

Supply chain drivers, partnerships and performance of high-tech SMEs

Supply chain
drivers

An empirical study using SEM

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Abstract

Purpose – The purpose of this paper is to examine high-tech small-to-medium-sized enterprises (SMEs) supply chain partnerships. Partnerships are considered at the level of business function rather than the entire organisation. Second, the drivers of SMEs to engage in partnerships are assessed to see whether functions engage in partnerships for different reasons. Third, performance per function is assessed to see the differential effect of partnerships on the function's performance.

Design/methodology/approach – In this study, the relationship between the drivers of SMEs to engage in partnerships, four types of partnerships (marketing and sales, research and development (R&D), purchasing and logistics, and production) and four types of functional performances of firms (marketing and sales, R&D, purchasing and logistics, and production) are examined. The data have been collected from 279 SMEs. The proposed hypotheses are tested using structural equation modelling.

Findings – The results indicate that there are considerable differences between business functions in terms of the degree of involvement in partnerships and the effect of partnerships on the performance of these functions. This paper contributes to research by explaining the contradictory results of partnerships on SMEs performance.

Practical implications – This study helps firms understand which type of partnership should be established based on the firm's drivers to engage in supply chain partnership; and which partnership has a significant effect on which type of business performance of the firm.

Originality/value – The originality of this study is to investigate the relationship between different drivers to engage in supply chain partnership and different types of partnerships and different functional performance of firm in a single model.

Keywords Performance, Supply chain management, SME, SEM, Drivers, High-tech, Partnership

Paper type Research paper

1. Introduction

High-tech small-to-medium-sized enterprises (SMEs) need to access external sources of information, knowledge, know-how and technologies, in order to build their own innovative capability (So and Sun, 2010; Lambert and Schwieterman, 2012; Bojica *et al.*, 2017). Partnerships provide opportunities to access the tacit knowledge and other non-tradable competencies that are critical for pursuing innovation-based competitive strategies (Delbridge and Mariotti, 2009). For example, in a survey of Chinese manufacturing SMEs, Zeng *et al.* (2010) found that inter-firm cooperation has the most significant positive impact on the innovation performance of SMEs. One criticism of much of the literature on supply



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chain partnerships is that the focus of the research has been on the purchasing and logistics functions. Perhaps the most serious disadvantage of this is that other business functions have been overlooked. Clearly these need to be taken into account as effective supply chain management (SCM) should internally and externally integrate all the functions (Mentzer *et al.*, 2001). Indeed, Croom *et al.* (2000) argued that suppliers and buyers do not merely exchange material assets. Suppliers and buyers also exchange financial assets, technological assets, information, and knowledge. This assortment of interactions calls for specific partnerships in different functional areas, such as “marketing and sales”, and “research and development” (R&D). Indeed, several studies have reported the wider benefits supply chain partnerships may provide for the partners involved (Chan *et al.*, 2003; Ellram and Cooper, 1990; Mentzer, 2004). The benefits of partnership are categorised as customer-related benefits (e.g. lead time reduction, market share increase, improved product quality), productivity-related benefits (e.g. material cost reductions), and innovation-related benefits (e.g. ability to implement new processes) (Cetindamar *et al.*, 2005). When one examines supply chain partnerships for SMEs the limited previous research has on occasion cast doubt on the potential benefits (e.g. Vaaland and Heide, 2007). For example, Arend and Wisner (2005) revealed a negative relationship between SMEs’ supply chain partnerships and overall firm performance. Such negative relationship might be because SMEs are relatively opportunistic and mostly concern short-term goals. On the other hand SMEs might benefit from SCM improving their core competencies through working with large enterprises. They can also leverage their competencies in innovation and new product development through access to the technological assets of their supply chain partners (Thakkar *et al.*, 2012).

The purpose of this paper is to examine partnerships around different business functions and investigate drivers and performance effects of these partnerships per business function. It is referred to business “functions” rather than “departments” because this work is set within smaller companies without formal departments. Data were collected on partnerships of four business functions (marketing and sales, R&D, purchasing and logistics, and production) using a survey of 279 high-tech SMEs. Structural equation modelling (SEM) was applied to investigate the hypothesised relationships between drivers and functional partnerships and between functional partnerships and performance of the functions.

The paper makes a number of significant contributions to research. The main contribution of the paper is to uncover the driving force behind different functional partnerships for SMEs. That is, the paper identifies the main categories of SMEs’ drivers to engage in supply chain partnership, and then sheds light on the relationship between SMEs’ drivers and functional partnerships. Furthermore, the paper investigates the relationship between supply chain partnership and performance for different functional areas. An investigation of partnership management for different functional areas could provide answers to several critical questions in the SCM literature, especially for SMEs. Several studies have already investigated the relationship between supply chain partnerships and firm performance (Hak *et al.*, 2006; Maloni and Benton, 1997; Vickery *et al.*, 2003; Gunasekaran *et al.*, 2004; Arend, 2006; Arend and Wisner, 2005). However, there are no systematic studies examining the relationship between supply chain partnership or firm performance in different functional areas. Although partnerships on the whole are beneficial (Morgan and Hunt, 1994; Lambert *et al.*, 1999), there are also disadvantages, such as an increased dependence on suppliers, communication costs, and the risk of losing confidential information (Kelle and Akbulut, 2005). As such, firms need to ensure they invest in relationships that are beneficial and meet their expectations.

The rest of the paper is organised as follows. In the next section the theory and hypotheses are presented. The methodology is discussed in Section 3, and the findings of the study are presented in Section 4. Finally, in Section 5, the discussion, managerial implications, and conclusions are provided.

2. Theory and hypotheses

SCM is defined as the systematic, strategic coordination of the traditional business functions and the procedures operating between these business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole (Mentzer *et al.*, 2001). In this definition, business functions occupy a central role.

We focus on a specific group of companies, high-tech SMEs. The SCM literature has traditionally focused on large firms (Thakkar *et al.*, 2008; Zheng *et al.*, 2007) although strategic partnerships also seem to be very important for SMEs. While large firms may benefit from “economies of scale, experience, brand name recognition, and market power” (Chen and Hambrick, 1995), SMEs are built around limited resources, and the knowledge and capabilities of a few people. This stimulates outsourcing and the formation of partnerships (Cooper, 2002). It would seem that partnerships leverage SMEs’ limitations and secure competitive advantage. SMEs also have several behavioural advantages such as their flexibility and entrepreneurial character (Rothwell, 1989) even during crisis times (Bartz and Winkler, 2016), which make them attractive to other supply chain partners. Despite this fact, however, SCM has not yet been adequately studied in the context of SMEs.

Although a few studies have recently been undertaken around SCM activities for SMEs (e.g. Tan *et al.*, 2006; Arend and Wisner, 2005; Arend, 2006; Rezaei *et al.*, 2015; Kumar *et al.*, 2017), many unanswered research questions remain to be investigated. Specifically, these relate to the characteristics of SMEs. SMEs are not miniaturised versions of large firms, in the same way that a caterpillar is not a small butterfly (Penrose, 1959). It is inappropriate to generalise from the findings on the literature on large firms to SMEs as there are several key differences between large firms and their smaller counterparts (Chen and Hambrick, 1995; Dollinger, 1984; Roy and Banerjee, 2012; Belvedere *et al.*, 2010; Beck *et al.*, 2005; Felzensztein and Gimmon, 2007; Nootboom, 1994). Given these different characteristics, the purpose of this study is to investigate what drivers influence the formation of partnerships around specific business functions and how these partnerships, in turn, influence performance. A conceptual framework is developed incorporating three groups of variables: drivers to engage in SCM; supply chain partnership around specific business functions; and performance of the business functions.

2.1 Drivers to engage in supply chain partnerships

The contemporary literature reveals that firms have a variety of reasons (drivers) to engage in partnerships with other firms (Min and Zhou, 2002; Forrest and Martin, 1992). These drivers need to be examined first (Lambert, 2008) as they should clarify the supply chain goals (Min and Zhou, 2002). In empirical research among manufacturers, Chin *et al.* (2004) found five important reasons for implementing partnerships in SCM: reducing costs of operation, improving customer satisfaction, improving inventory and lead time, and remaining competitive. Rajagopal *et al.* (2009) considered cost reduction, effective procurement, and inventory reduction as some important drivers for SMEs to engage in partnership. Lambert (2008) and Lambert *et al.* (1996) identified a comprehensive list of potential drivers. In total they distinguish 26 items representing drivers (see Table III), and these are divided in four main categories: asset/cost efficiency, customer service, marketing advantage, and profit stability/growth. It is decided to use the same 26 items and use a factor analysis to create the main categories, which resulted in six factors representing drivers that we label as “cost reduction”, “customer satisfaction”, “inventory optimisation”, “growth”, “innovation”, and “demand optimisation” (see Table III and Figure 1).

