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Supplier Partnership and Customer Relationship: The Role of Lean Practices

Roberto Chavez
Universidad Diego Portales

Wantao Yu
University of East Anglia

Mark Jacobs
University of Dayton

Brian Fynes
University College-Dublin

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Roberto Chavez
Facultad de Economía y Empresa
Universidad Diego Portales
Santiago
Chile

Wantao Yu
Norwich Business School
University of East Anglia
London
the UK

Mark Jacobs
University of Dayton School of Business
University of Dayton
Dayton
Ohio
Country: the USA

Brian Fynes
Smurfit Graduate School of Business
University College Dublin
Dublin
Ireland

Structured Abstract:

Purpose – The purpose of this study is to investigate the effect of both supplier partnership and customer relationship on internal lean practices, and the effect of internal lean practices on multiple operational performance dimensions.

Design/methodology/approach – The study is based on a questionnaire sent to 228 manufacturing companies in the Republic of Ireland, and the relationships proposed are analyzed through regression analysis.

Findings – The results indicate that supplier partnership and customer relationship are positively associated with internal lean practices, and internal lean practices is positively associated with operational performance. Further, internal lean practices was found to fully mediate the effect of supplier partnership and customer relationship on cost, and partially mediate the effect of customer relationship on quality and delivery.

Practical implications –When the objective is cost improvement, managers can enjoy cost advantage via their capability to translate the benefits of supplier partnership and customer relationship into internal lean practices. When the objective is quality and delivery improvement, internal lean practices can be developed before or in tandem with customer relationship.

Originality/value – Much supply chain integration literature tends to be biased towards its positive impact on operational performance. However, inconclusive results demand investigation of the mechanisms through which supply chain integration can lead to superior operational performance. We propose information quality as such mechanism. Further, mixed support in the integration literature has also been attributed to operational performance being often measured as an aggregated construct. We propose to disaggregate operational performance into four of its dimensions, namely quality, delivery, flexibility and cost.

Keywords: Customer relationship, Supplier partnership, Internal lean practices, Operational performance

1. Introduction

Since the publication of ‘Japanese Manufacturing Techniques’ (Schonberger, 1980) lean manufacturing has spread remarkably as companies such as Toyota succeeded and other companies follow their leadership (Jayaram *et al.*, 2008; Shook, 2008). Internal lean practices (ILP) refer to an integrated manufacturing system, which focuses on the elimination of all forms of waste, e.g. overproduction, inventory, or any other factor that can disrupt the swift even flow of goods through the supply chain (Slack *et al*., 2009). Researchers have offered empirical support for the positive association between ILP and operational performance (Shah and Ward, 2003); however, researchers have not been unified in their findings (e.g. Sakakibara *et al.*, 1997) with some providing anecdotes of failures (Gorman *et al*., 2009) and others offering methodological rationales for inconsistent findings (Swink *et al.*, 2005). It has been suggested that inconsistent findings may be attributed to operational performance being often measured as an aggregated construct (Ketokivi and Shroeder, 2004). It is thus relevant to identify the potentially different relationships between ILP and multiple operational performance dimensions.

To capture the perceived benefits of ILP, companies have promulgated its adoption through supply chain relationships (Jayaram *et al*., 2008). In particular, buyers have sought to leverage supplier capabilities in efforts to improve performance (Stuart, 1993; Li *et al.*, 2006). They have done so by bringing suppliers closer by engaging them in planning and problem solving (Li *et al.*, 2006; Swink *et al.*, 2007) and even in the design and development of products (Liker and Sobek II, 1996). As such there has been an emphasis of focus in the literature on upstream relationships (e.g. So and Sun, 2010). However, recent research has revealed the importance of downstream relationships (Droge *et al.*, 2012), which have been largely overlooked within the literature. Accordingly, it seems relevant to further analyze the association between supply chain relationships, from the upstream and downstream sides of the supply chain, and ILP.

