: the triple bottom line
15 perspective on firms' sustainability performance (Chen *et al.*, 2017; Miemczyk and Luzzini,
16 2018; Sudusinghe and Seuring, 2021). RSIs, although associated with certain lock-in risks and
17 transaction costs (Jap and Ganesan, 2000), facilitate trust, commitment, knowledge exchange,
18 and reciprocity between buyers and suppliers (De Vita *et al.*, 2011). These have been frequently
19 underlined by SC researchers as means to improve the sustainability performance of firms in
20 SCs (e.g. Flygansvær *et al.*, 2018; Mishra *et al.*, 2018; Hofmann, 2019; Howard *et al.*, 2019).
21 Although RSIs can be a critical factor for achieving sustainability performance, their impact
22 on sustainability performance lacks empirical support, and the underlying influence
23 mechanism also remains unclear.
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26 Scholars have categorized RSIs into different types (e.g. Williamson, 1985), including
27 property-based RSIs, knowledge-based RSIs (Hoetker and Mellewigt, 2009), and personal-
28 based RSIs (Wang *et al.*, 2014). Although the relational view proposes that RSIs allow firms
29 to pursue superior performance (Dyer and Singh, 1998), the empirical findings on the
30 relationship between RSIs and firm performance are inconclusive. Some studies have
31 confirmed a positive relationship (e.g. Liu *et al.*, 2009; Cao and Zhang, 2011; Wang *et al.*,
32 2014); others have reported a negative or insignificant relationship (e.g. Artz and Brush, 2000;
33 Roden and Lawson, 2014). According to the RSI literature, different types of RSIs play distinct
34 roles in business activities (Lohtia, 1994), and thus may influence firm performance in varying
35 ways. This highlights the imperativeness of fine-grained investigations into different types of
36 RSIs, examining the association with firm performance. It would therefore be of great
37 significance to differentiate the influence of different types of RSIs on firm sustainability
38 performance.
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41 Meanwhile, as critical resources that span organizational boundaries, RSIs may not
42 influence firm performance directly (Dyer *et al.*, 2018). The recent debate on the RSIs-firm
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performance relationship has highlighted the indirect link between the two (Nyaga *et al.*, 2010; Lai *et al.*, 2013; Huang and Huang, 2019). According to resource orchestration theory (ROT), merely possessing resources is not sufficient for achieving superior firm performance; it is necessary to orchestrate (manage) them (Sirmon *et al.*, 2011). Specifically, resources should be effectively managed through structuring, bundling, and leveraging in order to obtain competitive advantages and superior firm performance (Sirmon *et al.*, 2007). This indicates that to understand the influencing mechanism of interfirm resources such as RSIs on sustainability performance, we need to explore the potential mediators related to managerial actions at an interfirm level.

Recently, supply chain learning (SCL) has been increasingly proposed as an important way of managing interfirm resources related to sustainability performance (Silvestre, 2015; Gong *et al.*, 2018; Yang *et al.*, 2018). SCL is defined as the collective learning that occurs among multiple SC partners (Flint *et al.*, 2008). It has been recognized that SCL is a critical part of sustainability management in SCs (Gosling *et al.*, 2016), especially in the post-pandemic era (Pereira *et al.*, 2021). By facilitating sustainability knowledge acquisition and sharing with SC partners, SCL generates competitive advantages and leads to improved sustainability performance of SC firms (Silvestre *et al.*, 2020; Roy *et al.*, 2020). Scholars have also realized that such learning activities may be affected by RSIs. This is because past RSIs made in a relationship create favourable conditions for developing learning practices (Selnes and Sallis, 2003; Cheung *et al.*, 2010). It thus can be expected that RSIs will be a critical factor to trigger SCL, which further drives firm sustainability performance. Despite this, no research has empirically examined the mediating effect of SCL in the relationship between RSIs and sustainability performance.

Against the above backdrop, in this study, we draw on the relational view and ROT to explore the following research questions (RQs):

RQ1. How do different types of RSIs affect a firm's sustainability performance?

RQ2. How does SCL mediate the association between RSIs and sustainability performance?

To answer the RQs, we employed a multi-method approach combining a case study and survey. An exploratory case study of four Chinese manufacturing firms was first conducted; this was followed by a quantitative survey of data collected from 269 Chinese firms from different manufacturing industries. This study contributes to the literature in three ways. First, we extend the previous body of knowledge on RSIs by linking them with sustainability performance and differentiating the effects of different types of RSIs on sustainability performance. Our results show that property-based, knowledge-based, and personal-based

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3 RSIs positively impact firm sustainability performance. Second, we theorize the underlying
4 mechanism – that is, SCL – to uncover how RSIs affect sustainability performance. Our results
5 empirically confirm that SCL fully mediates the link between knowledge-based and personal-
6 based RSIs and sustainability performance, and partially mediates the link between property-
7 based RSIs and sustainability performance. By so doing, our study advances the SCL literature
8 through enriching its antecedents and consequences. Third, we contribute to the relational view
9 and ROT by integrating them to explain the strategic resource-action-performance pathway at
10 an interfirm level.
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13 The rest of the paper is structured as follows. Section 2 provides a review of the relevant
14 bodies of literature and theoretical lenses. Section 3 describes the overall methodological
15 approach and details the exploratory case study. Section 4 presents the results of the case study,
16 from which we developed the hypotheses and research framework. Section 5 presents the
17 design of the survey to test the hypotheses, and the results from the empirical test. Section 6
18 discusses the results. Section 7 concludes the paper with theoretical contributions, managerial
19 implications, limitations, and future research directions.
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22 23 24 25 26 27 28 29 30 31 **2 Literature review and theoretical background**

32 33 *2.1 The relational view and ROT*

34 The relational view proposes that relationship partners can develop strategic resources that span
35 organizational boundaries, facilitating competitive advantages and superior firm performance
36 (Dyer and Singh, 1998). This view extends the traditional resource-based view, which focuses
37 on individual firm resources. In today's business environment, firms are increasingly
38 competing at an interfirm level, for example between SCs, rather than at the firm level (Chen
39 *et al.*, 2013). From the relational view, RSIs embedded in interfirm relationships (e.g. buyer-
40 supplier) are critical resources that generate competitive advantages for firms (Dyer and Singh,
41 1998). When the relationship becomes established and institutionalized, the partnering firms
42 are willing to invest in relationship-specific assets that benefit both parties (Potter and Wilhelm,
43 2020). These dedicated investments reflect long-term commitment to the relationship, enabling
44 higher returns and sustained competitive advantages (Nyaga *et al.*, 2010), and contributing to
45 superior firm performance (Dyer and Chu, 2000). Thus, RSIs are the key to superior
46 performance for firms in the relationship.
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49 Further, the recent development of the relational view suggests that RSIs may not influence
50 firm performance directly (Dyer *et al.*, 2018). Instead, the relationship commitment reflected
51 by RSIs, as informal mechanisms, requires effective governance to benefit firm performance.
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3 However, relational view research has failed to pursue the question of how to develop
4 governance strategies for managing strategic resources such as RSIs (Arora *et al.*, 2016). ROT
5 supplements this by emphasizing the orchestration (management) of strategic resources to
6 achieve competitive advantages and superior firm performance (Sirmon *et al.*, 2011). It
7 provides insights into the process by which strategic resources are managed to realize superior
8 firm performance. ROT is becoming prevalent in research on the links between strategic
9 resources, managerial actions, and firm performance (D’Oria *et al.*, 2021).

