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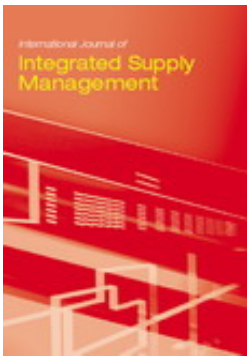

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Supply chain interdependence: a systematic review of the empirical evidence

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Abstract: The purpose of this study is to review findings of existing empirical studies on interdependence published between 1991 and 2022. We conducted a systematic review of 36 supply chain interdependence studies to identify categories, frequencies, and themes. We found that supply chain interdependence can have a positive, negative, or no effect on practices and performance. Fifty-three percent of our studies found positive effects of interdependence on practices and performance. Eight percent of our studies found negative effects of interdependence on practices and performance. This study offers suggestions for future research on supply chain interdependence.

Keywords: supply chain; dependence; collaboration; performance; power.

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1 Introduction

Creating an interdependent relationship can strongly contribute to the performance of a supply chain (Jayaraman and Liu, 2019; Whitehead et al., 2016; Zacharia et al., 2011). This orientation has also been called fostering mutual dependence and joint dependence. The associated behaviours have been termed collaboration, win-win problem solving and integrative bargaining (Lewicki et al., 2021). The supplier and customer organisations adopt a long-term orientation, which is characterised by increased trust and freely shared information (Hofer, 2015; Huo et al., 2018; Michalski et al., 2017; Wong et al., 1999; Yalcin et al., 2018).

In interdependent relations, the parties try to expand the pie, instead of competing over portions of a fixed pie. Fisher et al. (2011) have stressed four points. Common interests ought to be the focus, rather than positions on price. Negotiations should be depersonalised. The partners should open mindedly brainstorm improvements. Decisions may be based on objective criteria instead of the parties' relative power. Ultimately, beneficial outcomes can result: such as, greater learning, improved service, lower inventory levels, better quality results, more innovations and enhanced sustainability (Ma et al., 2019; Caniels et al., 2018; Yan and Nair, 2016; Vijayasarathy, 2010).

Creating interdependent relations stands in contrast to having asymmetric dependence. When one organisation in a supply chain holds more power, this can result in the stronger one taking advantage of the weaker one. Such situations have been called competitive, win-lose or distributive bargaining (Lewicki et al., 2021). Negotiations always involve common and conflicting interests. When there are limited resources, what one side gains the other must lose. Thus, information should be handled carefully. Some disclosures must be made, or no deal will be reached. Yet, if one party is too open, the other side may take advantage of the situation.

In distributive bargaining, each negotiation team normally generates an extreme opening position, a target where they would like to settle, and a bottom-line position they do not want to go beyond. If no agreement can be reached on an individual issue, a package deal might still be worked out. A short-term orientation tends to be taken and negative emotions can be generated. Critics emphasise these possibilities as major problems. Yet, experienced negotiators can reach outcomes that both sides consider fair. The underlying power imbalance, however, is generally thought to inhibit the generation of the benefits of interdependence.

The role of supply chain interdependence in shaping performance has become a popular theme in operations and supply chain research (Bashir et al., 2022; Elking et al., 2017; Vijayasarathy, 2010). Thomas et al. (2013) argue that supply chains consist of interdependent buyer-supplier relationships at the most fundamental level. Mishra et al. (2016) claim that dependence is essential in strengthening the relationship of a firm with its supply chain partners and in accomplishing its goals. Kähkönen et al. (2015) point out

that managers should understand the factors that affect dependence, which have a substantial influence on value creation in supply chains.

Despite the rhetoric favouring interdependence, some scholars still question whether firms always benefit from the interdependence (Eckerd and Sweeney, 2018; Grawe and Ralston, 2019; Yan and Wagner, 2017). Collaboration within an organisation has been given more attention than has collaboration between a supplier and customer in a supply chain (Ho and Lin, 2004). The limited existing literature reviews have examined financial interdependence (Clark et al., 2012; Li et al., 2012), intragroup interdependence (Van der Vegt and Van de Vliert, 2002), and resource-based dependence (Hillman et al., 2009; Lockett et al., 2009). None of these reviews have given particular attention to addressing whether interdependence really improves a firm's performance and its operational practices. Most of these studies described low levels of collaboration. This means the potential for future improvements appears to be very great. It is sometimes unclear what theories have been used in these prior studies to improve our understanding of interdependence.

This study will address three research questions. How has interdependence been defined and conceptualised? What has been the most popular theory used in interdependence studies? Did interdependence significantly improve SCM practices and performance? To answer the research questions, this study will review the methods and findings of empirical studies on interdependence published between 1991 and 2022 in premium journals from the fields of operations and supply chain management. A systematic review of the relevant empirical studies was conducted to identify themes in existing research and understand a range of influences on interdependence. Our focus on quantitative studies regarding performance and operational practices in premium journals differentiates our efforts from prior work.

This study offers several new contributions to the interdependence field. This study broadens our understanding of the impacts of interdependence by analysing a large body of the empirical studies on interdependence. Existing studies have mainly highlighted the theoretical side of resource dependence theory and collaboration (Hillman et al., 2009; Lockett et al., 2009). Our study concludes that interdependence does often lead to improvements in organisational practices and performance, but there are also situations where it does not. We will identify gaps in the literature. Suggestions for future research will be provided to encourage scholars to conduct promising investigations in the operations and supply chain management field. Overall, our results should help practitioners anticipate the possible and probable impacts of establishing interdependence.

The remainder of the paper is organised as follows. The ensuing section presents our methodology. Next, our findings will then be presented. The range of different definitions of interdependence found in our studies is set forth. This section is followed by our suggestions for future research. Our analysis will then be drawn to a close in a brief conclusion.