The above argument (the positive association between supply chain relationships and ILP, and between ILP and operational performance) suggests that ILP may act as a mediating variable in the relationship between supply chain relationships (buyers and suppliers) and operational performance. However, the literature lacks studies that explicitly investigate the indirect relationship, through ILP, between supply chain relationships and operational performance. Furthermore, this argument is not inconsistent with the literature as it provides mixed support for the direct relationship between supply chain relationships and operational performance (e.g. Shin *et al.*, 2000; Swink *et al.*, 2007). The state of the literature suggests a possible mediation effect. Herein we have adopted resource dependence theory (RDT) to theoretically explain the mediating effect of ILP. RDT posits that critical resources for organizations can be obtained from external sources (Pfeffer and Salancik, 1978). ILP are typically associated with high levels of process synchronization between chain members. Specifically, it has been suggested that supply chain relationships are a preliminary step to ensure central aspects of lean manufacturing such as frequent deliveries of small lots of products and a stable source of materials (Handfield, 1993). Accordingly, grounded on RDT, we expect that, in lean manufacturing environments, close interaction between buyers and suppliers will enable ILP, which, in turn, can lead to improved operational performance.

This research adds to the body of knowledge of supply chain management (SCM) and lean manufacturing by addressing three research questions: (1) To what extent do supply chain relationships associate with ILP, (2) To what extent do ILP associate with operational performance, and (3) To what extent do ILP mediate the relationship between supply chain relationships and operational performance. The answer to these questions will contribute to theory by means of further investigating the association between supply chain relationships and ILP. By disaggregating operational performance into its constituent dimensions this paper will be able to identify the potentially different associations with ILP, and thus clarify inconclusive findings. Finally, by investigating the mediating effect of ILP this paper will explore how external resources such as supply chain relationships interact with ILP to improve operational performance.

2. Theoretical background and hypotheses development

2.1 Resource dependence and supply chain relationships

Organization theory represents an important theoretical perspective for conducting empirical research related to supply chain relationships (Handfield, 1993). An important paradigm for organization theory is RDT, which suggests that organizations must become reliant on other entities (e.g. suppliers) in order to obtain critical resources for their continuing existence (Pfeffer and Salancik, 1978). This theory’s main premise is that only few organizations are self-sufficient with respect to needed resources (Fynes *et al.,* 2004), and thus RDT focus exclusively on resources that must be developed from external sources (Barringer and Harisson, 2000).

The need to obtain resources creates interdependence between organizations (Barringer and Harisson, 2000). However, interdependence is not necessarily symmetric or balanced, which creates environmental uncertainty (Pfeffer and Salancik, 1978). It has been suggested that in order to manage interdependence, and thus reduce uncertainty, organizations should acquire control over critical resources (absorbing the environment), which can decrease dependence on other organizations and/or increase the dependence of other organizations on them. However, this strategy tends to create positions of strength, which often drive exploitation between members. Alternatively, firms can participate in interfirm relationships and coordination efforts (negotiating the environment) in order to obtain access to critical resources and increase their power relative to competitors (Handfield, 1993: Barringer and Harisson, 2000).

For instance, in the area of SCM, buyers can make their suppliers over dependent on them, which may create dissonance between both parties. Rossetti and Choi (2005) describe the example of the aerospace industry, which used their leverage to reduce some of their suppliers’ margin. As a result, suppliers reacted selling products to final customers, and thus bypassing the original equipment manufacturer. According to Ketchen and Hult (2007), this strategy describes traditional supply chains, where chain members take advantage of resource dependence. Conversely, describing best value supply chains, interdependence and collective actions should be used to create trust rather that opportunistic behaviour (Ketchen and Hult, 2007). According to Paulraj and Chen (2007), as supply chains rely on sequential interdependence, which requires coordination, RDT has great potential to explain SCM phenomena. In this research, our constructs are grounded on RDT, which is used to emphasize how supply chain relationships are a viable alternative for managing interdependence, and thus reduce uncertainties, increase predictability (demand and supply) and stability (Paulraj and Chen, 2007). Specifically, the resulting social coordination and cooperation between interdependent chain members, through implicit relational aspects such as information sharing (Handfield, 1993), can become critical for ILP synchronization.

2.2 Theoretical constructs

Supplier partnership - also termed supply management orientation - is defined as a mutually beneficial relationship between suppliers and buyers, designed to leverage their individual resources and capabilities with the objective of improving performance (Stuart, 1993; Li *et al.*, 2006). Supplier partnership creates a "synergistic supply chain in which the entire chain is more effective than the sum of its individual parts" (Maloni and Benton, 1997, p. 420). Supplier partnership is characterized by common elements, including supplier involvement, supplier development and supplier management (Vickery *et al.*, 2003; Li *et al.*, 2006). Supplier partnership presupposes mutual planning and problem solving, and a fundamental shift away from the transactional mode of doing business towards a more cooperative relationship (Li *et al.*, 2006; Swink *et al.*, 2007). Benefits associated with mutual planning and problem solving with suppliers include breaking down boundaries to improve communication and collaboration, coordination, increased speed, commitment, customer-focused culture, adaptability and flexibility (Ellram and Pearson, 1993; Drew and Coulson-Thomas, 1996). Supplier partnership also entails the early supplier involvement in new product development and the sharing of supplier technological capabilities (Narasimhan and Das, 1999; Vickery *et al.*, 2003; Li *et al.*, 2006; Jayaram *et al.*, 2008). Furthermore, supplier partnership also refers to working closely with suppliers to improve their quality levels (Handfield *et al.*, 2000), and sharing the benefits of such collaboration (Vickery *et al.*, 2003).