15 The central argument of ROT is that “possessing resources alone does not guarantee the
16 development of competitive advantages; instead, resources must be accumulated, bundled, and
17 leveraged” (Sirmon *et al.*, 2011, p. 1391). The full value of strategic resources for generating
18 competitive advantages can be realized only when these resources are effectively managed
19 (Sirmon and Hitt, 2003; Sirmon *et al.*, 2007). Resource management includes structuring,
20 bundling, and leveraging actions. Specifically, the portfolio of resources needs to be structured,
21 through acquiring and accumulating; the structured resources then need to be bundled, to build
22 capabilities through stabilizing and enriching; and these capabilities need to be further
23 leveraged in the marketplace through mobilizing and coordinating. This ultimately leads to
24 superior firm performance (Sirmon *et al.*, 2007; Sirmon *et al.*, 2011). While each action is
25 important, it is in synchronizing the resource management actions that value can be added via
26 positive firm outcomes (Sirmon *et al.*, 2008). ROT explains how strategic resources can be
27 orchestrated and translated into competitive advantages and superior firm performance through
28 managerial actions. In other words, resources do not directly contribute to superior firm
29 performance; managerial actions mediate the relationship between them.

41 We thus synthesize the relational view and ROT to examine the link between RSIs and
42 sustainability performance, as well as the underlying influence mechanism. The integration of
43 the two theoretical lenses is particularly useful for this study. The relational view provides
44 insights into buyer-supplier relationships, viewing RSIs embedded in relationships as strategic
45 resources that generate superior firm performance; this is suitable for exploring the link
46 between RSIs and sustainability performance. The supplement of ROT allows us to understand
47 the influencing mechanism; that is, the degree to which firms translate their RSIs into improved
48 sustainability performance through resource management at the SC level, for example by SCL
49 (Silvestre, 2015; Gong *et al.*, 2018; Yang *et al.*, 2018).

58 2.2 RSIs and sustainability performance

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3 RSIs elucidate the various investments a firm makes in a specific relationship toward
4 facilitating and improving the collaboration with partners (Williamson, 1985; Heide and John,
5 1988). Scholars have often categorized interfirm RSIs into property-based RSIs and
6 knowledge-based RSIs, based on the governance mechanisms entailed (Hoetker and Mellewig,
7 2009). *Property-based RSIs* are investments in the tangible assets of a relationship partner,
8 such as sites, tools, machinery, infrastructure, and buildings. *Knowledge-based RSIs* are
9 investments in intangible assets; that is, techniques or skills that a firm learns from its partner,
10 such as management techniques and human resources training. In addition, Wang *et al.* (2014)
11 have recently proposed interpersonal RSIs (hereafter, *personal-based RSIs*), which are
12 investments in *guanxi* (personal relationships) with a specific partner, such as personal time,
13 attention, and resources. Personal-based RSIs are highly bound to specific individuals and their
14 relationships, rather than specific firms. Compared with property-based and knowledge-based
15 RSIs, personal-based RSIs are more private and informal, and involve more emotional and
16 irrational factors.

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Previous studies indicate that RSIs can profoundly impact firm performance (e.g. Nyaga
et al., 2010; Kwon, 2011; Wang *et al.*, 2014; Vázquez-Casielles *et al.*, 2017). However, these
studies predominantly focus on conventional economic performance outcomes. The SC
literature indicates that the focus of firm performance has advanced from economic aspects to
environmental and social aspects, considering the sustainability performance of firms
(Sudusinghe and Seuring, 2021). RSIs promote trust-building (Liu *et al.*, 2009; De Vita *et al.*,
2011), relationship commitment (Nyaga *et al.*, 2010), knowledge spillover (Kang *et al.*, 2009),
integration (Huang and Huang, 2019), and reciprocity (Kwon, 2011) between SC partners;
these have been underlined by recent SC research as critical means to improve sustainability
performance for firms in SCs (e.g. Mishra *et al.*, 2018; Flygansvør *et al.*, 2018; Hofmann, 2019;
Howard *et al.*, 2019). In this vein, RSIs may significantly affect sustainability performance.
Nevertheless, the impact of RSIs on sustainability performance lacks empirical support, and its
influence mechanism also remains unclear.

Although the relational view proposes that RSIs generate competitive advantages and
superior firm performance (Dyer and Singh, 1998; Dyer and Chu, 2000), different types of
RSIs exert varying effects on business activities and firm performance (Lohtia *et al.*, 1994;
Subramani and Venkatraman, 2003; Wang *et al.*, 2014). In this study, we therefore distinguish
the impacts of property-based, knowledge-based, and personal-based RSIs on sustainability
performance. ROT further provides an opportunity to uncover the influence mechanisms of
different types of RSIs on sustainability performance. Following ROT, we underline that the

relationship between a firm's RSIs (embedded in its SC relationship) and sustainability performance should be indirectly linked through the firm's managerial actions at the SC level, for example SCL (e.g. Gong *et al.*, 2018). In other words, to achieve sustainability performance, RSIs should be aligned with SCL rather than having independent effects.

2.3 RSIs, SCL, and sustainability performance

SCL has been proposed as an important way of managing interfirm resources to achieve sustainability (Silvestre, 2015; Gong *et al.*, 2018; Yang *et al.*, 2018). It includes four distinct but interrelated orientation dimensions: team orientation, learning orientation, system orientation, and memory orientation (Ojha *et al.*, 2018). These explain the ways a firm explores and exploits resources to enhance performance (Sirén *et al.*, 2012; Silvestre *et al.*, 2020).

Team orientation emphasizes collaboration and cooperation among team members. It promotes team spirit, commonality of purpose, and shared vision. It enables employees of SC members to share information, create new ideas, and work together to achieve desired outcomes (Gong *et al.*, 2013). *Learning orientation* describes the commitment of SC members to a learning process for long-term prosperity within SCs. Where such a learning culture exists, members acknowledge that learning is an investment in improving desired outcomes, and they engage in continuous learning of new knowledge (Khedhaouria *et al.*, 2017). *System orientation* requires individuals to understand the fit of their work into the overall system. Understanding the interconnection of a firm's own activities with those of others in the SC system allows for clarification and alignment of goals between SC members (Argote and Ophir, 2017). *Memory orientation* concerns the storage of learned knowledge, demonstrated by a culture that encourages communication of embedded knowledge, routines, and past experiences. It provides access to information through a repository of experiences, easing the transfer of knowledge between SC members (Hoetker and Agarwal, 2007). SCL occurs when SC members practise the four orientation dimensions of learning (Ojha *et al.*, 2018).

The SCL of sustainability-associated knowledge indicates a learning process aimed at social, environmental, and economic issues (Cormack *et al.*, 2021); this is essential for successful sustainability implementation and performance among SC members (Gong *et al.*, 2018; Yang *et al.*, 2018; Silvestre *et al.*, 2020). As a way of orchestrating (managing) resources (Gong *et al.*, 2018), this four-dimensional learning can occur from the interfirm level to the individual level (Pereira *et al.*, 2021), informed by multiple-level resources. RSIs, including interfirm (property-based and knowledge-based) and interpersonal RSIs, provide favourable conditions for the development of such learning practices (Selnes and Sallis, 2003; Cheung *et*

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3 *al.*, 2010). RSIs can be expected to be critical factors in fostering SCL of sustainability, which,
4 in turn, enhances the sustainability performance of firms in SCs. Despite this, no research has
5 empirically explored how SCL mediates the relationship between RSIs and sustainability
6 performance. There is a need to examine the mediating mechanism of SCL.
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10 11 12 **3 Research methods**