2 Methodology

This study used a systematic literature review methodology, which is a replicable method to identify the most relevant papers and synthesise them for managers and researchers (Denyer and Tranfield, 2009; Needleman, 2002). Systematic literature reviews utilise

explicit article selection criteria. The transparency with regard to these criteria and the analytic processes later used allow others to reproduce the results [Barczak, (2017), p.120]. Table 1 presents the systematic search procedure. Data were obtained from Web of Science (WOS). This is a well-known electronic database used for literature analysis. WOS has been considered one of the largest multidisciplinary databases of peer-reviewed literature and scientific data (Corallo et al., 2020; Ma et al., 2019). WOS has a powerful search engine that contains a wide range of detailed information and provides full results for an accurate analysis (Garcia-Buendia et al., 2022; Maheshwari et al., 2021).

Our article selection process was carefully designed to ensure that our review covers all publications in the mainstream of the supply chain interdependence literature. The selection procedure involved six steps. First, keywords were used to search for relevant articles. We examined prior review studies to identify a list of keywords. The keywords used in the review studies were coded in an Excel spreadsheet. Next, to identify appropriate search words, we performed interviews with practitioners who had explicit knowledge of the interdependent collaboration in supply chains. The interviews helped identify the following primary keywords: interdependence, mutual dependence, joint dependence, balanced dependence, and collaboration. Following Hillmann and Guenther (2021), we combined the primary search keywords with method-based keywords to identify empirical studies. The method-based keywords are data, empirical, finding*, test, statistical, and result*. We searched the abstracts of articles using these keywords. This resulted in an initial sample of 109,999 articles. Second, we limited our selection to articles published from 1991 to 2022. The sample was thereby reduced to 108,881 articles. Third, we searched for articles conducted in the context of operations and supply chain management. Our search was limited to articles published in OM/SCM journals, including *Decision Sciences*, *International Journal of Logistics Management*, *International Journal of Operations & Production Management*, *International Journal of Physical Distribution & Logistics Management*, *International Journal of Production Research*, *International Journal of Production Economics*, *Journal of Business Logistics*, *Journal of Operations Management*, *Journal of Purchasing and Supply Management*, *Journal of Supply Chain Management*, *Management Science*, *Manufacturing & Service Operations Management*, *Operations Management Research*, *Production and Operations Management*, *Production Planning & Control*, and *Supply Chain Management: An International Journal*. This step reduced the sample to 863 articles. Fourth, we screened all titles and abstracts of the selected articles to evaluate their relevance and fit with the research scope. The examination of the title and abstract resulted in 93 articles. Fifth, we read the entire articles and excluded articles that are non-empirical studies or did not clearly describe the methodology well. Articles that did not deal with interdependence as a variable were also excluded. This step produced 33 articles. Sixth, the references in each article were evaluated to look for additional articles. The same search process was repeated to search for articles in Google Scholar. Our systematic review ultimately produced a final sample of 36 articles. The selected articles were manually codified in an Excel data extraction sheet, specifying the author(s), year, title, type of outcome, sector, perspective, data source, interdependence measure, outcome measure, analytic technique, theory, and key findings.

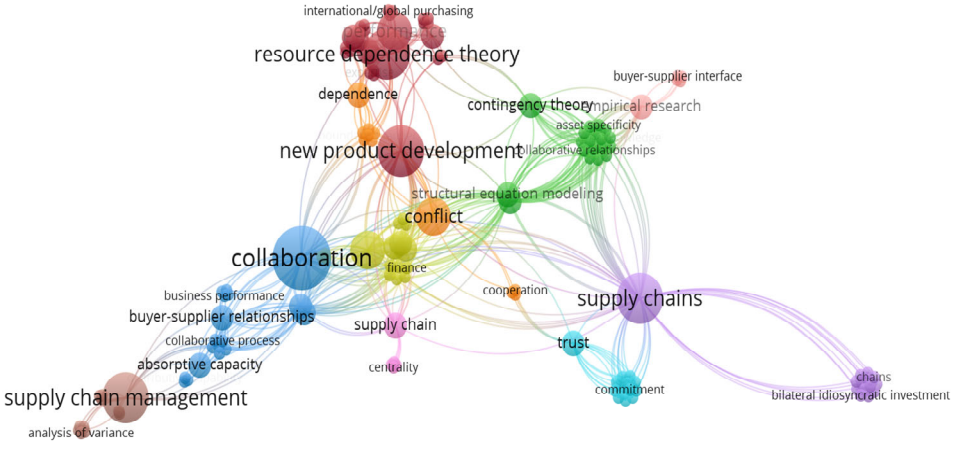
Table 1 Systematic search procedure

	Description	*Articles remaining*
Step 1	Searched for articles using primary keywords (interdependence, mutual dependence, joint dependence, balanced dependence, or collaboration) and method-based keywords (data, empirical, finding*, test, statistical, or result*)	109,999
Step 2	Limited the search to articles published from 1991 to 2020	108,881
Step 3	Searched for articles conducted in the context of operations and supply chain management	863
Step 4	Screened all titles and abstracts of the selected articles to evaluate their relevance	93
Step 5	Read the entire articles and excluded articles that did not fit the selection criteria	33
Step 6	Analysed references in each article to look for additional articles	36

3 Findings

Following the methodology proposed by Kazemi et al. (2019), we conducted bibliometric analysis to develop networks of keyword co-occurrences and identify key clusters from the pool of our selected articles. Bibliometric analysis is an objective quantitative technique. It generates visualised bibliometric networks that illustrate how a research field has been structured and developed over time (Wetzstein et al., 2019). We took two steps to perform the keyword-based analysis. We began bibliometric analysis by first loading the CSV data file that includes data of authors, titles, abstracts, keywords, references, and journal titles. The list of keywords of each paper was manually double-checked.

Figure 1 Networks of co-occurrences of keywords (see online version for colours)



We then utilised the VOSviewer software to develop networks of keyword co-occurrences. VOSviewer is network visualisation software that draws distance-based visualisations of bibliometric maps and helps uncover the knowledge structure of relevant

studies. Figure 1 presents the networks of co-occurrence of keywords, visualising the interlinkages of the selected articles graphically. The nodes represent keywords, while the links represent the interlinkages of the keywords. The figure shows several keywords in different colour-coded clusters: such as, collaboration, new product development, supply chain management, supply chains, conflict, and performance. The largest keyword cluster that has been most frequently used in the literature is collaboration. The next largest keyword clusters are new product development, resource dependence theory, and supply chain management.