Just like supplier partnership, *customer relationship* is often seen as a necessity and a critical competency for supply chains (Lambert and Cooper, 2000; Closs and Savitskie, 2003; Tracey *et al.*, 2005). It has been suggested that market orientation - through close customer relationship - and SCM are inextricably intertwined (Min and Mentzer, 2000). Traditionally, competitive advantage in companies has been the result of cost reduction and product assortment strategies; however, today's competitive environment demands a customer-driven approach, which considers the final customer as an integral part of the supply chain (Monczka and Morgan, 1997; Bowersox *et al.*, 2000; Waller *et al.*, 2000; McAdam and McCormack, 2001). According to Kumar (2001), having delivered goods or services to customers does not terminate with the SCM activities. Rather, installation, customer education, and after sales service are essential components of how the customer perceives the quality of the delivered product or service. Similarly, customer-focused practices such as determining and communicating customer's future needs, obtaining customer's feedback, and participating in the customer's marketing effort should be considered for fast response (Tan, 2002; Vickery *et al.*, 2003). In other words, customer relationships depend upon the firm's ability to determine its customers' preferences and needs, which, in turn, enable companies to differentiate from their competitors (Day *et al.* 2000), improve operational performance (e.g. Ettlie and Reza, 1992; Samson and Terziovski, 1999; Vickery *et al.*, 2003; Closs and Savitskie, 2003), and generate competitive advantage (Day, 2000; Tan, 2002; Vickery *et al.*, 2003; Li *et al.*, 2006; Swink *et al.*, 2007). We conceptualise customer relationship as a set of activities that organizations use for the purpose of managing customer complaints, building strategic customer relationships and improving customer satisfaction (Tan *et al.*, 1998; Li *et al.*, 2006).

The term "*lean*" refers to a production system pioneered by Toyota - also known as Toyota Production System - that focuses on the elimination of all forms of waste (Womack *et al.*, 1990). Waste in this context refers to overproduction, waiting time, inventory, defective goods or any other factor that can disrupt the even flow of goods along the transformation process (Cusumano, 1994; Slack *et al.*, 2009). Practices associated with the philosophy of waste elimination include pull-production systems, just-in-time (JIT), process set-up time reduction and quality management (Cua *et al.*, 2001; Shah and Ward, 2003; Simpson and Power, 2005; Li *et al.*, 2005; Jayaram *et al.*, 2008; So and Sun, 2010). Pull-production systems and JIT produce only what is actually demanded by the customer and only at the necessary time and quantity (Sugimori *et al.*, 1977). JIT eliminates waste through the simplification of production processes (Kannan and Tan, 2005), and go hand in hand with process set-up time reduction and quality management as a comprehensive strategy to reduce inventories and utilize resources more efficiently (Karlsson and Åhlström, 1996; Kannan and Tan, 2005). Process set-up time reduction is an important tool in reducing waste because it facilitates smaller batch sizes, which in turn enables work-in-process inventory reductions (Karlsson and Åhlström, 1996). With regard to quality management, ILP encourage mutual effort between participants who strive for continuous improvement and zero defects (Womack and Jones, 1994). The present study is concerned with the internal perspective of the lean strategy, and therefore we conceptualize ILP as an integrated approach to the management of internal manufacturing systems, characterized by pull-production systems, JIT techniques, reduced process machine set-up time and quality management, which aim at the elimination of all types of waste (Li *et al.*, 2005; Simpson and Power, 2005).