13 Multi-method research combines qualitative and quantitative approaches, either concurrently
14 or sequentially, to understand a phenomenon of interest in a single research study (Venkatesh
15 *et al.*, 2013). A key advantage of such methodological designs is the ability to address both
16 explanatory and confirmatory questions within the same study (Teddlie and Tashakkori, 2009;
17 Venkatesh *et al.*, 2013). SC scholars have also highlighted the value of adopting a multi-method
18 approach in SC studies (Boyer and Swink, 2008; Choi *et al.*, 2016). There are four major forms:
19 1) triangulation – that is, merging qualitative with quantitative data; 2) embedded – that is,
20 employing a qualitative technique in a largely quantitative approach; 3) explanatory; that is,
21 using qualitative data to explain quantitative results; and 4) utilizing quantitative data to test
22 and explain relationships found in qualitative data (Venkatesh *et al.*, 2013).
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31 In this study, we adopted a sequential multi-method approach (Le Meunier-FitzHug *et al.*,
32 2011; Liu *et al.*, 2017; Villena *et al.*, 2021). We first undertook a qualitative, exploratory case
33 study to identify if firm sustainability performance was affected differently by increases or
34 decreases in different types of RSIs and in SCL. From this, we established apparent differences
35 and developed hypotheses. We then conducted a quantitative study in the form of a survey to
36 confirm that the hypothesized relationships did exist, and to further refine the hypotheses. Such
37 a sequential approach, where the methods have unequal weights, is referred to as an initiation
38 approach (Teddlie and Tashakkori, 2009; Golicic and Davis, 2012). A qualitative approach is
39 suitable as a starting point when the phenomenon examined is complex and new (Golicic and
40 Davis, 2012); for example, the underdeveloped nature of the link between RSIs and
41 sustainability, and its influence mechanism. It allows an initial and detailed understanding of
42 the phenomenon. A qualitative case study also acts as a preliminary study for in-depth
43 understanding of the concept, to set up the more heavily weighted quantitative survey. Our
44 research is thus presented in two phases, beginning with the case study.
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56 57 *3.1 Data collection for the case study*

58 The selection of cases is the prerequisite for rigorous findings in a case study (Yin, 2009).
59 Following a theoretical sampling approach (Eisenhardt, 1989), we selected cases from Chinese
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3 manufacturing industries because, as the “factory of the world”, Chinese manufacturing firms
4 are a critical part in global SCs and have attracted great attention due to the various
5 sustainability issues they face (Yang *et al.*, 2022). To ensure the research objectives could be
6 fulfilled, the following criteria were applied: (1) The selected firms should have independent
7 SC departments and be relatively mature in managing SC relationships. (2) The selected firms
8 should collaborate with SC partners, making various RSIs possible. (3) The selected firms
9 should demonstrate learning activities with their SC partners toward sustainability. (4) The
10 selected firms should involve sustainability in their performance assessment.

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12 We identified four firms (A, B, C, and D) for data collection (see Table I). They differed
13 from each other in terms of their development of RSIs, SCL, and sustainability performance.
14 Unlike the other three, Firm D performed poorly in these aspects and was thus included as a
15 dummy case company for illustration (Gong *et al.*, 2023). The four firms were a machinery
16 manufacturer (A), two electronics manufacturers (B and C), and a pharmaceutical manufacturer
17 (D). After negotiations with their senior executives, all the firms allowed a high level of data
18 access.

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The data sources were primarily semi-structured interviews, supplemented by archival data
and personal observations as means for triangulation (Eisenhardt, 1989). The data collection
contained three stages and was carried out between May and August 2018. The first stage
involved a meeting with senior executives and managers in charge of the SC departments of
each firm, during which we outlined the research objectives. The firm and departmental
managers provided overall information on their SC relationships and sustainability, from which
we developed an interview protocol (Appendix 1). The second stage was the major round of
data collection, during which we conducted in-depth interviews with the firm and SC
departmental managers (see Table I). Each interview lasted approximately one hour, and was
often followed by a telephone interview to clarify certain issues. The third stage, recognizing
the need to validate some of the data, contained supplemental interviews to acquire the
sustainability performance data not gathered in the second stage (e.g. the waste reduction data).

In total, we conducted eight interviews, all of which were carried out in Mandarin Chinese.
The interviews were digitally recorded with the informed consent of the interviewees. The
recorded interviews were then transcribed into English by one researcher in the research team,
and stored in a case database that included transcripts and interview notes. This database also

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3 contained archival data on each firm, collected from their internal documents, websites, and
4 news coverage related to their SC relationships and sustainability performance. The research
5 team also conducted factory/plant tours at each firm to observe the relationship-related
6 investments (e.g. property-based assets); photos and notes were stored in the database.
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10 11 12 *3.2 Data coding and analysis*

13 Purposive coding was used to identify instances of property-based, knowledge-based, and
14 personal-based RSIs; SCL of sustainability; and the sustainability performance of the four case
15 firms (Voss *et al.*, 2010). We paid attention to the concepts and constructs identified in the
16 literature. For example, if an interviewee mentioned that “we keep in touch with our SC
17 partners frequently and send greetings by email on important festivals”, this would be coded
18 as personal-based RSIs. The SCL activities were coded based on Ojha *et al.*'s (2018) four
19 orientation dimensions: team, learning, system, and memory. Sustainability performance was
20 coded based on the three performance dimensions: environmental, social, and economic (e.g.
21 Miemczyk and Luzzini, 2018). By comparing the difference in each construct across cases, the
22 levels of RSIs, SCL, and sustainability performance (very high, high, medium, low, very low)
23 were coded, to identify potential patterns in the changes of one construct along with increases
24 or decreases in another construct (Yin, 2009).
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34 We employed Microsoft Excel for data coding. This is simple to use and, when combined
35 with manual data analysis, gave us flexibility and closeness to manage and retrieve data (Miles
36 *et al.*, 2018). Each case was manually coded into an Excel spreadsheet; the codes were then
37 extracted and compared across the cases on a separate Excel sheet. Two researchers in the team
38 coded the case materials independently and met to discuss the classifications. If there were
39 disagreements, the team thoroughly discussed the coding and case materials until consensus
40 was achieved. After many rounds of discussion, we finally reached agreement on all the
41 constructs and relationships.
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50 51 52 *3.3 Validity and reliability*

53 According to Yin (2009), we evaluate the whole research design by testing construct validity,
54 internal and external validity, and reliability. We established construct validity by triangulating
55 interview data with archival data and factory tour observations, internal validity by matching
56 the patterns with the predicted ones developed from the literature, and external validity by
57 adopting multiple cases to enable replication of the findings. We established reliability by using
58 an interview protocol and developing a case database.
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4 Case study findings and research hypotheses

This section analyses the RSIs, SCL of sustainability, and sustainability performance of the four case companies. By further combining the case findings with the existing literature, we develop the research hypotheses.

4.1 Analysis of RSIs, SCL, and sustainability performance

The findings of the four cases are summarized in Table II. Except for Firm D, all the companies exhibit property-based, knowledge-based, and personal-based RSIs; SCL of sustainability; and sustainability performance. However, they do so at different levels.

Insert Table II here

Except for Firm D, all the case firms are long-established and have made various types of investments in their relationships with key customers and suppliers. In terms of property-based RSIs, Firms A and B take into account customers or suppliers in opening sales offices and building factories, and they develop tools and equipment together with suppliers. Firm C mainly invests in equipment and materials; Firm D does not invest in any physical assets at present. In terms of knowledge-based RSIs, Firms A and B not only invest a lot in employee or talent training; they have also developed specialized systems for collaboration with SC partners. In contrast, Firm C only requires its suppliers to conduct training themselves, and Firm D does not invest in any techniques or skills. In terms of personal-based RSIs, Firm A pays great attention to building personal relationships with managers at partnering firms, Firms B and C focus primarily on maintaining relationships with suppliers rather than customers, and Firm D does not establish personal relationships with partners.