Table 2 shows the examples of definitions of interdependence that researchers have proposed. As Frayret et al. (2004) suggest, companies tend to fit within one of the six different types of interdependence: namely:

1 pooled interdependence
2 sequential interdependence
3 reciprocal relationships
4 intensive interdependence
5 task/subtask interdependencies
6 simultaneity interdependence.

Similarly, we found that researchers defined interdependence somewhat differently. Our analysis shows these definitions can be placed into three categories: specifically

1 relationship-based
2 goal-oriented
3 effort-related.

The relationship-based category views interdependence as an active status of a relationship between two firms. This research stream stresses interdependence should be conceptualised as who is dependent on whom, not what a firm depends on from other firms. For example, certain researchers defined interdependence as the degree of interdependence on one another (Hoejmose et al., 2013; Ren et al., 2015; Sambasivan et al., 2013; Whitehead et al., 2016), the degree of balance in dependence across customers and suppliers (Schwieterman et al., 2018; Vijayasarathy, 2010), and the sum of both parties' interdependence (Hofer, 2015; Thomas et al., 2018).

The goal-oriented category highlights the link between interdependence and its goals. Adherents of this research stream argue that interdependence should be viewed in terms of both the status of a relationship and the ultimate impact this has on outcomes. For instance, interdependence has been regarded as:

1 the extent to which two firms take each other into account to achieve goals (Grawe et al., 2012; Thomas et al., 2013; Van Der Vegt et al. 2000)
2 the extent to which firms need each other to research certain outcomes (Zacharia et al., 2011)
3 the extent to which a firm does not control all conditions necessary for the accomplishment of a goal or outcome (Monczka et al., 1998).

The effort-related category suggests that interdependence be viewed as the status directed toward relying on other firm's efforts, skills, information, and processes. This research stream assumes that the status of interdependence influences performance through the companies' efforts and activities. These researchers defined interdependence as:

1 the extent to which firm performance is dependent on the efforts, skills or technologies of other firms (e.g., Schmidt et al., 2022; Schoenherr et al., 2017; Tatikonda and Rosenthal, 2000; Wageman and Baker, 1997; Yan and Nair, 2016)

2 the extent to which firms equally share information, risks and benefits (Galbraith, 1977; Martínez Sanchez and Perez, 2005; Sosa, 2014).

Our review of interdependence studies reveals that resource dependence theory was the most popular individual theory (11/36 = 31%). This lens stresses that organisations must depend upon the external resources of other firms (Cai et al., 2017; Chang et al., 2022; Huo et al., 2022; Jajja et al., 2017; Kim et al., 2020; Vijayasarathy, 2010; Xiao et al., 2019). Ren et al. (2015, p.971) argue that "the more resources invested, the more specialised the relationship becomes and the higher interdependence is formed". Other theories used included transaction cost theory (4/36 = 11%), social network theory (3/36 = 9%), knowledge-based view (3/36 = 9%), and contingency theory (3/36 = 9%). Multiple theories were used in 11 studies (11/36 = 31%) (e.g., Cai et al., 2017; Chang et al., 2022; Huo et al., 2017; Jayaraman and Liu, 2019; Sambasivan et al., 2013; Wong et al., 1999; Zacharia et al., 2009, 2011).

Sixteen studies (16/36 = 46%) focused on examining how interdependence affects supply chain performance: such as, financial performance, operational performance, supply chain flexibility, and satisfaction (Caniels et al., 2018; Elking et al., 2017; Huo et al., 2017; Jajja et al., 2017; Ralston et al., 2020; Yan and Azadegan, 2017; Yan and Nair, 2016). Twenty studies (20/36; 57%) investigated how interdependence shapes organisational practices: such as, a level of supplier involvement, a level of collaborative engagement, a level of communication, and the use of a cooperative approach (Cai et al., 2017; Eckerd and Sweeney, 2018; Grawe and Ralston, 2019; Hoejmose et al., 2013; Jayaraman and Liu, 2019; Zacharia et al., 2011).

Twenty-one studies (21/36 = 60%) collected data from the manufacturing sector (e.g., Cai et al., 2017; Gattiker, 2007; Sosa, 2014; Vijayasarathy, 2010; Wong et al., 1999). Four studies (4/36 = 11 %) focused on the service sector (Grawe et al., 2012; Jayaraman and Liu, 2019). Ten studies (10/36 = 29 %) examined both sectors (e.g., Zacharia et al., 2009; Hoejmose et al., 2013; Whitehead et al., 2016).

Data were collected via questionnaires in 31 studies (31/36 = 86%) from either executives, directors, managers, or employees (Eckerd and Sweeney, 2018; Monczka et al., 1998; Hoejmose et al., 2013; Huo et al., 2017; Schoenherr et al., 2017). Five studies (5/36 = 14%) used archival data from the Compustat segment customer database, Bloomberg's database, or benchmarking and metrics database (Chang et al., 2022; Elking et al., 2017; Hui et al., 2008; Kim et al., 2020). All of the studies used a cross-sectional design. No study used a longitudinal design. The customer perspective was taken in 13 studies (13/36 = 36%). The supplier perspective was taken in 13 studies (13/36 = 36%). Consideration of both the customer and supplier perspectives was taken in nine studies (10/36 = 28%).

Structural equation modelling (SEM) was used as an analytic technique in 19 studies (19/36; 53%). Ordinary least squares (OLS) regression was used in ten studies (10/36;

28%). Other analytic techniques, such general linear squares (GLS), generalised estimating equations (GEE), polynomial regression, and ordered logit regression (OLR), were used in seven studies (7/36; 19%).