These drivers all indicate that the main desire of firms to engage in supply chain partnerships is to improve firm performance (Richey *et al.*, 2009). Nonetheless, although beneficial, a number of limitations have also been identified (Halldórsson and

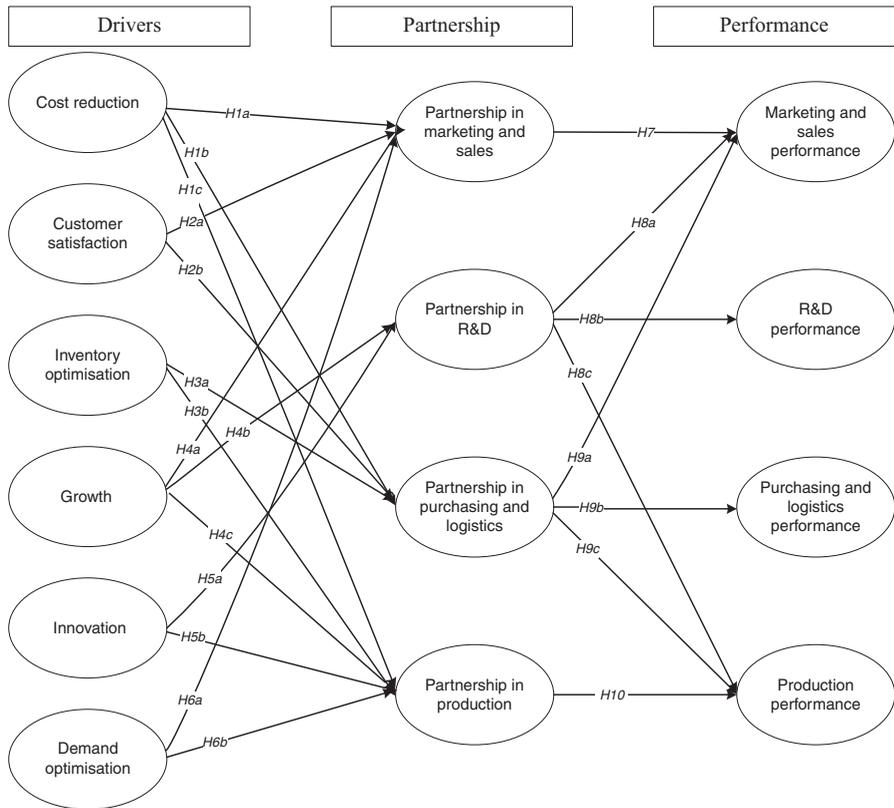


Figure 1.
A conceptual framework of SMEs functional partnership and its antecedents and consequences

Skjøtt-Larsen, 2004; Tai *et al.*, 2009) such as increased dependence on suppliers, increased communication costs, and loss of confidential information (Kelle and Akbulut, 2005). Thus, it is important for the firm to try to identify those relationships beneficial for the firm and which meet the expectations derived from the drivers.

2.2 Functional partnership

To fully understand the complex concept of collaboration between partners in the context of SCM it is necessary to look at both partnerships between entire organisations (the organisational perspective) and partnerships around specific functions within these organisations (the functional perspective). Partnership is a central concept in SCM. It is a type of inter-organisational relationship which can range from being based on transactional cost to vertical integration (Ellram and Cooper, 1990). The literature on SCM has mainly taken an organisational perspective on partnership. In this paper, partnerships around specific business functions are considered. This approach is referred to as the functional perspective (Rezaei *et al.*, 2015). This perspective provides an improved understanding of the partnerships of SMEs within the supply chain. Functional partnership occurs between a particular function in a firm, such as manufacturing or R&D, and partners within the supply chain, which occupy a central role in Figure 1.

2.3 Hypotheses part 1: drivers-partnership

Abdur Razzaque and Chen Sheng (1998) in their literature review argued that partnering for internal and external logistics is important because of the high levels of cost involved in

the activity. Also, different forms of partnering can be distinguished, such as joint ventures, full outsourcing, company pacts, exchange agreements, and contracts (Duysters and Hagedoorn, 2000; Mentzer *et al.*, 2000; Ploetner and Ehret, 2006). Gottfredson *et al.* (2005) suggested that outsourcing is becoming so sophisticated that even for core functions, such as purchasing and logistics, marketing and sales, and production, cost savings are identified as an important driver for partnering and outsourcing. These notions are reflected in the driver “cost reduction” that Lambert distinguished and the relationships that are hypothesised with several business functions. Four out of the 26 items that Lambert (2008) distinguished as drivers for partnerships refer to cost reduction. These items are “distribution costs”, “packaging costs”, “information handling costs”, and “price reductions”. These types of cost reduction specifically refer to the business functions: “purchasing and logistics”, “production”, and “marketing and sales”. It is therefore hypothesised that these three business functions engage in partnering to reduce costs:

- H1. SMEs with the driver “cost reduction” to engage in supply chain partnership are engaged in: (a) partnerships in marketing and sales; (b) partnerships in purchasing and logistics; (c) partnerships in production.

Customer satisfaction is another important driver for partnerships and is also central for organisational performance (Heikkilä, 2002). Indeed, Li *et al.* (2006) indicated that the customer relationship is not only important for organisational performance but also that this relationship can become a partnership. Those business functions that directly contact customers in their daily operations are most likely to partner with customers. These functions are typically: “marketing and sales” and “purchasing and logistics”. The link between customer satisfaction and the business function “purchasing and logistics” is illustrated by Heikkilä (2002): “Because of the good cooperation it was possible to remove the customer-specific inventory, resulting in major demand chain efficiency improvement and good customer satisfaction”. The link is also reflected in the driver customer satisfaction that Lambert (2008) distinguished and the relationships that is hypothesised with the business function of “purchasing and logistics”. Lambert (2008) distinguished three items that together with “customer satisfaction” form one factor in a factor analysis. These three items, “on-time delivery of products”, “accurate order deliveries” and “guaranteed supply”, share an intimate relationship with the business function “purchasing and logistics”. The link between customer satisfaction and the business function “marketing and sales” is also important because this function handles critical information required to supply and deliver products (Li and Lin, 2006). It is therefore hypothesised that the business functions: “purchasing and logistics”, and “marketing and sales” engage in partnering to increase customer satisfaction:

- H2. SMEs with the driver “customer satisfaction” to engage in supply chain partnership are engaged in: (a) partnership in marketing and sales; (b) partnership in purchasing and logistics.

Inventory optimisation is intimately related to the organisation of the two business functions purchasing and logistics, and production. These functions represent a chain from the supplies that enter a company to the final products that are sold to customers. The supply chain, however, extends to other suppliers and to customers and their customers. Optimising inventory, therefore, involves partnering of the business functions “production” and “purchasing and logistics” with these suppliers and customers (Angulo *et al.*, 2004). Several studies have acknowledged the importance of partnering in purchasing and logistics with the motivation of inventory optimisation – inventory reduction, inventory cost reduction, and inventory accuracy (e.g. Waller *et al.*, 1999; Kelle *et al.*, 2003). From Lambert’s (2008) initial list of 26 drivers, four items relate to

inventory management: “tracking of movement of products”, “paper work order processing”, “inventory cycle times”, and “inventory fill rates”. These items are related to production and purchasing and logistics and involve partnering. It is therefore hypothesised that the business functions “purchasing and logistics”, and “production” engage in partnering to increase inventory optimisation:

- H3.* SMEs with the driver “inventory optimisation” to engage in supply chain partnership are engaged in: (a) partnerships in purchasing and logistics; (b) partnerships in production.

SMEs that engage in supply chain partnerships because they are seeking growth have to increase their sales which necessitates increasing the production capacity and R&D activities. Partnerships in “marketing and sales” can help to increase sales at short notice. The balancing of marketing efforts between winning new customers and holding onto old ones will prove instrumental in pursuing sales and profit growth (Rosenberg and Czepiel, 1984). In both activities the business function “marketing and sales” is central. Expanding geographic coverage or company growth, especially for high-tech SMEs, calls for expanding R&D and production activities of the firm, hence partnership in these two functional areas. “Market expansion strategies encourage larger-scale incorporation of novel inputs into existing operations and accelerate the commercialization of radical innovations” (Branzei and Vertinsky, 2006). Growth happens via increasing the number of existing products or introducing new products or both which can be realized through R&D, production, and marketing and sales functional areas. As SMEs have limited resources in all these functional areas, they consider partnership. From the initial list of drivers (Lambert, 2008), seven items relate to growth: “entering new markets”, “joint advertising”, “increasing your firm’s sales”, “expanding geographic coverage”, “company growth”, “growth of the number of employees”, and “sales volume growth”. The first two items are intimately related to the business function “marketing and sales”, the latter items refer to other aspects to assess growth. It is therefore hypothesised that, for SMEs to satisfy their growth driver, the business functions “marketing and sales”, “R&D” and “production” engage in partnering:

- H4.* SMEs with the driver “growth” to engage in supply chain partnership are engaged in: (a) partnerships in marketing and sales; (b) partnerships in R&D; (c) partnerships in production.

Many SMEs engage in supply chain partnerships in order to improve their innovation performance. Rapid technological change means that these companies need to update their technological knowledge constantly. Acquiring external knowledge through R&D cooperation with partners is an essential input to the innovation activity of SMEs because they lack formal R&D activities (Acs *et al.*, 1994; Chun and Mun, 2012). On top of that, Tidd and Bessant (2014) showed that many products over their product life cycle contain increasing numbers of technologies. An example is provided by the steady increase in the number of technologies contained in mobile phones. These developments force SMEs to seek partners for product innovation. Finally, innovation can also relate to improvements in production. Innovation, either in the final product or in the production system is increased by partnerships (Belderbos *et al.*, 2004). From the initial list of drivers (Lambert, 2008), three items relate to innovation: “joint product development and product innovation”, “access to technology”, and “enhancing innovation potential”. It is therefore hypothesised that innovation is a prime driver of both the business functions of R&D and production to engage in partnerships (Grimpe and Kaiser, 2010):

- H5.* SMEs with the driver “innovation” to engage in supply chain partnership are engaged in: (a) partnerships in R&D; (b) partnerships in production.

Sometimes SMEs engage in supply chain partnerships to optimise or balance the demand for their products and services. This is especially so for firms facing high levels of fluctuating demand. These fluctuations can be more or less regular, such as the seasonal demand for agrochemicals, but they can also be more irregular. In both cases partnering can help to dampen the fluctuations. Pan and Nagi (2010) showed how close coordination between partners is vital to deal with demand uncertainty. From the initial list of drivers (Lambert, 2008), three items related to demand optimisation: “seasonal levelling”, “other cyclical levelling”, and “market share stability”. While partnerships in marketing and sales could help companies in market share stability, partnership in production could also help companies to use their partners’ production capacity in seasonal and cyclical levelling. It is therefore hypothesised that demand optimisation is a prime driver of both the business functions of marketing and sales and production to engage in partnerships:

H6. SMEs with the driver “demand optimisation” to engage in supply chain partnership are engaged in: (a) partnerships in marketing and sales; (b) partnerships in production.