All four firms have independent SC departments to deal with transaction and collaboration with upstream and downstream SC partners. With regard to SCL, Firms A and B both play leading roles in developing learning on sustainability along SCs. Their SC departments proactively produce new knowledge with SC partners through team and learning orientation, and distribute the knowledge produced to suppliers through system and memory orientation. While Firm C shows strong team and learning orientation to acquire new knowledge, it pays little attention to applying and spreading the knowledge learned; it therefore has weak system and memory orientation. As Firm D is a manufacturing plant in China and is not familiar with upstream and downstream SC partners, it is only interested in knowledge on specific

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3 manufacturing projects. Its team, learning, system, and memory orientation are all limited to
4 certain projects.
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6 The analysis of environmental, social, and economic performance across the four cases,
7 and the performance self-assessments of each firm, both indicate that the four firms show
8 differing levels of sustainability performance. Firm A achieves the most substantial
9 improvement in its sustainability performance, followed by Firm B and then Firm C. Firm D
10 does not pay attention to environmental protection or employee and social welfare; thus it
11 shows poor performance in sustainability.
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18 *4.2 The impact of RSIs on sustainability performance*

19 According to the relational view, RSIs embedded in a partnering relationship are critical
20 strategic resources that generate competitive advantages and superior performance for the firms
21 involved (Dyer and Singh, 1998). Various types of RSIs promote relationship commitment,
22 trust-building, knowledge spillover, and integration among SC partners (e.g. Liu *et al.*, 2009;
23 Nyaga *et al.*, 2010; Huang and Huang, 2019). These are critical means to successfully
24 implement sustainability and induce sustainability performance for firms in SCs (e.g. Mishra
25 *et al.*, 2018; Flygansvær *et al.*, 2018; Hofmann, 2019). Our case findings support this view.
26 Table II shows that the levels of property-based, knowledge-based, and personal-based RSIs
27 are closely associated with the level of firm sustainability performance. High levels of RSIs
28 are matched by a high level of sustainability performance (Firms A and B); medium and low
29 levels of RSIs (Firms C and D, respectively) lead to equivalent levels of sustainability
30 performance.
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41 Specifically, property-based RSIs guarantee the development and integration of
42 infrastructure related to sustainability (Subramani and Venkatrama, 2003); this is important in
43 the pursuit of sustainability performance (Howard *et al.*, 2019; Hofmann, 2019). Firms A and
44 B both invest in the development of dedicated tools together with suppliers. This enables their
45 suppliers to adopt tools and processes that are tailored to sustainability needs, for example Firm
46 A's recycling station and Firm B's cleaner production. The investment in physical assets
47 specified to a relationship also enables strong commitment from partners (Nyaga *et al.*, 2010).
48 The establishment of factories by Firms A and B proximate to key partners has led to
49 relationship commitment among the partners; this is essential for the implementation of
50 sustainability initiatives. For example, the green sustainability initiative of Firm A and the
51 introduction of strip transportation by Firm B depend largely on the collaboration of their
52 suppliers and customers.
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3 Knowledge-based RSIs enhance communication and knowledge-sharing routines of
4 sustainability (Zhao and Wang, 2011; Wang *et al.*, 2014), helping firms to address the
5 environmental or social issues they encounter (Flygansvær *et al.*, 2018; Villena *et al.*, 2021).
6 Firm A invests a lot in training for employees and suppliers, and Firm B jointly makes
7 substantial investments with suppliers in the cultivation of talent. These allow for the transfer
8 of knowledge, including know-how about sustainability, within the two firms and among
9 partners, equipping their employees and partners with the skills required to implement social
10 and environmental initiatives. Furthermore, Firm A, by building a collaborative office platform,
11 can smoothly communicate to partners its expectations on specific sustainability tasks and how
12 these can be executed. This platform also facilitates the collection of sustainability-related
13 information from suppliers and customers through mutual information exchange. As a result,
14 the sustainability performance of Firms A and B is much better than that of Firms C and D,
15 which make fewer or no knowledge-based RSIs.

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17 Personal-based RSIs are generally made and managed by boundary spanners who interact
18 frequently with individuals in partnering firms (Wang *et al.*, 2014). Such investment enhances
19 firm-level trust and long-term orientation (Chiou and Droge, 2006; Chen *et al.*, 2011), ensuring
20 the implementation of sustainability and the continuation of sustainability performance
21 (Flygansvær *et al.*, 2018; Hofmann, 2019). The purchasing manager in Firm A, through
22 frequent contact with managers in supplier and customer firms, builds interpersonal
23 connections with them. These connections make Firm A's partners more confident in its
24 decisions and more willing to engage in its sustainability initiatives. Moreover, Firm A's
25 manager notes that the implementation of its sustainability initiatives involves a number of
26 complex tasks. Personal relationships with partners facilitate the communication of various
27 tasks and reduce the complexity of implementing sustainability. Compared with the other firms,
28 which make relatively fewer investments in personal relationships, Firm A achieves the best
29 sustainability performance.

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31 Thus, we hypothesize that:

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33 **H1** A firm's (a) property-based RSIs, (b) knowledge-based RSIs, and (c) personal-based RSIs
34 are positively associated with its sustainability performance.

35 36 4.3 The mediating role of SCL

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38 As we elaborated earlier by supplementing the relational view with ROT, strategic resources
39 cannot directly affect firm performance, but they affect it indirectly through the management
40 of resources (Sirmon *et al.*, 2011). SCL is an important managerial action that influences the

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3 pursuit of sustainability (e.g. Gong *et al.*, 2018); it can be influenced by various types of RSIs
4 (Selnes and Sallis, 2003; Cheung *et al.*, 2010). SCL thus mediates the relationship between
5 RSIs and sustainability performance. Our case findings support this view: Table II shows that
6 the four case firms develop different levels of SCL. On the one hand, these depend on the levels
7 of different types of RSIs; on the other, they highly inform the level of sustainability
8 performance.

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13 The case findings show that property-, knowledge-, and personal-based RSIs are
14 associated with SCL. Various types of RSIs can explain SCL of sustainability with four-
15 dimensional orientations; a strong recourse base allows knowledge management in
16 relationships (Chang and Gotcher, 2007). Physical infrastructure, information flow, joint
17 training, and personal support are all frequently used resources to facilitate the creation and
18 dispersion of knowledge on sustainability (Luo *et al.*, 2009).

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24 Property-based RSIs provide physical infrastructure to promote learning between SC
25 members (Zhao and Wang, 2011). Firms A and B have built factories and sales offices close
26 to their key suppliers and customers, respectively. The short geographical distance enhances
27 their communications and interaction, through which the firms frequently exchange
28 information with their partners and discuss new ideas on sustainability initiatives. Knowledge-
29 based RSIs create sustaining knowledge-sharing routines (Selnes and Sallis, 2003), facilitating
30 SCL of sustainability. The collaborative office platform established by Firm A ensures a
31 smooth flow of sustainability-related information between the firm and its key partners. The
32 training programmes provided by Firms A and B enable them to continuously share and create
33 knowledge on eco-products, green production, and quality management with their suppliers.
34 Personal-based RSIs provide personal support to overcome the opportunism concern (Liu *et*
35 *al.*, 2018), which hinders the development of learning in a relationship (Jean *et al.*, 2010). The
36 purchasing manager in Firm A mentions that teamwork with suppliers on eco-components
37 requires the firm to expose its internal information. Good interpersonal connections and
38 friendships with managers at supplier firms enable Firm A to trust its suppliers, making it
39 willing to share information and develop learning practices with them.

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51 The case findings show that SCL of sustainability leads to better sustainability
52 performance, taking into account the environmental, social, and economic aspects. The pursuit
53 of sustainability requires the acquisition and sharing of new knowledge on sustainability
54 products, processes, and initiatives (Yang *et al.*, 2018; Silvestre *et al.*, 2020). The team,
55 learning, system, and memory orientations of SCL explain the knowledge management process
56 to achieve sustainability performance.