2.3 Hypothesis development

2.3.1 Supplier partnership, customer relationship and ILP

It has been suggested that tight coordination between supply chain partners, constitute a mechanism through which ILP are facilitated (Jayaram *et al.*, 2008). With regard to supplier partnership, the lean notion has always been linked to supply management (Lamming, 1996). This is understandable given that seminal work in the area focused on industry sectors such as the automotive, where most components are sourced from external suppliers (Womack *et al.*, 1990; McIvor, 2001). For instance, supplier partnership is vital to ensure frequent deliveries and eliminate the need for quality controls (Levy, 1997; Wu, 2003). So and Sun (2010) indicate that supplier coordination constitutes a relational platform to enable information integration between buyers and suppliers, which facilitates lean practices. Within the lean initiative, close coordination with suppliers enables the manufacturer to decrease inventories through information sharing, reduces business risks by joint R&D, enhances product quality and provides more stable supply prices (Hines, 1996; Levy, 1997; Sheth and Sharma, 1997; So and Sun, 2010). This is also supported by Cocks (1996), who argued that true reduction of waste in lean processes depends to a great extent on honest and open relationships, which are elements of relational norms of close supplier partnership.

With regard to customer relationship, manufacturing plants use customer relationship practices to understand and incorporate customer preferences and needs, and thus react more effectively (Vickery *et al.*, 2003). Previously, the main focus of the lean notion was the shop floor; however, there has been a gradual widening of focus that includes the identification of customer preferences, which goes beyond the single factory to include the upstream and downstream sides of the supply chain (Hines *et al.*, 2004). As noted previously, ILP are characterized by pull production systems and JIT, which produce only what is demanded by the customer at the time needed (Sugimori *et al.*, 1977); accordingly, ILP rely on customer needs and wants, which are transmitted upstream the supply chain. For instance, stable demand rates, through customer information coordination, enable firms to plan activities such as machine set-up more effectively (Jayaram *et al*., 2008). Similarly, ILP include systems of continuous improvement, which are centered on the needs of customers (Abdulmalek and Rajgopal, 2007).

A recent review of lean articles in a supply chain context revealed that most articles are case studies, and evidence for the benefits of lean in the supply chain is mostly anecdotal (Ugochukwu *et al.*, 2013). Specifically, it was found that studies on lean do not generally consider supply chain members in the implementation of lean practices (Ugochukwu *et al.*, 2013). As an exception, Kannan and Tan (2005) investigated the association between ILP, SCM and total quality management. Kannan and Tan (2005) found that various practices associate significantly with one another, which suggest that there are elements of ILP, SCM and total quality management that reinforce one another. Jayaram *et al.* (2008) examined the association between relationship building and ILP such as JIT, set-up time reduction, and cellular manufacturing. Their results emphasized that relationship building in the supply chain was associated with enhanced ILP. However, they used an aggregated construct for relationship building that did not differentiate between suppliers and customers. More recently, So and Sun (2010) studied and found support for the association between supplier integration, including key aspects of supplier partnership, and ILP. However, So and Sun (2010) did not consider the role of customer relationship as a potential enabler of ILP. It has been argued that downstream relationships are as critical as upstream ones in creating value that benefits the entire supply chain (Tracey *et al.,* 2005). Further, while ILP have helped individual organization to be more efficient, ILP should not be tested individually but rather simultaneously across the entire supply chain, which will results in benefits that surpass the benefits obtain within individual organizations (Behrouzi and Wong, 2011). Based on the above literature review and argument, we extend and complement the existing studies by including a theoretical model that investigates the association between both supplier partnership and customer relationship (downstream and upstream sides of the supply chain), and ILP. Therefore, the following hypotheses are stated:

H1a: Supplier partnership is positively associated with ILP
H1b: Customer relationship is positively associated with ILP

2.3.2 ILP and operational performance

Operational performance has been conventionally characterized in terms of the competitive priorities of operations strategy (Narasimhan and Das, 2001). The term competitive priority was first introduced by Hayes and Wheelwright (1984) as the strategic preferences from which companies choose to compete. There is a general agreement in the literature that quality, delivery, flexibility, and cost are the core and most often mentioned competitive priorities (Vickery, 1991; Ward *et al.*, 1998; Narasimhan and Jayaram, 1998; Pagell and Krause, 2002).