2.4 Functional performance

We have shown that the main desire of firms to engage in supply chain partnerships is to improve their performance (Richey *et al.*, 2009). In the context of SCM, “cost” is a predominant performance measure (Beamon, 1999). This is why in most studies overall performance is measured as a construct incorporating one or more financial dimensions. However, in this paper, firm performance is measured separately for each business function. This could help to distinguish between those partnerships that are beneficial and those that are less so. The four different business functions explored in this paper are: marketing and sales, R&D, purchasing and logistics, and production.

2.5 Hypotheses part 2: partnership-performance

Partnerships in marketing or co-marketing or, as called by Adler (1966), symbiotic marketing allow firms to benefit from their partners’ resources to create a much more powerful force in the market. This type of partnership is common and of special importance for high-tech firms where “even the largest firms cannot hope to maintain cutting-edge positions across all technologies of interest to their end users” (Bucklin and Sengupta, 1993). Market penetration strategies and market development strategies are the main strategies a firm could pursue through a partnership in marketing (Varadarajan and Rajaratnam, 1986). In sum, by partnering in marketing, firms can enter into new geographical markets which can lead to sales volume growth and market share growth (Varadarajan and Rajaratnam, 1986; Adler, 1966; Das *et al.*, 2003). Given the above discussion, the following hypothesis is developed:

H7. SME’s partnership in marketing and sales improves the performance of SME’s marketing and sales’ activities.

SMEs use “almost twice as much of their R&D expenditures towards R&D collaboration than large firms” (Narula, 2004). Partnering in R&D has become the heart of many firms innovation strategy (Legros and Galia, 2012). This type of partnership has been shown to increase new technology (Cho and Jun, 2013) and knowledge transfer and sharing (Yao and Wu, 2010) and thereby increases innovation performance. Kuittinen *et al.* (2013) also found that R&D partnerships had a significant impact on the intensity of R&D activity. The dominant view within the literature is that R&D partnership can improve different aspects of R&D performance. Partnerships in R&D may not only have a direct positive effect on R&D performance, it might improve the firm’s performance in production, and marketing and sales. For example, in production performance, Aschhoff and Schmidt (2008)

found a highly significant positive relationship between R&D partnerships and cost reduction. They argued that such partnerships significantly help firms to improve their production processes. That is, firms could, for instance, lower the percentage of defects, and increase the range of products and services offered. For marketing and sales performance Belderbos *et al.* (2004) and Lööf and Broström (2008) found positive relationship between R&D partnerships and new-to-the-market sales growth. So, based on the discussion, the following hypothesis is developed:

- H8.* SME's partnership in R&D improves: (a) performance of SME's marketing and sales' activities; (b) performance of SME's R&D activities; (c) performance of SME's production activities.

Perhaps the most recognised relationship in the literature is the relationship between partnerships in purchasing and logistics and performance in purchasing and logistics. Good examples of partnerships in purchasing and logistics are vendor-managed inventory (VMI), and third party logistics (3PL) which have been shown to have a positive effect on different aspects of these functions such as quality and the delivery of purchased products, delivered products to the customers, and order fill capacity. Knemeyer and Murphy (2004), in an empirical study of 3PL arrangements, found that firms wanting to make a partnership between their firm and a logistics provider in order to increase their performance should establish managerial components that demonstrate a higher level of trust and communication with their provider. Due to the integrative role of purchasing and logistics functions, this kind of partnership has an inclusive effect on different functional performances (Paulraj *et al.*, 2006; Ellram and Carr, 1994). More specifically, partnerships in purchasing and logistics could also improve the firm performance in production, and marketing and sales. For instance, it has been found that VMI could result in higher product availability, higher service level, and lower inventory costs (Waller *et al.*, 1999; Sari, 2007). Bordonaba-Juste and Cambra-Fierro (2009) also found that partnership with suppliers leads to production of high-quality products. The above discussion leads to the following hypothesis:

- H9.* SME's partnership in purchasing and logistics improves: (a) performance of SME's marketing and sales' activities; (b) performance of SME's purchasing and logistics activities; (c) performance of SME's production activities.

Partnerships in production can result in a reduction in the number of defects and cost per operation hour. They can also increase the capacity utilisation, range of products and services, and utilisation of economic order quantity. Such partnerships in production provide a condition for a firm to utilise their partners' production capabilities and capacities. An excellent example of partnership in production is what is happening in Silicon Valley between manufacturing companies and suppliers inside and outside the region, which has resulted in reductions in the costs of production, a shortening of the product cycles, and the provision of rapid technological changes (Saxenian, 1991). Lorentz (2008) observed a positive correlation between partnerships in production and performance change in production quality. Thus, based on this discussion, the following hypothesis is developed:

- H10.* SME's partnership in production improves performance of SME's production activities.

All the hypothesised relationships are shown in Figure 1.

3. Methodology

3.1 Population, sample, and data collection

The population of this study is Dutch SMEs in high-tech industries. The sample was drawn from the "Kompass" database[1]. In all, 17 product categories[2] out of the 99 on the database fitted the high-tech profile required for this study. The screening process delivered

10,947 high-tech SMEs. The selection procedure for high-tech firms is based on Medcof's (Medcof, 1999) classifications of high-tech industries. That is to say, a SME is considered as a high-tech SME if it belongs to an industry with a high "research intensity" (the ratio of the R&D expenditures of an industry to its total sales) or with a high total R&D expenditure (the absolute amount spent on R&D by an industry) or both.

A four-page questionnaire was devised which included questions relating to engagement in partnership, functional partnership with supply chain partners (marketing and sales partners, R&D partners, suppliers and logistics partners, production partners), and functional firm performance. The questionnaire was pre-tested in a series of personal interviews based on the Three-Step Test-Interview approach (TSTI) (Hak *et al.*, 2006) with managers of two high-tech SMEs. This resulted in some modifications. Finally, the questionnaire was translated into Dutch by a professional editor, and reviewed by one of the authors of this paper to correct potential translation errors.

The questionnaire, along with a covering letter (both in Dutch) and a pre-addressed stamped envelope, was sent to senior managers of 6,000 randomly selected high-tech SMEs from the initial 10,947 population. In total, 304 questionnaires were returned. From these questionnaires, 25 were excluded (six did not satisfy the inclusion requirements, i.e. the number of employees and/or turnover exceeded those of a standard SME, and 19 were excluded because more than 10 per cent of the data were missing). The net sample contained 279 high-tech SMEs. In Table I, some descriptive statistics of the sample and the respondents are provided.

3.2 Non-response bias, and common method bias

There are several methods to address the issue of non-response bias in surveys. One such method is to test for significant differences between responses returned early and responses returned late. The idea here is that late respondents are similar to non-respondents. The sample of 279 firms was split into three groups of 93 observations. Two groups were made using the first and last 93 responses and *t*-tests were performed on the means of the demographics of these two groups. The results show no significant differences between the responses of the early and late responders (see Table II). This suggests that the non-response bias is not a real concern in this study.

As a single respondent from each firm (CEO) answered all parts of the questionnaire; it is important to investigate common method bias. To control for this a TSTI is conducted (Hak *et al.*, 2006), taking particular care to avoid double-barrelled questions, define difficult terms and provide examples for complex items in the questionnaire (Podsakoff *et al.*, 2003). In addition, before starting the analysis, and as a statistical remedy, Harmon's single-factor test (Podsakoff and Organ, 1986) is used. As a result, four factors (with eigenvalues greater than 1)

	Minimum	Maximum	Mean	SD
<i>Characteristics of the firms</i>				
No. of employees	1	250	44.32	43.456
Annual turnover (1,000 euro)	100	50,000	10,763	12,675
Firm age	2.00	161.00	43.03	26.52
<i>Characteristics of the respondents</i>				
Years working for firm	1	47	16.51	10.74
Respondent age	22.00	81.00	49.84	9.74
Respondent sex	Male: 240 (86%), Female: 14 (5%), Missing: 25 (9%)			
Respondent degree	High School: 70 (25.1%), Bachelor: 87 (31.2%), Master: 65 (23.3%), PhD: 5 (1.8%), Other: 32 (11.5%), Missing: 20 (7.2%)			

Table I.
Some characteristics of the sample, and the respondents

were extracted from all the measurement items of this study. These factors together account for 65 per cent of the variance in total; the first accounting for 33 per cent of the variance. As one single factor did not emerge from the factor analysis, and one general factor did not account for most of the variance among the measures, the results indicate that the common method bias resulting from a single respondent did not affect the results.

3.3 Construct validity

Construct validity shows the extent to which a set of measurement items reflects the latent constructs which are aimed to measure. Construct validity has four main components which are described here (Hair *et al.*, 2006).

Nomological validity and face validity. Nomological validity shows if theory supports the correlation between different latent constructs. Face validity shows if theory supports the correspondence between measurement items and their corresponding latent construct. These two validity tests, in fact, should be checked before testing the model (Hair *et al.*, 2006). For this study standard instruments which have been used in several empirical studies are used which support the face and nomological validity of this study.

Convergent validity. It shows the extent to which the measurement items of a construct converge or share a large common variance. The convergent validity is measured in several different ways: first, factor loading: high (and statistically significant) factor loadings is used to show convergent validity. Standardized loadings should be higher than 0.5 and ideally higher than 0.7; second, variance extracted (VE): the average percentage of variance extracted from the measurement items shows the convergence and is calculated as follows:

$$VE = \frac{\sum_{i=1}^n \lambda_i^2}{n}$$

where λ_i shows the standardized factor loading of item i and n is the number of measurement items. VEs greater than 0.5 shows adequate convergent validity; third, construct reliability (CR): shows the extent to which the measurement items all consistently together represent the latent construct. The most commonly used reliability measure in SEM studies is calculated as follows:

$$CR = \frac{(\sum_{i=1}^n \lambda_i)^2}{(\sum_{i=1}^n \lambda_i)^2 + (\sum_{i=1}^n \delta_i)}$$

where λ_i and δ_i show the standardized factor loading and error variance of item i , respectively, and n is the number of items. CRs greater than 0.6 are acceptable and above 0.7 show good reliability (Hair *et al.*, 2006).