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3 Team orientation allows firms to acquire complementary knowledge on sustainability
4 beyond their organizational boundary and from their partners (Johansson, 2002). The
5 purchasing manager in Firm A explains that because its suppliers are experts in environmental
6 alternatives in materials, components, and processes, the firm works with them on a team basis
7 to co-develop new products that minimize energy consumption and pollution. Learning
8 orientation ensures the continuous acquisition of new knowledge and improvements regarding
9 sustainability (Ojha *et al.*, 2016). Firm B provides training on quality management programmes
10 to employees and suppliers. Its SC manager comments that continuous learning on
11 management of quality, environment, and working conditions enhances both the firm's and its
12 partners' knowledge of and commitment to sustainability. This helps it to implement cleaner
13 production and maintain safe working conditions. System orientation enables clear divisions
14 of labour and efficient processes for SC members to make complementary contributions to
15 sustainability (Luo *et al.*, 2009). Firms A and B both have a good understanding of the
16 interconnectedness of tasks and processes in implementing sustainability projects. Without this,
17 Firm A would not have considered the recycling stage in its SC or established a recycling
18 station. Memory orientation allows the storage of sustainability knowledge; it also facilitates
19 the sharing of best practices on sustainability between partners (Fang *et al.*, 2010). Firms A
20 and B frequently exchange experience and lessons learned on sustainability with their suppliers;
21 their sustainability performance is better than that of Firms C and D, which do not.

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36 Thus, we hypothesize that:

37 **H2** SCL of sustainability mediates the relationship between (a) property-based RSIs, (b)
38 knowledge-based RSIs, (c) personal-based RSIs, and firm sustainability performance.

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41 Figure 1 shows the overall research framework.

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Insert Figure 1 here

5 Survey and empirical tests for hypotheses

5.1 Sample and data collection

To test our hypotheses, an online survey was conducted from September to December 2018. Data were gathered from Chinese manufacturing firms in Fujian Province, a representative area for China's manufacturing industries. Fuzhou, Xiamen, Quanzhou, and Putian in Fujian Province are the primary industrial areas in China.

All data were collected through mail surveys. From a list of manufacturing firms, we randomly selected 2,000 companies; we then contacted them by telephone and email to obtain

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3 their preliminary agreement to participate in this research. A total of 574 firms indicated their
4 willingness to participate. Top and middle managers were set as the target respondents, as they
5 were familiar with the research constructs and were knowledgeable about their SC relationships.
6 The questionnaire was emailed to the informants who agreed to participate, with a cover letter
7 highlighting the research objective and guidelines on how to fill in the questionnaire. We sent
8 out 574 questionnaires via a web-based survey system and obtained 292 responses. After
9 excluding the questionnaires with missing data and those not answered carefully (e.g. the
10 answer time was less than one minute, or all the answers were the same), 269 valid
11 questionnaires were finally obtained, for a valid response rate of 46.9%.

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13 The final sample includes firms from more than 14 manufacturing industries, including
14 electronics, machinery, food, textiles, automobiles, pharmaceuticals, and chemicals. Of the
15 firms, 102 are relatively small (fewer than 500 employees), 113 are medium-sized (500 to 1000
16 employees), and 54 are large (more than 1000 employees). Within the sample, 86 firms are
17 relatively young (under 10 years old), 84 are middle-aged (11 to 20 years), and 99 are relatively
18 old (over 20 years). State-owned enterprises make up 33 of the firms; the rest are non-state-
19 owned enterprises.

32 5.2 Operationalization and measurement

33 The items used to measure RSIs, SCL, and sustainability performance were drawn from prior
34 research. A five-point rating scale (1 = strongly disagree; 5 = strongly agree) was used for each
35 of the items. Following the back-translation procedure (Schaffer and Riordan, 2003), we
36 designed the survey questionnaire in English, translated it into Chinese, and then translated it
37 back into English; this resolved conceptual equivalence issues.

38 **RSIs.** There are three types of RSIs in this study. Following Zhao and Wang (2011) and
39 Vázquez-Casielles *et al.* (2017), the property-based RSIs and knowledge-based RSIs measures
40 each had four items. We developed measures for personal-based RSIs from Chinese *guanxi*
41 literature (Zhuang *et al.*, 2007; Wang *et al.*, 2014; Lin *et al.*, 2017), and adapted them to the
42 context of RSIs with four items.

43 **SCL of sustainability.** Following Ojha *et al.* (2018), a total of 16 items for four dimensions
44 (team, system, learning, and memory orientations), were used to measure SCL.

45 **Sustainability performance.** In line with Zhu *et al.* (2011) and Abdul-Rashid *et al.* (2017),
46 we used 14 items to measure sustainability performance with economic, environmental, and
47 social outcomes.

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3 **Controls.** We controlled for firm size (measured by the number of employees) and firm
4 age (measured by the years the firm had been established) by 3-point scales; firm type by a
5 dummy variable (1 for state-owned firms, 0 otherwise); and industry type by a series of dummy
6 variables.
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10 11 12 *5.3 Non-response and common method bias*

13 In order to assess non-response bias, we compared early respondents (the first 30
14 questionnaires) with late respondents (the last 30) (Silva *et al.*, 2014). We then performed t-
15 tests between the two groups on the main characteristics of the sample, such as firm age ($p =$
16 0.727), number of employees ($p = 0.294$), and firm ownership ($p = 0.167$). These insignificant
17 results indicate that non-response is not a serious concern for our data.
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21 To address the potential issue of common method bias, we adopted some procedural
22 methods. For example, the measures in our survey came from different sources, and
23 respondents were assured of anonymity to reduce evaluation apprehension (Silva *et al.*, 2014).
24 Furthermore, Harman's one-factor test showed that the largest factor explains only 25% of the
25 total variance, which indicates that common method bias is not a major concern (Podsakoff *et*
26 *al.*, 2003).
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33 34 35 *5.4 Reliability and validity of the survey*

36 We assessed the reliability of each multi-item scale using an alpha coefficient of 0.7, a
37 composite reliability (CR) index of 0.7, and an average variance extracted (AVE) value of 0.5.
38 **Table III** shows that all the alpha coefficients, CR estimates, and AVE values are above their
39 respective cut-offs. Hence, the results provide evidence for adequate scale reliability.
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43 To assess convergent validity, factor loadings of scale items on their corresponding
44 constructs were examined. We can see from **Table III** that all first-order item standardized
45 loadings are above the threshold of 0.7.
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Insert **Table III** here

We evaluated discriminant validity by comparing the correlation between the constructs
and the square root of AVE (Fornell and Larcker, 1981). The correlations among the variables
are represented in **Table IV**. We can see that the square root of the AVE value of each variable
is higher than its associations with the other variables, providing evidence of discriminant
validity. The above results together provide evidence for convergent and discriminant validity.

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Insert Table IV here

5.5 Survey results

Linear regression analysis was conducted to estimate the models. The results of the regression analyses are shown in Table V. Models 1–3 include sustainability performance as the dependent variable; models 4–5 include SCL as the dependent variable.

5.5.1 Main effects

To establish a baseline, Model 1 tests the effects of the control variables on sustainability performance. Model 2 adds the direct effects of the independent variables. The results show that all three types of RSIs have significant and positive direct effects on sustainability performance ($\beta = 0.339$, $p < 0.01$; $\beta = 0.318$, $p < 0.01$; $\beta = 0.102$, $p < 0.05$). This provides support for H1.

Insert Table V here

5.5.2 The mediating effect of SCL

To test for the significance of the indirect mediation effect, we first compared the strength of the independent variable and dependent variable relationships after considering the mediator (Aryee *et al.*, 2012). The results show that in Model 5, the three types of RSIs are positively and significantly associated with SCL. The results for Model 3 indicate that the strength of the relationship between property-based RSIs and sustainability performance (assessed earlier without including mediators) is reduced ($\beta = 0.223$, $p < 0.01$). For knowledge-based and personal-based RSIs, the relationships with sustainability performance become insignificant ($\beta = 0.051$, $p > 0.1$; $\beta = 0.015$, $p > 0.1$). We therefore conclude that the indirect effects of property-based RSIs on sustainability performance are partially mediated by SCL, and the indirect effects of knowledge- and personal-based RSIs on sustainability performance are fully mediated by SCL (Baron and Kenny, 1986).