Table 2 Example definitions of interdependence

Relationship-based	*Goal-oriented*	*Effort-related*
• The average degree of balance in dependence across the customers and suppliers (Schwieterman et al., 2018)	• The extent to which customers and suppliers take each other into account to achieve individual goals (Thomas et al., 2013)	• The extent to which an individual's completion of a task depends on the efforts of others (Schoenherr et al., 2017)
• The degree of interdependence on each other (Hoejmose et al., 2013; Whitehead et al., 2016)	• The degree to which members are presented with goals or provided with group feedback (Grawe et al., 2012; Van Der Vegt et al. 2000)	• The degree to which an individual's task performance relies on the efforts or skills of others (Wageman and Baker, 1997; Yan and Nair, 2016)
• The degree of interdependence between alliance partners (Sambasivan et al., 2013)	• The way in which different companies perceive they need each other to perform their work and reach desired outcomes (Zacharia et al., 2009)	• The degree of dependence on others to perform activities in work processes (Rai and Hornyak, 2013)
• A deeper and more committed relationship between interacting companies (Ren et al., 2015)	• The perception companies need each other to perform their work and reach certain outcomes (Zacharia et al., 2011)	• The extent to which there is an equal sharing between the companies of risks, burden, and benefits (Martínez Sanchez and Perez, 2005)
• The extent to which a focal firm and its supplier are dependent on each other (Vijayasarathy, 2010)	• The extent to which an actor does not entirely control all of the conditions necessary for achievement of a desired outcome or an action (Monczka et al., 1998)	• The amount of information that should be processed between decision makers during the execution of the task to get a given level of performance (Sosa, 2014)
• The sum of both companies' dependence (Thomas et al., 2018)		• The interdependence among development stages as well as the interdependence among product modules (Yan and Azadegan, 2017)
• The sum of both firms' dependence levels (Hofer, 2015)		• The degree of interdependence between and among the process and product technologies to be developed (Tatikonda and Rosenthal, 2000)
• The influence of one task on other tasks (Peng et al., 2014)		• The degree of interdependence among process and product technologies (Schmidt et al., 2022)
• The relational condition between business partners (Ralston et al., 2020)		

It is important to note that the existing studies have used a wide variety of measures to operationalise interdependence. More specifically, interdependence was alternatively operationalised by one item (Elking et al., 2017; Hoejmose et al., 2013; Kim, 2017; Peng et al., 2014; Schoenherr et al., 2017; Sosa, 2014), two items (Hui et al., 2008), three items (Grawe and Ralston, 2019; Jayaraman and Liu, 2019; Martínez Sanchez and Perez, 2005; Monczka et al., 1998; Sambasivan et al., 2013; Thomas et al., 2013; Yan and Azadegan,

2017; Yan and Nair, 2016; Yan and Wagner, 2017), four items (Cai et al., 2017; Grawe et al., 2012; Jajja et al., 2017; Rai and Hornyak, 2013; Whitehead et al., 2016; Xiao et al., 2019; Zacharia et al., 2009; Zacharia et al., 2011), five items (Wong et al., 1999; Caniels et al., 2018), six items (Vijayasarathy, 2010; Ren et al., 2015) or eight items (Eckerd and Sweeney, 2018). This enormous variation in the number of interdependence items used make it very difficult to determine whether interdependence improved practices and performance.

Positive effects of interdependence on performance and practices were reported in 53% (19/36) of the studies analysed (Cai et al., 2017; Caniels et al., 2018; Huo et al., 2017; Jayaraman and Liu, 2019; Sambasivan et al., 2013; Sosa, 2014; Thomas et al., 2013; Whitehead et al., 2016). Negative effects were found in 8% (3/36) (Martínez Sanchez and Perez, 2005; Yan and Nair, 2016). No impact was reported in 8% (3/36) of our studies (Yan and Wagner, 2017; Eckerd and Sweeney, 2018; Grawe and Ralston, 2019). Thirty-one percent (11/36) of the studies explored moderating effects of interdependence on performance and practices (Elking et al., 2017; Hui et al., 2008; Kim, 2017; Kim et al., 2020, b; Peng et al., 2014; Rai and Hornyak, 2013; Schoenherr et al., 2017; Xiao et al., 2019).

Nineteen studies found positive effects of interdependence on performance or practices (Table 3). Fourteen of these 19 studies reported that interdependence was positively related to organisational practices: such as, a cooperative approach, coordination improvement, relationship commitment, and the frequency of interactions (Cai et al., 2017; Gattiker, 2007; Grawe et al., 2012; Hoejmose et al., 2013; Jayaraman and Liu, 2019; Sosa, 2014; Thomas et al., 2013; Vijayasarathy, 2010; Whitehead et al., 2016; Wong et al., 1999; Zacharia et al., 2009; Zacharia et al., 2011). These 14 studies were 39% (14/36) of the overall cases we examined.

These positive results were based on questionnaires completed by managers, directors, and executives. Researchers operationalised the level of interdependence in various ways, ranging from using one item (Hoejmose et al., 2013) to six items (Vijayasarathy, 2010). The practice variables were alternatively operationalised by one item (Sosa, 2014), two items (Vijayasarathy, 2010; Cai et al., 2017), and more than four items (Jayaraman and Liu, 2019; Thomas et al., 2013; Whitehead et al., 2016). SEM was mainly used in these studies (e.g., Cai et al., 2017; Gattiker, 2007; Jayaraman and Liu, 2019). No archival data sources were used.

Five studies (5/36 = 14%) examined how interdependence is positively related to performance in various ways: including, operational performance, supplier satisfaction, relational capital, value co-creation, partnership quality, and alliance success (Caniels et al., 2018; Huo et al., 2017; Monczka et al., 1998; Ren et al., 2015; Sambasivan et al., 2013). These studies examined the manufacturing and service sectors. Surveys were collected from employees, managers, and executives. None of these studies used archival data. SEM was used in two studies (Huo et al., 2017; Sambasivan et al., 2013). Other three studies relied on OLS, Polynomial regression, and PLS (Caniels et al., 2018; Monczka et al., 1998; Ren et al., 2015).

Only modest attention has been given to behavioural issues that may impact managerial decision making and strategies (e.g., Eckerd and Sweeney, 2018; Hofer, 2015; Thomas et al., 2018). Hofer (2015) claims inter-organisational interdependence can influence the attitudinal and behavioural dimensions of supply partners. Hofer's study

found that a customer's perceived interdependence is positively associated with its long-term orientation in the relationship. Thomas et al. (2013) assumed that supply chains at the most fundamental level consist of interdependent buyer–supplier relationships. They contend opportunistic behaviours, which deviate from expectations of mutual benefit, encourage punitive actions. This will naturally jeopardise future information flows between these suppliers and customers.