Discriminant validity. It shows the extent to which a latent construct is distinct from other latent constructs. One of the best ways to check the discriminant validity is the

Table II.
t-Test for means of demographics of the initial 93 responses and the last 93 responses

Variable	df	<i>t</i> -value	Sig. (2-tailed)
Firm age	174	0.743	0.458
Number of employees	166	-0.839	0.403
Annual turnover/euro (last year)	143	0.221	0.826
Number of partners in marketing and sales	179	0.278	0.781
Number of partners in R&D	179	1.096	0.275
Number of partners in logistics and purchasing	179	1.600	0.111
Number of partners in production	179	-0.732	0.465

following rule (Hair *et al.*, 2006):

For two latent constructs p and q , good evidence of discriminant validity exists

if $VE_p > (\varphi_{pq})^2$ and $VE_q > (\varphi_{pq})^2$, otherwise there is a discriminant validity problem.

where VE is the variance extracted (as calculated above) and φ_{pq} shows the correlation between the two constructs p and q .

3.4 Analysis

In this section, to evaluate the fit of the model, SEM following the steps suggested by Schumacker and Lomax (2010) was performed using LISREL 8.80 (Jöreskog and Sörbom, 2007).

Step 1. Model specification. In this step, different models are specified according to different hypothesised relationships between observed variables and hypothesised factors.

Step 2. Model identification. Prior to the estimation of parameters, it is necessary to solve the problem of identification. This will show whether the factor loadings can be estimated. To this end, first the “order condition” is assessed, which means that the number of free parameters to be estimated has to be less than or equal to the number of distinct values in the sample variance-covariance matrix S ($p(p+1)/2$).

Step 3. Model estimation. The free parameters are then estimated. Several procedures can be applied such as maximum likelihood, generalised least square, and weighted least squares. There are also several software packages; however, in this study, the LISREL 8.80 program (Jöreskog and Sörbom, 2007) is used to estimate the parameters.

Step 4. Model testing and modification. Once the parameters have been estimated, it is very important to see if the estimates are significant and the overall fit is acceptable. Multiple fit indices were used to assess the goodness-of-fit of the models. If the overall fit is not acceptable or the estimate is insignificant, the specified model is modified or rejected.

Confirmatory factor analysis. Anderson and Gerbing (1988) recommended a two-step modelling approach. That is, first, the measurement model should be evaluated to check the fitness of the model, then the whole model (structural model) should be examined. While the measurement model assesses the convergent and discriminant validity of the model, the structural model assesses the predictive validity of the whole model (Schumacker and Lomax, 2010).

To measure the drivers to engage in partnerships, items provided by Lambert *et al.* (1996) and Lambert (2008) are used. For this part of the model we have 26 items (observed variables) (p), and six hypothesised factors (latent variables): cost reduction, customer satisfaction, inventory optimisation, growth, innovation, and demand optimisation. To measure the supply chain partnerships around separate business functions, the so-called functional partnerships, a standard instrument is used which has been grounded in the literature (Rezaei *et al.*, 2015; Lambert, 2008; Lambert *et al.*, 1996, 2004). The instrument has 26 items (observed variables) (p) and four hypothesised factors (latent variables) namely: partnership in marketing and sales, partnership in R&D, partnership in purchasing and logistics, and partnership in production. To measure the functional performance, prior research is used to derive the items. That is, a standard instrument is used for measuring R&D developed by Kerssens-van Drongelen and Bilderbeek (1999). For marketing and sales, purchasing and logistics performances the standard instruments developed by Green *et al.* (2008) with some small modifications are used, and for production performance the instrument developed by Gunasekaran *et al.* (2004) is used. This part of the model includes 33 items (observed variables) (p) and four hypothesised factors (latent variables) namely: performance of marketing and

sales, performance of R&D, performance of purchasing and logistics, and performance of production.

The CFA is conducted using LISREL 8.80 and all the measurement items with a loading below 0.70 are excluded from the model. In Table III the standardised estimations are shown, while Table IV shows the correlations between the constructs. As can be seen from Table III, the CR are very high. The VE by each specific construct is also greater than the square of the correlation between that and the other constructs, which indicates high discriminant validity for the constructs.

We use a number of goodness-of-fit (GFI) indices to evaluate the model. χ^2 which is a statistical test is the most important measure and is desirable to be insignificant. For large sample sizes ($N > 250$) and large number of observed variable ($m \geq 30$), however, usually a significant χ^2 is expected (Hair *et al.*, 2006). For this model $\chi^2 = 1,619.37$ with a degree of freedom, $df = 1,109$, which results in a ratio less than 2 (1.46) indicating an acceptable fit. Normed fit index (NFI) is a GFI proposed by Bentler and Bonett (1980), which has been used by many studies. Bearden *et al.* (1982), however, showed that NFI is greatly affected by the sample size, and cannot reach 1 even if the model is correct (Bentler, 1990), which is why a modified NFI called non-normed fit index (NNFI) is used (Bentler and Bonett, 1980). NNFI greater than 0.90 indicates a good fit. Comparative fit index (CFI) (Bentler and Bonett, 1980) is another commonly used GFI which should be greater than 0.90 to have a good fit. In this model NNFI = 0.97 and CFI = 0.98. Root mean square error of approximation (RMSEA) (Steiger, 1990) is also used as an index next to GFI indices. It should be less than 0.10 to have a good fit and less than 0.05 to have a very good fit. For this model RMSEA = 0.041 (p -value for Test of Close Fit (RMSEA < 0.05) = 1.0). As can be seen, the results for CFA model show a very good model fit.

4. Structural model

In this part, the path analysis is presented and its findings are discussed. Path analysis (historically referred to as causal modelling) is a method to analyse direct and indirect relationships between a number of variables (Schumacker and Lomax, 2010). The main requirement for using a path method, the presence of a temporal ordering of variables, is met by the conceptual model. The hypothetical relationships between constructs (*H1-H10*) are tested with LISREL 8.80 (Jöreskog and Sörbom, 2007), the result of which is depicted in Figure 2.

In Figure 2, the standardised estimates and their corresponding t -values are shown. It is important to not only have significant estimates for the paths, but also a good overall fit for the model. For this overall model, $\chi^2 = 2,292.11$, which is relatively high considering the $df = 1,163$, yet it is less than 2 (1.97) indicating an acceptable fit. The NNFI = 0.96 and the CFI = 0.96, which are very high, along with the RMSEA = 0.059 (p -value = 0.000), show a good model fit. Here the results of different parts of the overall model are discussed.

4.1 Drivers-partnerships

The first set of hypotheses is about the relationship between the drivers (six categories: cost reduction, customer satisfaction, inventory optimisation, growth, innovation, demand optimisation), and functional partnerships (Section 2.3). *H1* is partly supported. That is, a significant positive relationship is observed between “cost reduction” and “partnership in marketing and sales” (*H1a*). There is also a significant positive relationship between “cost reduction” and “partnership in purchasing and logistics” (*H1b*); however, there is no support for *H1c*. *H2* is also supported partially. That is, “customer satisfaction” positively influences “partnership in purchasing and logistics”; however, it has no significant effect on “partnership in marketing and sales”. “Inventory optimisation” has no significant effect on “partnership in purchasing and logistics” and “partnership in production”. The relationship between “growth”

Items ^a	Standardized coefficient (loadings)	<i>t</i> -values (all significant ($p < 0.001$))
<i>Drivers</i>		
Cost reduction (VE = 0.66; CR = 0.79)		
Distribution costs	0.87	13.85
Packaging costs	0.75	12.13
Customer satisfaction (VE = 0.65; CR = 0.85)		
On-time delivery of products	0.78	14.59
Accurate order deliveries	0.85	16.36
Customer satisfaction	0.79	14.77
Inventory optimisation (VE = 0.83; CR = 0.91)		
Inventory cycle times	0.94	18.03
Inventory fill rates	0.88	16.60
Growth (VE = 0.74; CR = 0.92)		
Increasing firm's sales	0.76	14.59
Company growth	0.92	19.84
Growth of the number of employees	0.83	16.79
Sales volume growth	0.93	20.20
Innovation (VE = 0.72; CR = 0.88)		
Jointly product development and product innovation	0.75	14.11
Access to technology	0.84	16.74
Enhancing innovation potential	0.94	19.79
Demand optimisation (VE = 0.73; CR = 0.85)		
Seasonal levelling	0.80	12.85
Other cyclical levelling	0.91	14.52
<i>Partnership</i>		
Partnership in marketing and sales (MS) (VE = 0.64; CR = 0.92)		
Control-MS	0.81	16.72
Decision-MS	0.85	17.52
Risk/Reward-MS	0.79	15.96
Investment-MS	0.73	14.17
Communication-MS	0.81	17.13
Partnership in research and development (RD) (VE = 0.65; CR = 0.92)		
Control-RD	0.82	17.27
Decision-RD	0.88	18.73
Risk/Reward-RD	0.77	15.54
Investment-RD	0.77	15.68
Communication-RD	0.78	16.32
Partnership in purchasing and logistics (PL) (VE = 0.59; CR = 0.90)		
Control-PL	0.77	15.82
Decision-PL	0.80	16.49
Risk/Reward-PL	0.77	15.25
Investment-PL	0.72	13.99
Communication-PL	0.79	16.49
Partnership in production (Pr) (VE = 0.60; CR = 0.82)		
Control-Pr	0.75	14.67
Decision-Pr	0.85	17.21
Communication-Pr	0.71	14.01
<i>Performance</i>		
Performance – MS (VE = 0.80; CR = 0.93)		
Average market share growth	0.90	19.11
Average sales volume (units) growth	0.93	20.03
Average turnover growth	0.86	17.51