To more robustly test this mediated effect, we adopted the bootstrapping procedure proposed by Preacher and Hayes (2004), based on 5,000 bootstrap samples at a 95% confidence interval. The results indicate that the mediating effects of SCL between the three types of RSIs and sustainability performance are 0.308, 0.467, and 0.217, and the confidence intervals are (0.210, 0.439), (0.342, 0.605), and (0.115, 0.316), respectively. These intervals do not contain

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3 zero, suggesting that the mediating effects are significant. Therefore, we can confirm H2. In
4 addition, knowledge-based RSIs have the strongest total effect on sustainability performance
5 (total effect 0.650); property-based RSIs come next (total effect 0.539); and finally personal-
6 based RSIs (total effect 0.217).
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10 11 12 **6 Discussion**

13 The objective of this study was to explore the linkages between different types of RSIs and
14 sustainability performance, as well as the mediating mechanism. Based on the relational view,
15 we find that property-based, knowledge-based, and personal-based RSIs are positively
16 associated with a firm's sustainability performance. These results are in accordance with prior
17 studies that find RSIs to be critical resources for firms to achieve superior performance (Liu *et al.*,
18 2009; Cao and Zhang, 2011; Wang *et al.*, 2014). Our findings further enrich this view by
19 examining the RSIs-performance link in the context of sustainability performance rather than
20 traditional economic performance. Meanwhile, supplemented by the ROT perspective, we
21 propose a mediating role for SCL in the relationship between RSIs and firm sustainability
22 performance. Our findings show that knowledge- and personal-based RSIs contribute to
23 sustainability performance fully through SCL of sustainability, while property-based RSIs
24 enhance sustainability performance both directly and indirectly through SCL. These results
25 confirm the need to distinguish the impacts of different types of RSIs on firm performance
26 (Subramani and Venkatraman, 2003).
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37 The mediating mechanism through SCL echoes recent studies that highlight the essential
38 role of SCL in the pursuit of sustainability performance for firms in SC (Gong *et al.*, 2018;
39 Yang *et al.*, 2018; Silvestre *et al.*, 2020). SCL of sustainability is found to fully mediate the
40 relationship between knowledge- and personal-based RSIs and sustainability performance.
41 This is consistent with prior studies showing that simple investments in knowledge and
42 personal relationships do not guarantee performance improvement. Instead, firms need to
43 facilitate SCL by building knowledge transfer routines (Selnes and Sallis, 2003), and by
44 providing personal support to reduce opportunism concerns (Liu *et al.*, 2018). SCL is found to
45 partially mediate the relationship between property-based RSIs and sustainability performance.
46 This is similar to Nyaga *et al.* (2010) and Zhao and Wang (2011) that investing in physical
47 assets enhances performance both directly (as it reflects strong commitment to the relationship)
48 and indirectly (by providing infrastructure to promote SCL). These findings reinforce the key
49 assumption of ROT in that learning how to structure, bundle, and leverage different strategic
50 resources is critical to creating value for firms (Sirmon *et al.*, 2011).
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3 Our findings for SCL of sustainability also endorse the synergistic effects of RSIs and
4 relationship learning on firm performance (Zhao and Wang, 2011; Lin *et al.*, 2017). The results
5 provide further insights by revealing the varying synergistic effects. Knowledge-based RSIs
6 and SCL have the strongest synergistic effects in improving sustainability performance,
7 followed by property-based RSIs, and finally personal-based RSIs. This is consistent with
8 Wang *et al.* (2013) that knowledge-based RSIs directly provide the necessary knowledge
9 resources to develop SCL, thus enhancing firm performance further. The findings of varying
10 synergistic effects also support the view of Selnes and Sallis (2003) that compared with
11 property- and personal-based RSIs, knowledge-based RSIs can be constantly accumulated via
12 sustaining knowledge-sharing routines built into the relationship, thereby generating greater
13 synergistic effects with SCL on sustainability performance.
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24 **7 Conclusion**

25 *7.1 Theoretical contributions*

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27 Our study contributes to the literature in three ways. First, it enhances the body of knowledge
28 on RSIs by investigating the underexplored relationship between RSIs and sustainability
29 performance. Existing studies mainly focus on the impacts of RSIs on firm economic
30 performance (e.g. Artz and Brush, 2000; Liu *et al.*, 2009; Wang *et al.*, 2014); the findings on
31 the association between different types of RSIs and firm performance are also inconclusive.
32 Drawing on the relational view, our study investigates three types of RSIs – property-,
33 knowledge-, and personal-based RSIs – at both the firm and individual levels. It reveals that
34 RSIs come with competitive advantages in achieving superior sustainability performance. This
35 enriches our understanding of the broader implications of RSIs for firms from a sustainability
36 perspective. The distinct effects of RSIs on sustainability performance further underline the
37 imperativeness of distinguishing between different types of RSIs in studying their roles in
38 business activities and firm performance.
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48 Second, and more notably, our study advances the understanding of SCL by revealing its
49 mediating role in the relationship between RSIs and sustainability performance. The impact of
50 RSIs on sustainability performance is a complex phenomenon; to unpack the relationship, it is
51 necessary to explore the potential mediators. Responding to the recent call for investigating the
52 mediating mechanism (Nyaga *et al.*, 2010; Lai *et al.*, 2013; Huang and Huang, 2019), our study
53 builds on the ROT lens and suggests that SCL bridges the link between RSIs and sustainability
54 performance. This highlights the important role of SCL in explaining how RSIs matter for
55 sustainability performance. Meanwhile, our study extends the SCL literature by enriching its
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3 antecedents and consequences. The positive relationships between the three types of RSIs and
4 SCL, as unravelled by this study, join the stream of SCL literature that examines the effects of
5 SC relationship-related factors on SCL, such as the length of the relationship (Rebolledo and
6 Nollet, 2011) and relational capital (Agarwal and Selen, 2009). We also expand on the study
7 of Lin *et al.* (2017), which only analysed the impact of general asset specificity on joint learning
8 with key customers. In addition, the research on SCL highlights how it matters for firm
9 innovation performance and relationship performance (Yang *et al.*, 2018). The theoretical
10 model and empirical test in our study show that SCL is also important for firms to manage
11 interfirm resources to achieve sustainability performance; this responds to the call of Yang *et*
12 *al.* (2018) to pay more attention to the implications of SCL for sustainability performance.

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21 Third, this study also makes contributions to the relational view and ROT through
22 interlinking their perspectives to advance theory. The relational view is appropriate for
23 examining SC relationships; it provides insights into RSIs built in partnering relationships
24 (Dyer and Singh, 1998). Despite the belief that RSIs, as strategic resources, generate
25 competitive advantages and superior firm performance, the relational view ignores the
26 management of strategic resources between SC partners (Arora *et al.*, 2016). We thus
27 supplement the relational view with ROT to investigate the role of SCL in the relationship
28 between RSIs and sustainability performance. ROT emphasizes managerial actions on strategic
29 resources (Sirmon *et al.*, 2011), although it focuses on resource management at the individual-
30 firm level. Integrating these two theoretical lenses, our study suggests that interfirm resources
31 (e.g. RSIs) provide a foundation for developing managerial actions between SC partners (e.g.
32 SCL). These actions further facilitate superior performance (e.g. sustainability performance)
33 for firms in the SC. The integration of the relational view and ROT provides a novel view of
34 the strategic resources-actions-performance pathway at an interfirm level.