Table 4 presents six studies that reported negative effects or no effect between interdependence and performance or practices. Negative effects from interdependence were reported in three studies (3/36 = 8%). These studies involved data collected through surveys of purchasing managers. Martínez Sanchez and Perez (2005), in a study of 126 Spanish automotive suppliers, took the supplier perspective and used multivariate analysis. Their results indicate perceived interdependence between firms was negatively related to supply chain flexibility. Interdependence was measured by the extent there was an equal sharing of risks, burden, and benefits or the proportion of supplier members who were located near customer members. Yan and Nair (2016) applied contingency theory by suggesting the national environment influenced inter-organisational interactions. Using data from 426 employees, they examined a relationship between interdependence and project performance. Their results indicated there was a negative link between interdependence and project performance. Further, the fit between the national context and the intergroup structure explained the differences in group performance.

No effect of interdependence on practices was reported in three studies (3/36; 8%). Yan and Wagner (2017) examined the association between technology interdependence and relationship conflicts. Their study of 272 new product development projects found no evidence that technology interdependence positively affects relationship conflicts. They suggested future studies examine how different types of interdependence influence conflicts in workgroups and supply chains. Eckerd and Sweeney (2018) studied 187 manufacturers in 10 industries. They found jointly dependent partners tend to forgo formal conflict governance strategies in favour of relational ones. Their hypothesis regarding increased joint dependence being related to increased use of relational governance mechanisms to resolve conflict was not supported. Grawe and Ralston (2019) analysed data collected from 309 implanted logistics service providers. Their hypothesis about the link between task interdependence and cognitive congruence was not supported. They concluded that relying on one another for information and resources does not necessarily result in the ability to understand the role that each plays in the operation.

Pfeffer and Salancik (1978, p.1) state "to understand the behavior of an organization you must understand the context of that behavior – that is, the ecology of the organization". Researchers have examined the contextual influences of independence on practices and performance. Table 5 presents 11 studies (11/36 = 31%) that utilised the interdependence as a moderating variable. Two studies (2/36; 6%) found a positive moderating effect of interdependence on practices, such as on the level of collaboration and the level of involvement in production processes. Peng et al. (2014) examined 212 product development projects. They found the use of IT tools and collaboration was positively moderated by the extent the project tasks depended upon each other. Xiao et al. (2019) focused on how interdependence and technology uncertainty affect supplier involvement in production processes. They found that supplier involvement moderated the fit between interdependence and technological uncertainty.

Table 3 Positive effect of interdependence on practices and performance

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
Positive effect of interdependence on practices										
Wong et al. (1999)	Practice	Manufacturing	Customer	107 firms in Hong Kong	Survey of managers	The extent to which a customer and a supplier depend upon each other (5 items)	The use of cooperative approach (5 items)	SEM	Cooperation and competition theory	Interdependence leads to a reliance on a cooperative approach.
Gattiker (2007)	Practice	Manufacturing	Supplier	124 firms	Survey of managers, schedulers, and planners	The amount of interdependence between manufacturing and marketing (7 items)	Improvements in coordination (4 items)	SEM	Information-processing theory	ERP-enabled coordination improvement is positively affected by interdependence.
Zacharia et al. (2009)	Practice	Manufacturing and service	Customer and supplier	60 collaboration projects	Survey of supply chain managers	The degree of the interdependence of knowledge and process (4 items)	The level of collaboration among firms (7 items)	SEM	Resource-based view and relational view	The interdependence of knowledge and process is positively related to the level of collaboration among firms.
Vijayasarathy (2010)	Practice	Manufacturing	Customer and supplier	276 manufacturing firms	Survey of supply chain executives and managers	The extent to which two firms are dependent on each other (6 items)	Commitment (2 items) and supply integration (4 items)	PLS	Resource dependence theory	There are positive relationships between commitment and interdependence, and between supply integration and interdependence.
Zacharia et al. (2011)	Practice	Manufacturing and service	Customer and supplier	473 companies in several industries	Survey of managers, directors, and CEOs	The level of perceived interdependence (4 items)	The level of collaborative engagement (10 items)	SEM	Knowledge-based view and relational view	The level of interdependence positively affects the level of collaborative engagement.

Table 3 Positive effect of interdependence on practices and performance (continued)

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
Positive effect of interdependence on practices										
Grawe et al. (2012)	Practice	Service	Customer and supplier	81 dyads of service providers and customers	Survey of senior-level executives	The level of agreement relating to outcome interdependence (4 items)	Relationship commitment (5 items)	SEM	Interdependence theory	Inter-organisational interdependence has a positive effect on relationship commitment.
Hoejmose et al. (2013)	Practice	Manufacturing and service	Customer	339 buyer-supplier relationships	Survey of procurement officers	The level of interdependence (1 item)	The implementation of socially responsible practices (5 items)	OLS	Not provided	Joint dependence positively influences the buyer engagement with socially responsible supply chain.
Thomas et al. (2013)	Practice	Manufacturing and service	Customer and supplier	78 respondents	Survey	The degree of Interdependence (3 items)	The level of information exchange, communication quality, and operational knowledge transfer (10 items)	SEM	Social exchange theory	An increase in levels of interdependence leads to an increase in knowledge sharing behaviours in interdependent relationships.
Sosa (2014)	Practice	Manufacturing	Customer	606 dyadic relationships	Survey and interview	The level of product-related communications (1 item)	The need for rework (1 item)	Logit regression	Social network theory	Task interdependence is positively related to higher propensity to realise the need for rework.