(continued)

Table III.
Standardized
estimations of
the CFA

Items ^a	Standardized coefficient (loadings)	t-values (all significant ($p < 0.001$))
Performance – RD (VE = 0.64; CR = 0.96)		
Customer satisfaction/market response	0.80	15.83
% of products succeeding in the market	0.78	15.21
Professional esteem to customers	0.85	17.33
Agreed milestone/objectives met	0.81	16.11
Number of products/projects completed	0.76	14.72
Speed	0.70	13.12
Quality of output/work	0.79	15.49
Performance – LP (VE = 0.62; CR = 0.91)		
Delivery speed to your customers	0.79	15.30
Delivery dependability	0.83	16.23
Responsiveness to your customers	0.74	13.74
Delivery flexibility to your customers	0.77	14.58
Order fill capacity	0.81	15.63
Performance – Pr (VE = 0.62; CR = 0.77)		
Cost per operation hour	0.70	9.43
Capacity utilisation	0.87	11.92

Notes: VE, variance extracted; CR, construct reliability. ^aAll items with loading below 0.70 have been excluded from the model. The items were: production costs, information handling costs, paper work order processing, entering new markets, joint advertising, price reduction, expanding geographic coverage, guaranteed supply, market share stability, scope of all functional areas, time frame of contract of all functional areas, trust and commitment of all functional areas, risk/reward-Pr, investment-Pr, behaviour of people involved in R&D activities, no. of patents, no. of ideas/findings, creativity/innovation level, network building activities of firm, expected or realized IRR/ROI, per cent of sales by new products, profit due to R&D, market share gained due to R&D, price of purchased products, quality of purchased products, delivery of purchased products, per cent of defects, range of products/services, utilisation of economic order quantity

Table III.

and “partnership in marketing and sales” is highly significant, which lends strong support for *H4a*. There is no significant relationship between “growth” and the other partnerships. “Innovation” is also shown to be a strong driver for both “partnership in R&D”, and “partnership in production”, which supports *H5*. Finally, *H6* is partially supported, implying that “demand optimisation” is not a notable driver for SMEs to engage in “partnership in marketing and sales” but it motivates them to engage in “partnership in production”.

4.2 Partnerships-performances

A significant positive relationship is found between “partnership in marketing and sales”, and a firm’s “marketing and sales performance”, which supports *H7*. *H8* is partially supported. That is, “partnership in R&D” has a significant positive effect on a firm’s “marketing and sales performance” and “R&D performance” (*H8a* and *H8b*). This kind of partnership, however, has shown to be not significant for a firm’s “production performance” (*H8c*). There is a one-to-one relationship between “partnership in purchasing and logistics” and a firm’s “purchasing and logistics performance” (support for *H9b*). This partnership has no significant effect on a firm’s “marketing and sales performance” or “production performance”, which implies no support for *H9a* and *H9c*. Finally, it is observed that “partnership in production” has a significant positive effect on a firm’s “production performance”, lending strong support to *H10*.

5. Discussion

The purpose of this study is to determine the nature of the partnerships that SMEs make within their supply chain. It is acknowledged that SMEs are built around limited resources

Constructs	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Cost reduction	3.25	1.45	1.00													
2. Customer satisfaction	5.15	1.18	0.34*	1.00												
3. Inventory optimisation	3.61	1.42	0.44*	0.49*	1.00											
4. Growth	3.91	1.31	0.37*	0.53*	0.27*	1.00										
5. Innovation	4.04	1.45	0.37*	0.46*	0.27*	0.61*	1.00									
6. Demand optimisation	2.85	1.31	0.30*	0.23*	0.30*	0.43*	0.26*	1.00								
7. Partnership in marketing and sales (MS)	2.64	1.43	0.26*	0.13	0.18*	0.32*	0.38*	0.26*	1.00							
8. Partnership in research and development (RD)	2.67	1.39	0.31*	0.17*	0.20*	0.30*	0.44*	0.21*	0.70*	1.00						
9. Partnership in purchasing and logistics (PL)	2.88	1.34	0.39*	0.27*	0.26*	0.33*	0.36*	0.22*	0.69*	0.72*	1.00					
10. Partnership in production (Pr)	3.11	1.47	0.21*	0.24*	0.23*	0.26*	0.32*	0.28*	0.59*	0.64*	0.65*	1.00				
11. Performance – marketing and sales (MS)	4.39	0.96	0.21*	0.16*	0.15*	0.40*	0.27*	0.13*	0.34*	0.34*	0.26*	0.19*	1.00			
12. Performance – research and development (RD)	4.75	1.14	0.02	0.23*	0.18*	0.13*	0.19*	0.04	0.14*	0.22*	0.07	0.11	0.34*	1.00		
13. Performance – purchasing and logistics (PL)	5.42	0.98	0.01	0.25*	0.14*	0.05	0.03	0.01	0.08	0.05	0.12	0.09	0.03	0.34*	1.00	
14. Performance – production (Pr)	4.41	1.14	0.10	0.27*	0.22*	0.16*	0.22*	0.15*	0.04	0.09	0.13	0.25*	0.19*	0.39*	0.38*	1.00

Note: * $p < 0.01$

Table IV.
Correlation table

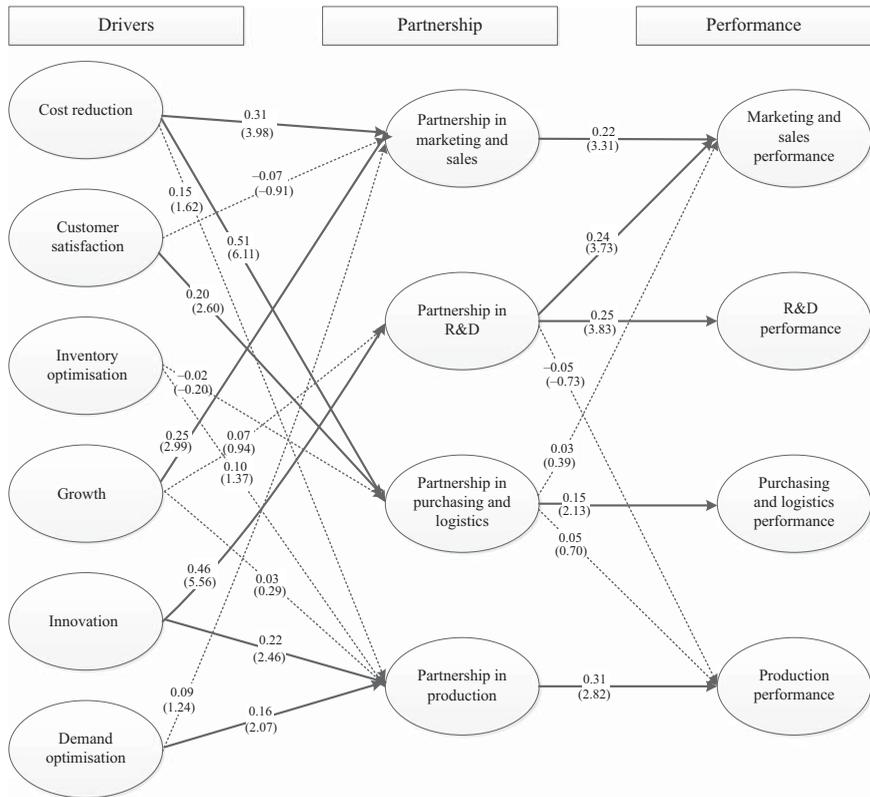


Figure 2.
Path model: drivers-
functional
partnership-functional
performance

and the knowledge and capabilities of a few people, predisposing them to outsource as well as to form partnerships (Cooper, 2002). For SMEs, even more than for large firms, partnerships offer the opportunity to secure competitive advantages. However, previous research has on occasion cast doubt on the potential benefits of partnerships for SMEs (e.g. Vaaland and Heide, 2007). The influential study by Arend and Wisner (2005) even revealed a negative relationship between SMEs' supply chain partnerships and overall firm performance. This finding, however, was based on data collected from a survey among senior production managers only. Thus, it raises the question of whether different types of partnerships may have different outcomes; and this question formed the basis of this study and its contribution to the literature. Partnerships around specific business functions, such as R&D and production, in high-tech SMEs are investigated. Insight is gained in these so-called functional partnerships in SCM by investigating the drivers of these partnerships and the results of these partnerships in terms of performance. A unique model was developed to investigate the relationship between drivers, supply chain partnership, and performance for different business functions. Below first the drivers for different functional partnerships are discussed and then the effect of these partnerships on performance is explained.

5.1 Drivers-partnerships

Using CFA six main driver categories for SMEs to engage in partnerships are found: cost reduction, customer satisfaction, inventory optimisation, growth, innovation, demand optimisation.