45 46 7.2 Managerial implications

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48 Our study has important managerial implications. First, firms face increasing pressures to
49 ensure sustainability in their operations. Our study suggests that to achieve sustainability
50 performance, firms should invest in physical assets dedicated to their SC partners. Specifically,
51 they can locate factories close to key suppliers, open sales offices in customer markets, co-
52 develop machinery or tools with suppliers, and design equipment tailored to their partners'
53 processes. These investments can not only involve partners in firms' sustainability initiatives
54 but also provide a platform for specifying sustainability performance criteria to partners. In
55 addition, as knowledge-based and personal-based RSIs improve firm sustainability

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3 performance fully through SCL, managers should pay attention to techniques and skills specific
4 to partners and personal relationships with partnering firms. They need to provide training to
5 equip partners with know-how about sustainability, and maintain interpersonal connections
6 with managers at partnering firms to exchange sustainability-related information.
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10 Second, our study underlines the critical role of SCL in particular. To pursue sustainability,
11 it is not sufficient for managers merely to make RSIs; they need to realize the importance of
12 learning with SC partners. Managers should build cross-organizational teams with partners and
13 create a learning culture for themselves as well as partners to encourage new ideas and
14 knowledge regarding sustainability. They should also understand their interconnection with SC
15 partners and develop knowledge storage mechanisms to spread sustainability-related
16 knowledge to partners. As RSIs and SCL have varying synergistic effects in improving
17 sustainability performance, managers are advised to take advantage of the knowledge resources
18 and knowledge-sharing routines created by knowledge-based RSIs to better facilitate learning
19 of sustainability. They should also effectively utilize the physical infrastructure established by
20 property-based RSIs to promote learning in achieving sustainability. Although personal-based
21 RSIs and SCL are found to have minimal synergistic effects on sustainability, managers should
22 be aware that in China, *guanxi* often comes first before business (Wang *et al.*, 2014). When
23 doing business in China or with Chinese partners, they need to reinforce their interpersonal
24 relationship strategy to achieve their desired outcomes.
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38 7.3 Limitations and future research directions

39 This study has certain limitations. First, it was conducted from the perspective of focal
40 companies. Future research could take a dyadic or even a triadic perspective to test our
41 framework with suppliers' and/or customers' perceptions. In dyads or triads, the sustainability
42 performance of SC partners might also be considered. Second, our case study and survey were
43 both conducted with Chinese firms. The findings might be influenced by the institutional
44 environment in China. Future research could validate and generalize our findings in other
45 country contexts. Third, in addition to the RSIs examined by this study, future research could
46 examine other factors embedded in SC relationships as antecedents to SCL, such as social
47 capital, relationship power, and SC structure. Fourth, as we adopted a multi-method approach
48 combining a case study and survey, our research may suffer from the limitations of the two
49 methods, such as the generalizability of case studies and the objectivity of surveys. However,
50 as Venkatesh *et al.* (2013) suggested, a multi-methods approach is more suitable than a single
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method in an under-researched and complex area. Thus, we encourage future research to try different combinations of multi-methods, such as using a case study to explain survey results.

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Appendix 1. Interview protocol

Part A. Relation-specific investments

1. Does your company invest in dedicated property assets to your supply chain partners, such as factories, equipment, tools, and so on? Please give details of these investments.
2. Does your company invest in dedicated knowledge resources for your supply chain partners, such as training, information management systems, and so on? Please give details of these investments.
3. What is your personal relationship with managers at supply chain partnering firms? Please describes how you build and maintain the relationship.

Part B. Supply chain learning of sustainability

4. How does your company exchange sustainability-related knowledge with your supply chain partners? How do you help your partners learn? Please describe the learning process between your company and partners.
5. Does your company build sustainability project teams with partners? Do the team members have shared visions and goals?
6. Does your company view learning with supply chain partners on sustainability knowledge as important, and consider learning as an investment rather than a cost?
7. Does your company recognize its position and role in implementing sustainability along supply chains? How do you collaborate with upstream and downstream partners on sustainability initiatives?
8. How does your company deal with lessons learned and past experience in sustainability with your supply chain partners?

Part C. Sustainability performance

9. What is your company's performance in sustainability, including environmental, social, and economic performance? Please describe your company's achievements in each performance dimension.

Table I. Basic Information of Cases

Case	Establishment	Industry	No. of employee	Sales revenue	SC department	Interviewees
A	1993	Machinery	3,000	USD 555 million	203 employees	General Manager; Purchasing Manager
B	1984	Electronic	14,000	USD 900 million	80 employees	General Manager; SC Manager
C	1984	Electronic	2,000	USD 135 million	40 employees	Deputy Director; SC Manager
D	2008	Pharmaceutical	50	USD 15 million	6 employees	General Manager; Purchasing Manager

Table II. Case findings

Case	Property-based RSIs	Knowledge-based RSIs	Personal-based RSIs	SCL of sustainability	Sustainability performance
A	High Jointly builds new factories, and develops tools and components of products together with suppliers	Very high Provides a lot of training for employees and suppliers, and develops a collaborative office platform to ensure timely information sharing with suppliers and customers	High Frequently liaises with suppliers and customers, sends email greetings on important festivals, and maintain good personal relationships with suppliers and customers	Very high <ul style="list-style-type: none"> • Team orientation: teamwork with suppliers on developing eco-products and eco-components • Learning orientation: proactively communicates with suppliers and customers for new ideas on environmental and social initiatives • System orientation: has a clear job specification and supply chain process in implementing sustainable projects with partners • Memory orientation: frequently discusses with suppliers on best practices and errors made on sustainability-related attempts 	Very high <ul style="list-style-type: none"> • Environmental: deals with pollutant emissions, develops green sustainability initiatives, establishes recycling stations; energy consumption and pollution emissions are lower than industry standards • Social: pays great attention to employee health and safety, establishes a good reputation among the local community, proactively engages in philanthropy such as donating to disaster areas and participating in rescues • Economic: sales revenue in 2018: USD 555 million
B	High Selectively establishes sales offices and factories close to customers, and invests in developing dedicated tools	Very high Invests a lot in the cultivation of talent and the development of advanced technology together with suppliers; currently has more than 400 patents granted	Medium Hosts supplier annual meetings each year, but rarely interacts with customers	High <ul style="list-style-type: none"> • Team orientation: has shared its vision with suppliers and customers on green production and social welfare • Learning orientation: provides quality management training for internal employees and suppliers • System orientation: specifies the responsibilities of itself and its suppliers in implementing cleaner production in the supply chain • Memory orientation: establishes a mechanism for summarizing lessons learned on sustainability 	High <ul style="list-style-type: none"> • Environmental: advocates cleaner production, introduces strip transportation, reduces waste, and saves energy in production • Social: provides employees with safe working conditions and a comfortable living environment • Economic: sales revenue in 2018: USD 900 million

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3	C	Medium	Low	Medium	Medium
4		Invests in the	Encourages suppliers	Sends email	<ul style="list-style-type: none"> • Team orientation: has shared organizational goals on sustainability with suppliers and partners
5		purchase of	to conduct relevant	greetings to certain	<ul style="list-style-type: none"> • Learning orientation: views learning on sustainability as important, but rarely applies what is learned from partners
6		proprietary	training, but no	customers on	<ul style="list-style-type: none"> • System orientation: SC partners are aware of their roles in joint sustainable initiatives, but the boundary between partners is not clear enough
7		equipment and	training for internal	important festivals,	<ul style="list-style-type: none"> • Memory orientation: not good at summarizing and learning from past experience; repeated problems such as materials handover often occur
8		materials, but	employees	hosts supplier	
9		makes location		meetings annually	
10		decisions without			
11		considering			
12		customers			
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18	D	Very low	Very low	Low	Low
19		No specific	No specific	Keeps only working	<ul style="list-style-type: none"> • Team orientation: establishes teams with partners but not for sustainable projects
20		investment	investment	relationships with	<ul style="list-style-type: none"> • Learning orientation: learns new knowledge from partners about products and processes, but not very relevant to sustainability
21				suppliers and	<ul style="list-style-type: none"> • System orientation: responsible solely for manufacturing activities; not familiar with other processes such as sales or the roles of partners
22				customers	<ul style="list-style-type: none"> • Memory orientation: summarizes and analyses lessons learned on certain projects, but has not established any mechanism on storing knowledge about sustainability
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Table III. Construct reliability and validity