Table 3 Positive effect of interdependence on practices and performance (continued)

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
Positive effect of interdependence on practices										
Whitehead et al. (2016)	Practice	Manufacturing and service	Customer	310 supply chain firms	Survey of purchasing managers	The level of perceived interdependence between firms (4 items)	The level of collaborative engagement (6 items)	SEM	Knowledge-based view	The level of perceived interdependence between firms is positively associated with the level of collaborative engagement.
Cai et al. (2017)	Practice	Manufacturing	Customer and supplier	One cell phone manufacturer and 277 retailers in China	Survey of sales managers	The level of dependence between a manufacturer and its retailer (4 items)	The frequency of interactions (2 items)	SEM	Resource dependence theory and transaction cost theory	Interdependence is positively associated with the frequency of interactions between managers.
Jayaraman and Liu (2019)	Practice	Service	Supplier	192 Indian professional service providers	Survey of COO and CEO	The degree of a task's interdependence (3 items)	Service capabilities (4 items)	SEM	Information processing theory and contingency theory	Interdependence increases the service provider's service capabilities.
Ralston et al. (2020)	Practice	Manufacturing and service	Customer	237 decision-makers	Survey of decision-makers in firms	The degree of partner interdependence (4 items)	Supply chain collaboration (4 items)	SEM	Relational view and resource-based view	Partner interdependence is positively related to supply chain collaboration.
Huo et al. (2022)	Practice	Manufacturing	Customer and supplier	200 manufactures in China	Survey of managers	The degree of supplier dependence and customer dependence (8 items)	Relational ties (5 items)	Polynomial regression	Resource dependence theory and social exchange theory	Dependence asymmetry is positively related to relational ties.

Table 3 Positive effect of interdependence on practices and performance (continued)

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
Positive effect of interdependence on performance										
Monczka et al. (1998)	Performance	Manufacturing	Customer	154 alliances	Survey of procurement professionals	The degree of interdependence in alliance and partnerships (3 items)	Alliance success (7 items)	OLS	Resource dependence theory	Interdependence is positively associated with successful strategic supplier alliances.
Sambasivan et al. (2013)	Performance	Manufacturing	Customer and supplier	260 strategic alliances	Survey of senior executives	The level of interdependence measured as task, goal, and reward interdependencies (3 items)	The level of relational capital (3 items)	SEM	Transaction cost theory, resource-based view, contingency theory, social exchange theory, and personal relationship	The level of interdependence positively influences the level of relational capital between alliance partners.
Ren et al. (2015)	Performance	Manufacturing and service	Customer and supplier	110 supplier and client relationships	Survey	The level of the client dependence and the supplier dependence (total 6 items)	Value co-creation (6 items) and partnership quality (5 items)	PLS	Inter-organisational theory	Resource interdependence positively affects value co-creation and partnership quality.
Huo et al. (2017)	Performance	Manufacturing	Customer	617 manufacturers in China	Survey of top management and middle managers	The level of joint dependence measured as the overall level of power (18 items)	Operational performance (6 items)	SEM	Resource dependence theory and embeddedness theory	Interdependence is positively related to the focal firm's operational performance.
Caniels et al. (2018)	Performance	Manufacturing	Supplier	109 buyer-supplier dyads in the chemical industry	Survey of purchasing employees	The level of interdependence (5 items)	Supplier satisfaction (5 items)	OLS	Power-dependence view and resource-dependence theory	Interdependence is positively associated with supplier satisfaction.

Table 4 Negative or no effect of interdependence on practices and performance

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
Negative effect of interdependence on performance										
Martinez Sanchez and Perez (2005)	Performance	Manufacturing	Supplier	126 Spanish automotive suppliers	Survey of purchasing managers	The extent to which there is an equal sharing of risks, burden, and benefits (3 items)	Supply chain flexibility (10 items)	OLS	Not provided	A high level of perceived interdependence between firms is negatively related to supply chain flexibility.
Yan and Nair (2016)	Performance	Manufacturing	Customer	426 employees in the USA and China	Online and offline survey	The proportion of supplier members who are conveniently located near buyer members during the collaboration (3 items)	Project performance (10 items)	SEM	Contingency theory	The negative effect of task interdependence on project performance is smaller in China than that in the USA.
Chang et al. (2022)	Performance	Manufacturing and service	Customer and supplier	5,371 suppliers and 2,113 customers	Archival data from Compustat customer segment	The level of interdependence	Supplier financial performance (1 item)	OLS	Transaction cost theory and resource dependence theory	Major customers' bargaining power has a less negative impact on supplier financial performance in the presence of strategic fit.

Table 4 Negative or no effect of interdependence on practices and performance

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
No effect of interdependence on practices										
Yan and Wagner (2017)	Practice	Manufacturing	Customer and supplier	272 new product development projects in 21 industries	Survey of vice presidents, managers, and engineers	The level of interdependence among modules, stages, and technologies (3 items)	The level of relationship conflicts (4 items)	SEM	Behavioural theory	A hypothesis regarding technology interdependence being positively related to relationship conflicts was not supported.
Eckerd and Sweeney (2018)	Practice	Manufacturing	Customer and supplier	187 manufacturers in 10 industries	Survey of employees	The degree of interdependence (8 items)	The extent of usage of governance mechanisms (3 items)	OLS	Transaction cost theory	A hypothesis regarding interdependence being related to the use of relational governance mechanisms to resolve conflict was not supported
Grawe and Ralston (2019)	Practice	Service	Supplier	309 implanted logistics service providers	Survey of representatives	The degree of task interdependence (3 items)	Cognitive congruence (3 items)	SEM	Resource orchestration theory	A hypothesis regarding intra-organisational task interdependence results being related to cognitive congruence was not supported.