Our findings reveal that each function has a unique combination of drivers to engage in partnerships. The main drivers for firms to engage in partnerships in marketing and sales are “cost reduction” and “growth”. Previous results also support this, as it has been shown that marketing partnerships can result in overseas markets being opened up more quickly, thus leading to a firm’s growth (Doyle, 2000). It has also been found that SMEs partner with other firms in distributing their products in order to reduce distribution costs (Kuo and Chen, 2010). No significant relationship has been found between “customer satisfaction” or “demand optimisation”, and “partnerships in marketing and sales”. This implies that SMEs use “partnerships in marketing and sales” for their market expansion purposes rather than satisfying their customers or manage their inventory. In fact market expansion and growth is considered by SMEs’ as a propensity for survival (Crick and Spence, 2005), which can be achieved via “partnerships in marketing and sales”. It is found that the main driver for firms to engage in partnerships in R&D is “innovation”. This is also in line with previous research. R&D and technology partnerships mainly aim to access technology and know-how resources (e.g. licensing, purchase of rights, and royalty agreements) (McArthur and Schill, 1995; Watts and Hamilton Iii, 2011). It is, however, found that “growth” is not a significant driver for SMEs to partner in R&D. This might be because to grow they need new markets and increase in sales which leads them think about partnership in marketing and sales rather than in R&D. The main drivers for firms to engage in partnerships in purchasing and logistics are “cost reduction” and “customer satisfaction”. This type of partnership could be, for instance, between an SME and a 3PL provider. The literature strongly supports the finding as this type of partnership is mainly derived from cost reduction (Sahay and Mohan, 2006; Power *et al.*, 2007) and customer satisfaction (Bhatnagar *et al.*, 1999). “Inventory optimisation”, however, has no significant relationship with partnership in purchasing and logistics. In fact, “inventory optimisation” is not considered by SMEs to make any kind of partnership, which might be due to their lack of knowledge about this function (Soinio *et al.*, 2012). The main drivers for firms to engage in partnerships in production are “innovation” and “demand optimisation”. As mentioned by Swamidass (1993), access to technology is an important reason for inter-firm partnerships as internalising the technology may be prohibitive for most manufacturers. Through partnership in production, firms can utilise the production capacity of their partners to handle seasonal and other cyclical demand fluctuations. The other hypothesised relationship between drivers “cost reduction”, “inventory optimisation” and “growth” have no significant relationship with partnership in production.

It appears that for cost reduction, SMEs focus on partnership in marketing and sales and also on partnership in purchasing and logistics rather than partnership in production. They also rely on their partnership in production to handle cyclical demand fluctuations rather than optimising their inventories. Finally, although it seems logical to see growth as a driver for partnerships at all front, the data show that SMEs follow their growth driver only in their partnerships in marketing and sales. The differences in the sets of drivers for different functions justify distinguishing functional partnerships rather than considering partnerships between companies as a whole.

5.2 Partnerships-performances

Apart from partnerships in R&D, there is a one-to-one relationship between partnerships in specific business functions and the corresponding performance of these functions. This is an interesting finding, as it shows that when a firm has a specific functional objective, i.e. it wants to improve a specific functional performance, it is best placed to make a partnership in that specific function. For example, as discussed before, in this study it is found that if the driver of a firm to engage in supply chain partnerships is “growth” then the firm should make a partnership in marketing and sales. A one-to-one relationship suggests that making

partnerships in marketing and sales results in an improved performance in marketing and sales. Looking at Table III, it can be seen that performance in marketing and sales is composed of three items: “average market share growth”, “average sales volume (units) growth”, and “average turnover growth”. As can be seen, performance in marketing and sales is orientated around “growth” and this is precisely the aim of the firm.

The findings of the study suggest that partnerships in R&D seem to have a central role in performance, not only for the R&D function but also for the marketing and sales function. R&D partnership, however, has no significant relationship with production performance. The two items which have significant loadings for production performance are operations costs and capacity utilisation which might be improved via partnership in production rather than partnership in R&D. Partnership in purchasing and logistics also has no significant relationship with marketing and sales performance and production performance, which implies that this partnership has only a direct relationship to purchasing and logistics performance. The performance of this function might affect the performance of other functions which are not hypothesised in this study.

6. Scientific contribution, managerial implications, and future research

6.1 Scientific contribution

This work contributes in several ways. First, a possible explanation was found for the conflicting results regarding the effect of SME partnerships on their performance. The work shows that drivers differ for partnerships in different functions. Similarly, there is a difference in level of involvement of functions in partnerships and the effect on performance differs per function. The results indicate that a more R&D-oriented SME, such as the high-tech SMEs in this study, will benefit more from partnerships than other SMEs thereby explaining the conflicting performance effects found earlier. Second, this study contributes by operationalising the set of six drivers, and by operationalising partnerships per function and performance per function. These measurement instruments facilitate more fine-grained assessment of partnership formation and thereby contribute to future research.

6.2 Managerial implications

For each of the business functions, the drivers of forming partnerships and the effects of these partnerships on the performance of the business function are investigated. This is a scientific novelty with high practical relevance. From a managerial perspective it can be shown that different functions in different ways contribute to overall firm performance. Managers can now adopt strategies to strengthen particular functions or particular relationships between functions in their company, measure the results using functional performance measures and thereby increase overall firm performance. This work improves the ability of managers to analyse their organisation and act upon the findings because a distinction is made between partnership and the role and effect of particular types of partnership. Furthermore, this work helps managers monitor or even influence the drivers that in turn will affect functional partnership. Costs, for example, act as an important driver that influences partnership in purchasing and logistics and partnership in marketing and sales functional areas. In contrast, growth acts as a driver that primarily influences the partnership in marketing and sales while innovation acts as a driver influencing both production partnership and R&D partnership.

The evidence from this study suggests that SMEs need to consider carefully how potential partnerships may affect performance at the business function level, such as R&D and production. SCM is different for SMEs. Some SMEs do not perceive their suppliers to be potential partners, in the same way as big firms do; rather they perceive them as a safeguard, protecting them from a lack of production (Udomleartprasert *et al.*, 2003).

Supply chain partnership affects SMEs in different ways. On the one hand, they can provide quality, cost reduction, customer service, and leverage benefits for the SMEs. On the other hand, SCM exposes the SMEs to greater management and control hazards while reducing their particular differentiation advantages. SMEs may be able to establish different functional forms of supply chain partnerships with the same firm. This may help them avoid the feeling that they are indirectly managed by larger customers and have to yield to standards specified by the buyer. This may help improve the harmony between SMEs and the supply chain.

6.3 Future research

One of the main limitations of this study is the sample size, which calls for careful consideration of the findings and also further studies with larger sample size. This study shows that distinguishing different partnerships by looking at separate firm functions can be highly relevant, both scientifically and managerially. Future research should determine under what circumstances overall firm partnerships as distinct from functional partnerships should be investigated. Some aspects that may be important for partnerships might be firm based, whereas other aspects may be more function based. Future research might look for a more complete set of antecedents, such as specific market conditions that affect the formation of partnerships. Future research should also consider relevant moderating variables such as the type of product, the type of company (e.g. in terms of strategic position such as entrepreneurial orientation) and the type of industry. Finally, the focus of this study was on SMEs in high-tech sectors in the Netherlands. Further research could explore the extent to which the findings of this study can be generalised. Functional partnerships of large companies, companies in other countries, and companies in low-tech industries deserve separate investigations that in turn can be compared to the findings of this study.

Notes

1. www.kompass.com
2. A complete list of the product categories is available upon request.

References

- Abdur Razzaque, M. and Chen Sheng, C. (1998), "Outsourcing of logistics functions: a literature survey", *International Journal of Physical Distribution & Logistics Management*, Vol. 28 No. 2, pp. 89-107.
- Acs, Z.J., Audretsch, D.B. and Feldman, M.P. (1994), "R&D spillovers and recipient firm size", *The Review of Economics and Statistics*, Vol. 76 No. 2, pp. 336-340.
- Adler, L. (1966), "Symbiotic marketing", *Harvard Business Review*, Vol. 44 No. 6, pp. 59-71.
- Anderson, J.C. and Gerbing, D.W. (1988), "Structural equation modeling in practice: a review and recommended two-step approach", *Psychological Bulletin*, Vol. 103 No. 3, pp. 411-423.
- Angulo, A., Nachtmann, H. and Waller, M.A. (2004), "Supply chain information sharing in a vendor managed inventory partnership", *Journal of Business Logistics*, Vol. 25 No. 1, pp. 101-120.
- Arend, R.J. (2006), "SME-supplier alliance activity in manufacturing: contingent benefits and perceptions", *Strategic Management Journal*, Vol. 27 No. 8, pp. 741-763.
- Arend, R.J. and Wisner, J.D. (2005), "Small business and supply chain management: is there a fit?", *Journal of Business Venturing*, Vol. 20 No. 3, pp. 403-436.
- Aschhoff, B. and Schmidt, T. (2008), "Empirical evidence on the success of R&D cooperation – happy together?", *Review of Industrial Organization*, Vol. 33 No. 1, pp. 41-62.