Constructs	Items	First order loading	Second order loading	Cronbach's α	CR	AVE
Property-based RSIs	We have made significant investments in facilities (siting, size and characteristics of warehouses and / or distribution platforms) dedicated to our partners	0.826		0.911	0.912	0.723
	We have made significant investments in equipment, tools, and engineering design dedicated to our partners	0.894				
	We have dedicated immense capital investments to meet the requirements of dealing with our partners	0.866				
	If we switched to another partner, we would lose a lot of investments made in the present supply chain relationship	0.812				
Knowledge-based RSIs	We have spent a lot of time with the partners in learning their operational routines	0.761		0.877	0.878	0.643
	We have made substantial investments in staff training dedicated to our partners	0.784				
	We have made significant investments to adapt the way we act (sales systems, inventory management, ordering systems, information technology, logistical systems, brand image) to the partners' requirements	0.856				
	If the supply chain relationship ends, we will have wasted significant investments in knowledge adapted to the relationship with the partners	0.804				
Personal-based RSIs	We usually keep in touch with our partners by telephone, email, or WeChat, as friends do	0.735		0.848	0.851	0.589
	We would not forget our partners at festival events, and always present them with something valuable	0.808				
	We often have meals or participate in entertaining activities together after work	0.800				
	If we switched to another partner, we would lose a lot of the investments in relationship building we've made for this one	0.722				
SCL of sustainability				0.967	0.967	0.650

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5	Team	A team spirit pervades our ranks in the supply chain processes toward sustainability	0.830	0.798	0.920	0.922	0.746
6	orientation	There is a commonality of purpose on sustainable development in the supply chain processes	0.875	0.837			
7		There is total agreement on our organizational vision in the supply chain processes toward					
8		sustainability	0.904	0.854			
9							
10		We are committed to sharing our vision of the supply chain processes toward sustainability across					
11		all levels, functions, and divisions	0.844	0.833			
12	System	All activities toward sustainability that take place in the supply chain processes are clearly defined	0.836	0.810	0.929	0.930	0.769
13	orientation	We understand the contribution of the various supply chain processes toward sustainability to the					
14		basic value chain, and how our work fits into that chain	0.900	0.872			
15							
16		We have a good sense of the interconnectedness of all parts toward sustainability of the supply					
17		chain processes	0.902	0.868			
18							
19		We understand where all activities toward sustainability fit in the supply chain processes	0.868	0.833			
20	Learning	The sense around here is that employee learning of sustainability-related knowledge is an					
21	orientation	investment, not an expense	0.839	0.799	0.918	0.920	0.742
22							
23		The basic values of the supply chain processes include learning sustainability-related knowledge					
24		as a key to improvement	0.909	0.810			
25							
26		The collective wisdom involved in the supply chain processes is that once we quit learning, we					
27		endanger our future	0.859	0.751			
28							
29		We basically agree that our ability to learn sustainability-related knowledge is the key to					
30		improvement in the supply chain processes	0.837	0.774			
31	Memory	There is a good deal of supply chain conversation that keeps alive the lessons toward sustainability					
32	orientation	learned from history	0.797	0.737	0.901	0.902	0.698
33							
34		We always keep records of unsuccessful supply chain endeavours and widely communicate the					
35		lessons learned toward sustainability	0.848	0.753			
36							
37		We have specific mechanisms for sharing lessons toward sustainability learned in the supply chain					
38		processes from project to project	0.856	0.788			
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5		We have formal routines that we use to uncover faulty assumptions toward sustainability that we	0.840	0.763		
6		have made about the supply chain processes				
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8		Sustainability performance			0.964	0.964 0.657
9	Economic	Decrease in costs of materials purchasing	0.797	0.714	0.926	0.928 0.723
10	performance	Decrease in costs of energy consumption	0.826	0.737		
11		Decrease in fees for waste treatment	0.932	0.761		
12		Decrease in fees for waste discharge	0.932	0.783		
13		Decrease in fines for environmental accidents	0.747	0.771		
14						
15	Environmental	Reduction of air emissions	0.915	0.882	0.955	0.955 0.808
16	performance	Reduction of waste water	0.947	0.896		
17		Reduction of solid wastes	0.954	0.913		
18		Decrease in consumption of hazardous/harmful/toxic materials	0.858	0.860		
19		Decrease of frequency for environmental accidents	0.812	0.839		
20						
21	Social	Improved relationship with the community and stakeholders	0.911	0.832	0.932	0.932 0.775
22	performance	Improved work safety	0.860	0.807		
23		Improved work environment	0.862	0.763		
24		Improved living quality of surrounding community	0.888	0.762		
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Table IV. Means, standard deviations, and correlations

	1	2	3	4	5	6	7	8
1. Firm size	-							
2. Firm age	0.190**	-						
3. Firm type	0.014	0.170**	-					
4. Property-based RSIs	0.276**	0.124*	0.051	0.850				
5. Knowledge-based RSIs	0.305**	0.115	0.104	0.682**	0.802			
6. Personal-based RSIs	0.151*	0.085	0.019	0.176**	0.253**	0.767		
7. SCL	0.433**	0.120*	-0.016	0.634**	0.726**	0.369**	0.806	
8. Sustainability performance	0.290**	0.051	-0.081	0.602**	0.596**	0.267**	0.726**	0.811
Mean	1.822	2.048	0.123	3.589	3.612	3.453	3.847	3.438
Standard deviation	0.742	0.829	0.329	0.904	0.744	0.800	0.713	0.869

Notes: Square root of AVE is shown on the diagonal of the matrix in bold. *p < 0.1, **p < 0.05.

Table V. Regression results

Variable	Performance			SCL	
	Model 1	Model 2	Model 3	Model 4	Model 5
Control variables					
Firm size	0.278***	0.092*	-0.013	0.395***	0.189***
Firm age	-0.004	-0.038	-0.037	0.036	-0.003
Firm type	-0.103	-0.132***	-0.080*	-0.051	-0.094**
Industry type	Included	Included	Included	Included	Included
Independent variables					
Property-based RSIs		0.339***	0.223***		0.210***
Knowledge-based RSIs		0.318***	0.051		0.479***
Personal-based RSIs		0.102**	0.015		0.156***
Mediating variables					
SCL			0.557***		
R2	0.158	0.482	0.586	0.271	0.664
Adjust R2	0.101	0.441	0.551	0.222	0.637
F	2.765***	11.550***	16.665***	5.486***	24.556***
N	269	269	269	269	269

Notes: Standardized coefficients are reported. *p < 0.1, **p < 0.05, ***p < 0.01.

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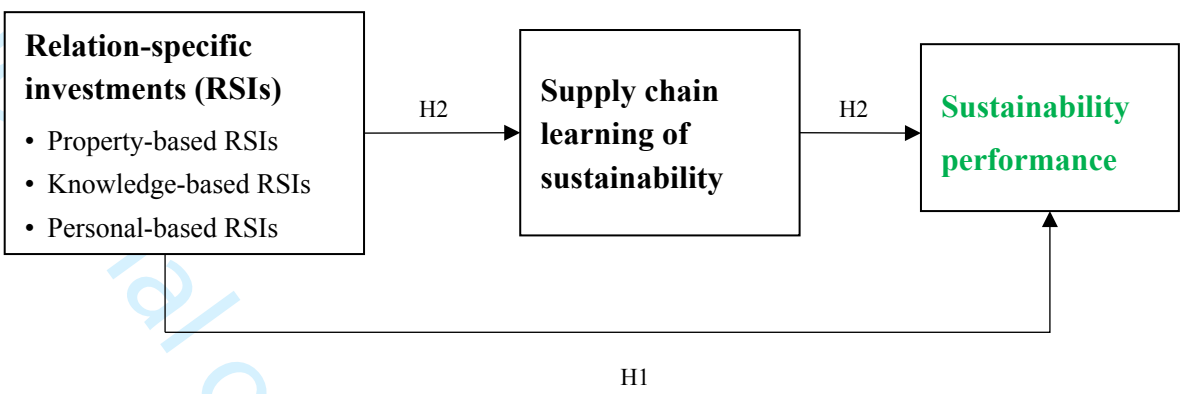


Figure 1. Research framework