Table 5 Moderating effect of interdependence on practices and performance

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
Moderating effect of interdependence on practices										
Peng et al. (2014)	Practice	Manufacturing	Supplier	212 new product development projects in nine countries	Survey of managers	The extent to which project tasks depend upon each other (1 item)	The level of collaboration (3 scales)	SEM	Organisational information processing theory	The association between the use of IT tools and NPD collaboration is smaller for NPD projects with a higher degree of task interdependence.
Xiao et al. (2019)	Practice	Manufacturing	Customer	125 manufacturers	Survey of managers	The degree of interdependence between buyer and supplier (4 items)	Supplier involvement in production processes (7 items)	OLS	Resource dependence theory	Interdependence and technology uncertainty positively affect supplier involvement in production processes.
Moderating effect of interdependence on performance										
Hui et al. (2008)	Performance	Service	Supplier	323 capital facility construction projects	Archival data from the benchmarking and metrics database	The level of interdependent activities (2 items)	Project performance measured by percentage cost overrun variables (1 item)	GEE	Structural contingency theory	Interdependence moderates the relationship between outsourcing structures and performance.
Rai and Hornyak (2013)	Performance	Manufacturing	Customer	125 sourcing professionals in the paper products and related chemicals industry	Survey of sourcing professionals	The extent to which employees' work activities depend on others (4 items)	Job satisfaction (4 items)	PLS	Not provided	Work process interdependence moderates the relationship between the use of sourcing enterprise systems and job satisfaction.

Table 5 Moderating effect of interdependence on practices and performance (continued)

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
Moderating effect of interdependence on performance										
Elking et al. (2017)	Performance	Manufacturing	Customer	3,638 buyer-supplier relationships	Archival data from the Compustat and Bloomberg's SPLC databases	The level of interdependence between customer and supplier (1 item)	Financial performance measured by the customer firm's return on assets (1 item)	GLS	Resource dependence theory	Interdependence moderates the relationship between focal firm inventory leanness and focal firm financial performance.
Kim (2017)	Performance	Manufacturing and service	Supplier	717 suppliers and 257 customers	Archival data from the Compustat Segment database	The symmetric mutuality of dependence between supplier and customer (1 item)	Financial performance measured by ROA and ROS (2 items)	OLS	Social network theory	Interdependence positively moderates the relationship between customer concentration and the supplier's profitability.
Kim et al. (2020b)	Performance	Manufacturing and service	Supplier	16,404 supplier firm-year observations	Archival data from the Compustat segment customer database	The degree of firms' dependent relationships measured based on total sales	Supplier performance measured as return on assets (1 item)	OLS	Social network theory and resource dependence theory	Customer network centrality and resource dependence help improve supplier performance.
Schmidt et al. (2022)	Performance	Manufacturing	Customer	251 manufacturing firms in Italy	Survey of managers and engineers	The degree of technology interdependence (3 items)	The level of product design quality (3 items)	SEM	Knowledge management view	Technology interdependence moderates the relationship between knowledge inputs and product design quality.

Table 5 Moderating effect of interdependence on practices and performance (continued)

Author	*Type of outcome*	*Sector*	*Perspective*	*Sample*	*Data collection*	*Interdependence measure*	*Outcome measure*	*Analytic technique*	*Theory*	*Key finding*
No moderating effect of interdependence on performance										
Schoenherr et al. (2017)	Practice	Manufacturing	Customer and supplier	107 IT implementation team members	Survey of the members of IT implementation project teams	The extent to which the interactions employees have with each of their team members (1 item)	An individual's perception level of help provided by team members (1 item)	OLS	Equity theory	A hypothesis regarding task interdependence negatively moderating the negative relationship between negative inequity and subsequent peer-reported helping was not supported.
Jajja et al. (2017)	Performance	Manufacturing	Supplier	296 firms	Survey of middle and senior managers in Pakistan and India	The level of interdependence between customer and supplier (4 items)	Product innovation (3 items)	SEM	Resource dependence theory	A hypothesis regarding interdependence moderating the impact of supplier innovation activities on focal firm product innovation was not supported.
Yan and Azadegan (2017)	Performance	Manufacturing	Customer	272 projects in 21 industries	Survey of middle and top-level managers	The extent to which various technologies interact with each other (3 items)	The level of product novelty (3 items) and financial performance (3 items)	SEM	Knowledge-based view	A hypothesis regarding technology interdependence negatively moderating the effect of inter-organisational NPD strategies on product novelty was not supported.

Six studies (6/36; 17%) found a positive moderating effect of interdependence on performance: such as, financial performance (Elking et al., 2017; Kim, 2017; Kim et al., 2020), operational performance (Hui et al., 2008), and satisfaction (Rai and Hornyak, 2013). Kim (2017) studied how supplier firms' customer concentration in revenue influenced their financial performance. She found that the supplier firms' profitability moderated the fit between customer concentration and interdependence. Elking et al. (2017), in a study of 3,638 buyer–supplier relationships, found interdependence moderated the influence of a focal firm's inventory leanness on its financial performance. Hui et al. (2008) analysed archival data. They found the impact of outsourcing structures on performance depended on the level of interdependence between firms.

Three studies (3/36; 8%) reported a non-significant moderating effect of interdependence. Jajja et al. (2017) investigated the effect of supplier innovation activities on product innovation. Their study did not find support for the relationship between supplier innovation activities and the focal firm's product innovation being moderated by interdependence among supply chain partners. Yan and Azadegan (2017), based on behavioural theory, studied how a firm's inter-organisational strategies influenced its financial performance and product novelty. Their study found no support for the moderating influence of interdependence on the relationship between inter-organisational strategies and product novelty. Schoenherr et al. (2017) examined the influence of negative inequity and subsequent peer-reported helping. Their investigation showed no moderating effect of interdependence on the relationship between negative inequity and peer-reported helping.

4 Discussion

Fifty-three percent of our sample studies showed positive effects from interdependence. On one hand, this is a substantial result. It far outweighed the negative effects found in 8% of the studies. On the other hand, given the potential benefits, one should consider why even more positive results were not found. Several suggestions will be offered for future research.

The initial position of the two firms needs to be considered. Launching a partnership between organisations that have relatively equal power should be the easiest. If one firm has historically dominated another, launching a partnership would be far more difficult. The initial transition could result in the weaker firm improving its financial performance, while the stronger would probably do worse. This would be a challenging financial and behavioural adjustment for the formerly stronger firm. The benefits of sharing more information and doing joint research and development, however, could become evident as the relationship matures.