- Bartz, W. and Winkler, A. (2016), "Flexible or fragile? The growth performance of small and young businesses during the global financial crisis – evidence from Germany", *Journal of Business Venturing*, Vol. 31 No. 2, pp. 196-215.
- Beamon, B.M. (1999), "Measuring supply chain performance", *International Journal of Operations & Production Management*, Vol. 19 No. 3, pp. 275-292.
- Bearden, W.O., Sharma, S. and Teel, J.E. (1982), "Sample size effects on chi square and other statistics used in evaluating causal models", *Journal of Marketing Research*, Vol. 19 No. 4, pp. 425-430.
- Beck, T., Demirguc-Kunt, A. and Levine, R. (2005), "SMEs, growth, and poverty: cross-country evidence", *Journal of Economic Growth*, Vol. 10 No. 3, pp. 199-229.
- Belderbos, R., Carree, M. and Lokshin, B. (2004), "Cooperative R&D and firm performance", *Research Policy*, Vol. 33 No. 10, pp. 1477-1492.
- Belvedere, V., Grando, A. and Papadimitriou, T. (2010), "The responsiveness of Italian small-to-medium sized plants: dimensions and determinants", *International Journal of Production Research*, Vol. 48 No. 21, pp. 6481-6498.
- Bentler, P.M. (1990), "Comparative fit indexes in structural models", *Psychological Bulletin*, Vol. 107 No. 2, pp. 238-246.
- Bentler, P.M. and Bonett, D.G. (1980), "Significance tests and goodness of fit in the analysis of covariance structures", *Psychological Bulletin*, Vol. 88 No. 3, pp. 588-606.
- Bhatnagar, R., Sohal, A.S. and Millen, R. (1999), "Third party logistics services: a Singapore perspective", *International Journal of Physical Distribution & Logistics Management*, Vol. 29 No. 9, pp. 569-587.
- Bojica, A.M., del Mar Fuentes-Fuentes, M. and Fernández Pérez, V. (2017), "Corporate entrepreneurship and codification of the knowledge acquired from strategic partners in SMEs", *Journal of Small Business Management*, Vol. 55 No. S1, pp. 205-230.
- Bordonaba-Juste, V. and Cambra-Fierro, J.J. (2009), "Managing supply chain in the context of SMEs: a collaborative and customized partnership with the suppliers as the key for success", *Supply Chain Management: An International Journal*, Vol. 14 No. 5, pp. 393-402.
- Branzei, O. and Vertinsky, I. (2006), "Strategic pathways to product innovation capabilities in SMEs", *Journal of Business Venturing*, Vol. 21 No. 1, pp. 75-105.
- Bucklin, L.P. and Sengupta, S. (1993), "Organizing successful co-marketing alliances", *Journal of Marketing*, Vol. 57 No. 2, pp. 32-46.
- Cetindamar, D., Çatay, B. and Basmacı, O.S. (2005), "Competition through collaboration: insights from an initiative in the Turkish textile supply chain", *Supply Chain Management: An International Journal*, Vol. 10 No. 4, pp. 238-240.
- Chan, F.T.S., Qi, H.J., Chan, H.K., Lau, H.C.W. and Ip, R.W.L. (2003), "A conceptual model of performance measurement for supply chains", *Management Decision*, Vol. 41 No. 7, pp. 635-642.
- Chen, M.-J. and Hambrick, D.C. (1995), "Speed, stealth, and selective attack: how small firms differ from large firms in competitive behavior", *The Academy of Management Journal*, Vol. 38 No. 2, pp. 453-482.
- Chin, K.-S., Tummala, V.M.R., Leung, J.P.F. and Tang, X. (2004), "A study on supply chain management practices: the Hong Kong manufacturing perspective", *International Journal of Physical Distribution & Logistics Management*, Vol. 34 No. 6, pp. 505-524.
- Cho, M. and Jun, B.-h. (2013), "Information sharing with competition", *Economics Letters*, Vol. 119 No. 1, pp. 81-84.
- Chun, H. and Mun, S.-B. (2012), "Determinants of R&D cooperation in small and medium-sized enterprises", *Small Business Economics*, Vol. 39 No. 2, pp. 419-436.
- Cooper, A.C. (2002), "Networks, alliances, and entrepreneurship", in Hitt, M.A., Ireland, R.D., Camp, S.M. and Sexton, D.L. (Eds), *Strategic Entrepreneurship: Creating a New Mindset*, Blackwell Publishing Ltd, Malden, MA, pp. 203-245.

- Crick, D. and Spence, M. (2005), "The internationalisation of 'high performing' UK high-tech SMEs: a study of planned and unplanned strategies", *International Business Review*, Vol. 14 No. 2, pp. 167-185.
- Croom, S., Romano, P. and Giannakis, M. (2000), "Supply chain management: an analytical framework for critical literature review", *European Journal of Purchasing & Supply Management*, Vol. 6 No. 1, pp. 67-83.
- Das, S., Sen, P.K. and Sengupta, S. (2003), "Strategic alliances: a valuable way to manage intellectual capital?", *Journal of Intellectual Capital*, Vol. 4 No. 1, pp. 10-19.
- Delbridge, R. and Mariotti, F. (2009), "Racing for radical innovation: how motorsport companies harness network diversity for discontinuous innovation", Advanced Institute of Management Research (AIM), London.
- Dollinger, M.J. (1984), "Environmental boundary spanning and information processing effects on organizational performance", *The Academy of Management Journal*, Vol. 27 No. 2, pp. 351-368.
- Doyle, P. (2000), "Valuing marketing's contribution", *European Management Journal*, Vol. 18 No. 3, pp. 233-245.
- Duysters, G. and Hagedoorn, J. (2000), "Organizational modes of strategic technology partnering", *Journal of Scientific and Industrial Research*, Vol. 59 Nos 8/9, pp. 640-649.
- Ellram, L.M. and Carr, A. (1994), "Strategic purchasing: a history and review of the literature", *International Journal of Purchasing and Materials Management*, Vol. 30 No. 1, pp. 9-19.
- Ellram, L.M. and Cooper, M.C. (1990), "Supply chain management, partnership, and the shipper – third party relationship", *International Journal of Logistics Management, The*, Vol. 1 No. 2, pp. 1-10.
- Felzensztein, C. and Gimmon, E. (2007), "The influence of culture and size upon inter-firm marketing cooperation: a case study of the salmon farming industry", *Marketing Intelligence & Planning*, Vol. 25 No. 4, pp. 377-393.
- Forrest, J.E. and Martin, M. (1992), "Strategic alliances between large and small research intensive organizations: experiences in the biotechnology industry", *R&D Management*, Vol. 22 No. 1, pp. 41-54.
- Gottfredson, M., Puryear, R. and Phillips, S. (2005), "Strategic sourcing", *Harvard Business Review*, Vol. 83 No. 2, pp. 132-139.
- Green, K.W. Jr, Whitten, D. and Inman, R.A. (2008), "The impact of logistics performance on organizational performance in a supply chain context", *Supply Chain Management: An International Journal*, Vol. 13 No. 4, pp. 317-327.
- Grimpe, C. and Kaiser, U. (2010), "Balancing internal and external knowledge acquisition: the gains and pains from R&D outsourcing", *Journal of Management Studies*, Vol. 47 No. 8, pp. 1483-1509.
- Gunasekaran, A., Patel, C. and McGaughey, R.E. (2004), "A framework for supply chain performance measurement", *International Journal of Production Economics*, Vol. 87 No. 3, pp. 333-347.
- Hair, J.F., Black, B., Babin, B., Anderson, R.E. and Tatham, R.L. (2006), *Multivariate Data Analysis*, 6th ed., Pearson Prentice Hall, Upper Saddle River, NJ.
- Hak, T., van der Veer, K. and Ommundsen, R. (2006), "An application of the three-step test-interview (TSTI): a validation study of the Dutch and Norwegian versions of the 'illegal aliens scale'", *International Journal of Social Research Methodology*, Vol. 9 No. 3, pp. 215-227.
- Halldórsson, Á. and Skjøtt-Larsen, T. (2004), "Developing logistics competencies through third party logistics relationships", *International Journal of Operations & Production Management*, Vol. 24 No. 2, pp. 192-206.
- Heikkilä, J. (2002), "From supply to demand chain management: efficiency and customer satisfaction", *Journal of Operations Management*, Vol. 20 No. 6, pp. 747-767.
- Jöreskog, G. and Sörbom, D. (2007), *LISREL 8.80*, Scientific Software International, Inc., Lincolnwood, IL.
- Kelle, P. and Akbulut, A. (2005), "The role of ERP tools in supply chain information sharing, cooperation, and cost optimization", *International Journal of Production Economics*, Vols 93-94, pp. 41-52.

- Kelle, P., Al-khateeb, F. and Anders Miller, P. (2003), "Partnership and negotiation support by joint optimal ordering/setup policies for JIT", *International Journal of Production Economics*, Vols 81-82, pp. 431-441.
- Kerssens-van Drongelen, I.C. and Bilderbeek, J. (1999), "R&D performance measurement: more than choosing a set of metrics", *R&D Management*, Vol. 29 No. 1, pp. 35-46.
- Knemeyer, A.M. and Murphy, P.R. (2004), "Evaluating the performance of third-party logistics arrangements: a relationship marketing perspective", *Journal of Supply Chain Management*, Vol. 40 No. 1, pp. 35-51.
- Kuittinen, H., Puumalainen, K., Jantunen, A., Kyläheiko, K. and Pätäri, S. (2013), "Coping with uncertainty – exploration, exploitation, and collaboration in R&D", *International Journal of Business Innovation and Research*, Vol. 7 No. 3, pp. 340-361.
- Kumar, R., Kumar, R., Kumar Singh, R. and Kumar Singh, R. (2017), "Coordination and responsiveness issues in SME supply chains: a review", *Benchmarking: An International Journal*, Vol. 24 No. 3, pp. 635-650.
- Kuo, J.-C. and Chen, M.-C. (2010), "Developing an advanced multi-temperature joint distribution system for the food cold chain", *Food Control*, Vol. 21 No. 4, pp. 559-566.
- Lambert, D.M. (Ed.) (2008), *Supply Chain Management: Processes, Partnerships, Performance*, Supply Chain Management Institute, Sarasota, FL.
- Lambert, D.M. and Schwieterman, M.A. (2012), "Supplier relationship management as a macro business process", *Supply Chain Management: An International Journal*, Vol. 17 No. 3, pp. 337-352.
- Lambert, D.M., Emmelhainz, M.A. and Gardner, J.T. (1996), "Developing and implementing supply chain partnerships", *International Journal of Logistics Management*, Vol. 7 No. 2, pp. 1-18.
- Lambert, D.M., Emmelhainz, M.A. and Gardner, J.T. (1999), "Building successful logistics partnerships", *Journal of Business Logistics*, Vol. 20 No. 1, pp. 165-182.
- Lambert, D.M., Knemeyer, A.M. and Gardner, J.T. (2004), "Supply chain partnerships: model validation and implementation", *Journal of Business Logistics*, Vol. 25 No. 2, pp. 21-42.
- Legros, D. and Galia, F. (2012), "Are innovation and R&D the only sources of firms' knowledge that increase productivity? An empirical investigation of French manufacturing firms", *Journal of Productivity Analysis*, Vol. 38 No. 2, pp. 167-181.
- Li, S. and Lin, B. (2006), "Assessing information sharing and information quality in supply chain management", *Decision Support Systems*, Vol. 42 No. 3, pp. 1641-1656.
- Li, S., Ragu-Nathan, B., Ragu-Nathan, T.S. and Subba Rao, S. (2006), "The impact of supply chain management practices on competitive advantage and organizational performance", *Omega*, Vol. 34 No. 2, pp. 107-124.
- Löf, H. and Broström, A. (2008), "Does knowledge diffusion between university and industry increase innovativeness?", *The Journal of Technology Transfer*, Vol. 33 No. 1, pp. 73-90.
- Lorentz, H. (2008), "Collaboration in Finnish-Russian supply chains: effects on performance and the role of experience", *Baltic Journal of Management*, Vol. 3 No. 3, pp. 246-265.
- McArthur, D.N. and Schill, R.L. (1995), "International cooperative technology arrangements: improving their role in competitive strategy", *Journal of Business Research*, Vol. 32 No. 1, pp. 67-79.
- Maloni, M.J. and Benton, W.C. (1997), "Supply chain partnerships: opportunities for operations research", *European Journal of Operational Research*, Vol. 101 No. 3, pp. 419-429.
- Medcof, J.W. (1999), "Identifying 'super-technology' industries", *Research-Technology Management*, Vol. 42 No. 4, pp. 31-36.
- Mentzer, J.T. (2004), *Fundamentals of Supply Chain Management: Twelve Drivers of Competitive Advantage*, Sage Publications, Inc., Thousand Oaks, CA.
- Mentzer, J.T., Min, S. and Zacharia, Z.G. (2000), "The nature of interfirm partnering in supply chain management", *Journal of Retailing*, Vol. 76 No. 4, pp. 549-568.