In order to study the evolution of a partnership, a longitudinal design must be used. To date, most researchers have focused on doing cross-sectional survey analyses. This approach does not allow the researchers to capture the dynamics of time and sequence in the formation of an interdependent relationship (Huo et al., 2018; Kähkönen et al., 2015; Peng et al., 2014; Vijayasarathy, 2010). The interdependence literature, however, suggests that longitudinal studies can make more robust causal arguments and broaden our understanding of the antecedents and outcomes of interdependence (Jajja et al., 2017; Sambasivan et al., 2013). Changes in the behaviours a customer and a supplier exhibit over time and the influence of strategies on performance can become evident

(Schwieterman et al., 2018). Longitudinal studies can account for the long-term path characteristics of organisational decisions and capture the impacts of their control mechanisms being periodically activated (Huo et al., 2017; Zhang and Huo, 2013).

Future researchers should also recognise cultural differences between organisations might inhibit the development of collaboration. For example, 18 cultural differences have been outlined between US and Japanese companies [White and Rackerby, (1994), p.135]. Dealing with differences, such as a cultural orientation toward short-term profits versus obtaining greater long-term market share, and an individualistic versus a collectivistic orientation, appears to be quite challenging (Hofstede and Hofstede, 2005). Further, some American leaders focus on the positions taken in formal negotiations, while some Japanese leaders put more emphasis on developing relationships in informal settings, such as over drinks, at dinner or on the golf course (Meyer, 2014). Observation and interviewing may be able to identify if such matters are problems.

Future research studies could also explore the dark side of interdependence and provide a broader picture of such relationships. Most of the studies we reviewed characterised interdependence as a desirable and mutually beneficial relationship. Only two studies explored how interdependence decreased supply chain flexibility and resulted in negative outcomes (Martínez Sanchez and Perez, 2005; Yan and Nair, 2016). The development of interdependence often requires a supplier to make relationship-specific investments for a customer. This increases costs and creates uncertainty. Similarly, a customer firm that mutually depends on a supplier may come to trust the supplier excessively and lose its objectivity in monitoring the supplier products and services. This might result in a failure to detect the supplier firm's misbehaviours promptly.

Conflicting results have been found across studies for the hypothesised effects of interdependence on practices, such as relationship commitment and collaborative engagement. Some studies report that the level of perceived interdependence between firms has a positive effect on the level of collaborative engagement and interactions (Cai et al., 2017; Grawe et al., 2012; Whitehead et al., 2016; Zacharia et al., 2011). Others found no evidence that interdependence is associated with inter-organisational conflicts, the use of relationship mechanisms, and cognitive congruence (Eckerd and Sweeney, 2018; Grawe and Ralston, 2019; Yan and Wagner, 2017). These mixed results indicate there is no comprehensive picture with regard to the relationship between interdependence and organisational practices. Therefore, future studies could fruitfully examine how firms develop practices and processes to stably produce greater value from interdependence.

A few other subjects have received little attention in interdependence studies to date. Enhanced sustainability could be fostered by a collaborative relationship that develops from interdependence (Ma et al, 2019). More work should be done to show if positive statistically significant results exist. Historically, innovation has been explored in a few dependence asymmetry studies with mixed results (Kim and Fortado, 2020). The weaker firm in such situations may over time have the necessary funds for research and development depleted by the demands of the stronger party for lower prices or other costly arrangements. Such issues should not exist in an interdependent relationship, because both parties should be making ample profits. Further, the partners could work together on innovations. These are promising issues to explore in the future.

We suggest that future studies explore learning perspectives that may lead to a better understanding of the organisational capabilities and decision-making processes in an interdependent relationship. The current literature has paid little attention to the role that

the interdependent relationship plays in influencing the effectiveness of the inter-firm learning (Yan and Nair, 2016). Although researchers have examined the impact of interdependence, explanations regarding the impact on learning mechanisms are limited. Little is known about the extent to which inter-firm learning has been increased by supply chain partners in interdependent relationships. In what ways does interdependence influence the speed and quality of learning? Which factors affect whether interdependence offers firms an opportunity to learn new skills and boost knowledge sharing? When do firms in interdependent relationships hesitate to pursue learning activities? Is learning effectiveness associated with a certain type of interdependence?

It would be interesting for future studies to examine the impacts of interdependence from a behavioural lens. A few studies have shed light on the behavioural aspect of power that exists in interdependent relationships (Huo et al., 2018; Thomas et al., 2018). Yet, past research overlooked how managers perceive bargaining power for unilateral benefits and adopt behavioural patterns within the context of supply management. Little is known about how behaviours negatively affect supply performance and competitive advantage opportunities. Some questions seem pertinent. Does interdependence reduce the opportunistic behaviours of a supplier or customer? Does interdependence promote supplier retention? Do ongoing interdependent buyer–supplier relationships influence collaborative knowledge sharing behaviours? Do supply chain managers' cognition and anger affect supplier retention in an interdependent relationship?

Far more quantitative studies have been conducted to date in the manufacturing sector than the service sector. Going forward, service operations deserve more attention. Each data gathering method has its own strengths and weaknesses. Survey data has been used far more extensively to date than archival data. Archival data could be explored more fully in the future. Slightly more studies took a customer perspective as opposed to a supplier perspective. Given the main subject is interdependence, it would be desirable to see more studies in the future that examined both perspectives. Moreover, some additional questions deserve to be explored. When is interdependence detrimental to a supply chain's operations, costs, and flexibility? What factors affect the decision of a customer or a supplier to pull back from interdependence? How do customer and supplier firms manage the risks and rewards associated with interdependence?

5 Conclusions

This study aims to make contributions to the literature on interdependence by reviewing existing empirical research. We found that interdependence can have a positive, negative, or no effect on practices and performance. We found a marked increase in quantitative studies dealing with interdependence in supply chains from 2012 to 2022. Resource dependence theory was the most popular individual choice for researchers. Multiple theories were used in 31% of the studies we reviewed. Given these results, theoretical diversity appears to be more popular than utilising one theory. The various contexts, data sources and measures in our sample studies make it difficult to conclude whether supply chain interdependence improves performance and practices. Our discussion section offered numerous suggestions for future research on SCM interdependence. While much has been learned to date, even more questions remain to be explored.

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