- Mentzer, J.T., DeWitt, W., Keebler, J.S., Min, S., Nix, N.W., Smith, C.D. and Zacharia, Z.G. (2001), "Defining supply chain management", *Journal of Business Logistics*, Vol. 22 No. 2, pp. 1-25.
- Min, H. and Zhou, G. (2002), "Supply chain modeling: past, present and future", *Computers & Industrial Engineering*, Vol. 43 Nos 1/2, pp. 231-249.
- Morgan, R. and Hunt, S. (1994), "The commitment-trust theory of relationship marketing", *Journal of Marketing*, Vol. 58 No. 3, pp. 20-38.
- Narula, R. (2004), "R&D collaboration by SMEs: new opportunities and limitations in the face of globalisation", *Techovation*, Vol. 24 No. 2, pp. 153-161.
- Nooteboom, B. (1994), "Innovation and diffusion in small firms: theory and evidence", *Small Business Economics*, Vol. 6 No. 5, pp. 327-347.
- Pan, F. and Nagi, R. (2010), "Robust supply chain design under uncertain demand in agile manufacturing", *Computers & Operations Research*, Vol. 37 No. 4, pp. 668-683.
- Paulraj, A., Chen, I.J. and Flynn, J. (2006), "Levels of strategic purchasing: impact on supply integration and performance", *Journal of Purchasing and Supply Management*, Vol. 12 No. 3, pp. 107-122.
- Penrose, E.T. (1959), *The Theory of the Growth of the Firm*, Basil Blackwell, Oxford.
- Ploetner, O. and Ehret, M. (2006), "From relationships to partnerships – new forms of cooperation between buyer and seller", *Industrial Marketing Management*, Vol. 35 No. 1, pp. 4-9.
- Podsakoff, P.M. and Organ, D.W. (1986), "Self-reports in organizational research: problems and prospects", *Journal of Management*, Vol. 12 No. 4, pp. 531-544.
- Podsakoff, P.M., MacKenzie, S.B., Lee, J.-Y. and Podsakoff, N.P. (2003), "Common method biases in behavioral research: a critical review of the literature and recommended remedies", *Journal of Applied Psychology*, Vol. 88 No. 5, pp. 879-903.
- Power, D., Sharafali, M. and Bhakoo, V. (2007), "Adding value through outsourcing: contribution of 3PL services to customer performance", *Management Research News*, Vol. 30 No. 3, pp. 228-235.
- Rajagopal, P., Zailani, S. and Sulaiman, M. (2009), "Assessing the effectiveness of supply chain partnering with scalable partnering as a moderator", *International Journal of Physical Distribution & Logistics Management*, Vol. 39 No. 8, pp. 649-668.
- Rezaei, J., Ortt, R. and Trott, P. (2015), "How SMEs can benefit from supply chain partnerships", *International Journal of Production Research*, Vol. 53 No. 5, pp. 1527-1543.
- Richey, R.G. Jr, Chen, H., Upreti, R., Fawcett, S.E. and Adams, F.G. (2009), "The moderating role of barriers on the relationship between drivers to supply chain integration and firm performance", *International Journal of Physical Distribution & Logistics Management*, Vol. 39 No. 10, pp. 826-840.
- Rosenberg, L.J. and Czepiel, J.A. (1984), "A marketing approach for customer retention", *Journal of Consumer Marketing*, Vol. 1 No. 2, pp. 45-51.
- Rothwell, R. (1989), "Small firms, innovation and industrial change", *Small Business Economics*, Vol. 1 No. 1, pp. 51-64.
- Roy, D. and Banerjee, S. (2012), "Strategic branding roadmap for SMEs operating in business-to-business sector: a study on Indian auto component sector", *Journal of Research in Marketing and Entrepreneurship*, Vol. 14 No. 2, pp. 142-163.
- Sahay, B. and Mohan, R. (2006), "3PL practices: an Indian perspective", *International Journal of Physical Distribution & Logistics Management*, Vol. 36 No. 9, pp. 666-689.
- Sari, K. (2007), "Exploring the benefits of vendor managed inventory", *International Journal of Physical Distribution & Logistics Management*, Vol. 37 No. 7, pp. 529-545.
- Saxenian, A. (1991), "The origins and dynamics of production networks in Silicon Valley", *Research Policy*, Vol. 20 No. 5, pp. 423-437.
- Schumacker, R.E. and Lomax, R.G. (2010), *A Beginner's Guide to Structural Equation Modeling*, 3rd ed., Routledge, New York, NY.

- So, S. and Sun, H. (2010), "Supplier integration strategy for lean manufacturing adoption in electronic-enabled supply chains", *Supply Chain Management: An International Journal*, Vol. 15 No. 6, pp. 474-487.
- Soinio, J., Tanskanen, K. and Finne, M. (2012), "How logistics-service providers can develop value-added services for SMEs: a dyadic perspective", *The International Journal of Logistics Management*, Vol. 23 No. 1, pp. 31-49.
- Steiger, J.H. (1990), "Structural model evaluation and modification: an interval estimation approach", *Multivariate Behavioral Research*, Vol. 25 No. 2, pp. 173-180.
- Swamidass, P.M. (1993), "Import sourcing dynamics: an integrative perspective", *Journal of International Business Studies*, Vol. 24 No. 4, pp. 671-691.
- Tai, Y.-M., Ho, C.-F. and Wu, W.-H. (2009), "The performance impact of implementing web-based e-procurement systems", *International Journal of Production Research*, Vol. 48 No. 18, pp. 5397-5414.
- Tan, E.N., Smith, G. and Saad, M. (2006), "Managing the global supply chain: a SME perspective", *Production Planning & Control*, Vol. 17 No. 3, pp. 238-246.
- Thakkar, J., Kanda, A. and Deshmukh, S.G. (2008), "Supply chain management in SMEs: development of constructs and propositions", *Asia Pacific Journal of Marketing and Logistics*, Vol. 20 No. 1, pp. 97-131.
- Thakkar, J., Kanda, A. and Deshmukh, S.G. (2012), "Supply chain issues in Indian manufacturing SMEs: insights from six case studies", *Journal of Manufacturing Technology Management*, Vol. 23 No. 5, pp. 634-664.
- Tidd, J. and Bessant, J. (2014), *Strategic Innovation Management*, John Wiley & Sons, New York, NY.
- Udomleartprasert, P., Jungthirapanich, C. and Sommechai, C. (2003), "Supply chain management-SMEs approach", *Engineering Management Conference on Managing Technologically Driven Organizations: The Human Side of Innovation and Change*, pp. 345-349.
- Vaaland, T.I. and Heide, M. (2007), "Can the SME survive the supply chain challenges?", *Supply Chain Management: An International Journal*, Vol. 12 No. 1, pp. 20-31.
- Varadarajan, P.R. and Rajaratnam, D. (1986), "Symbiotic marketing revisited", *Journal of Marketing*, Vol. 50 No. 1, pp. 7-17.
- Vickery, S.K., Jayaram, J., Droge, C. and Calantone, R. (2003), "The effects of an integrative supply chain strategy on customer service and financial performance: an analysis of direct versus indirect relationships", *Journal of Operations Management*, Vol. 21 No. 5, pp. 523-539.
- Waller, M., Johnson, M.E. and Davis, T. (1999), "Vendor-managed inventory in the retail supply chain", *Journal of Business Logistics*, Vol. 20 No. 1, pp. 183-204.
- Watts, A.D. and Hamilton, R.D. (2011), "Scientific foundation, organization structure, and performance of biotechnology and pharmaceutical firms", *The Journal of High Technology Management Research*, Vol. 22 No. 2, pp. 81-93.
- Yao, C.-Y. and Wu, F.-S. (2010), "How should we measure collaborative research and development performance?", *International Journal of Learning and Intellectual Capital*, Vol. 7 No. 3, pp. 360-373.
- Zeng, S.X., Xie, X.M. and Tam, C.M. (2010), "Relationship between cooperation networks and innovation performance of SMEs", *Technovation*, Vol. 30 No. 3, pp. 181-194.
- Zheng, J., Knight, L., Harland, C., Humby, S. and James, K. (2007), "An analysis of research into the future of purchasing and supply management", *Journal of Purchasing and Supply Management*, Vol. 13 No. 1, pp. 69-83.

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