Benefits associated with ILP include operational performance improvement such as higher quality, reduced lead-times, flexibility, higher productivity, reduced manufacturing cost, and the reduction of trade-offs between operational performance dimensions (Jayaram *et al.*, 2008). While numerous empirical studies have found support to the positive association between ILP and operational performance (e.g. Flynn *et al.*, 1995; Koufteros *et al.*, 1998; Shah and Ward, 2003; Kannan and Tan, 2005), other studies have produced mixed results (e.g. Sakakibara *et al.*, 1997; Callen *et al*., 2000). For instance, Sakakibara *et al.* (1997) found that there was not sufficient evidence to support a significant relationship between ILP (such as set-up time reduction) and operational performance. Similarly, Callen *et al.* (2000) found that only certain lean dimensions appeared to be positively associated with operational performance improvement when comparing JIT and non-JIT plants. This lack of consistency in the results may be attributed to the general complexity in the link between manufacturing practices and performance, which is not well understood and sometimes acknowledged as self-evident (Skinner, 1969; Swink *et al.* 2005). More specifically, it has been suggested that previous studies have used operational performance as an aggregated construct (e.g. Koufteros *et al.*, 1998; Shah and Ward, 2003; Rahman *et al.*, 2010), and thus have disregarded its individual components (Swink *et al.*, 2005). Similarly, Ketokivi and Schroeder (2004) stated that operational performance is usually measured as a composite of several performance dimensions, which suggests a possible bias towards the universal applicability of manufacturing practices.

While there is empirical evidence of the link between ILP and multiple operational performance measures (e.g. Flynn *et al.*, 1995; Lawrence and Hottenstein, 1995;

Sakakibara *et al.*, 1997; Nakamura *et al.*, 1998; Callen *et al.*, 2000; Cua *et al.*, 2001; Fullerton and McWatters, 2001; Kannan and Tan, 2005; Hallgern and Olhager, 2009), the use of single measures for analysing ILP and/or operational performance might not have captured the constructs accurately. As an exception, Narasimhan *et al.* (2006) investigated and found that firms that implement ILP such as JIT appear to be associated with operational performance dimension such as efficiency, quality control and reliability. Narasimhan *et al.* (2006) have significantly furthered our understanding of the association between ILP and multiple operational performance dimensions; however, their exploratory approach demands further empirical investigation. Another important study is Swink *et al.* (2005) wherein the association between ILP (e.g. JIT and process quality management) and two operational performance dimensions, namely cost and flexibility was investigated. Swink *et al.* (2005) found that lean practices are significantly associated with flexibility but not with cost, which suggests that ILP may be more strongly associated with certain operational performance dimensions. In view of this argument, the following section extends this work by identifying the potentially different relationships between ILP and quality, delivery, flexibility and cost.

Firstly, ILP strive for high levels of *quality* through a zero-defect policy and by continuously identifying and reducing sources of waste (Nakamura *et al.*, 1998; Li *et al.*, 2005). For instance, it was found that quality is a performance objective consistently affected by the implementation of ILP such as JIT (Kannan and Tan, 2005). Similarly, improvement in percentages of orders that pass final inspection without rework, and thus a decrease in the number of inspections, and machine downtime due to failure during normal shifts, have been associated with *kanban* systems, JIT and quality management (Nakamura *et al.*, 1998; Fullerton and McWatters, 2001). Accordingly, it is hypothesized that:

H2a: ILP are positively associated with quality

Secondly, *delivery* has received significant attention in the lean literature since lean manufacturing focuses on the reduction of variability and throughput time (Naylor *et al.*, 1999; Fullerton and McWatters, 2001). For instance, it was found that improvement in queue and move time, machine downtime and, thus, throughput time, were aspects that constantly appeared in JIT adopters (Fullerton and McWatters, 2001). Delivery reliability (e.g. percentage of timely orders, average cycle time and lead time) has been associated with ILP such as JIT, the planning of activities such as machine set-up time, quality management, and team-based and multitask training (Nakamura *et al.*, 1998). Similarly, the planning of activities such as daily production schedules have been associated with on-time delivery (Cua *et al.*, 2001). Formally, this gives the following hypothesis:

H2b: ILP are positively associated with delivery

Thirdly, *flexibility* has been associated with ILP, which can still achieve product variety and lead time reduction without compromising cost (Gerwin, 1993). For instance, it was found that JIT has a positive effect on the ability to substitute current products with new products or changeover flexibility (Upton, 1995). Similarly, pull production systems, cell manufacturing, continuous improvement programmes, and the production of small lot sizes, have shown positive links with changeover flexibility as well as process flexibility (Swink *et al.*, 2005). Other ILP such as JIT purchasing and *kanban* systems were also found to improve levels of flexibility (Fullerton and McWatter, 2001). Accordingly, it is hypothesized that:

H2c: ILP are positively associated with flexibility

Fourthly, it has been asserted that *cost* improvement is the direct and most common benefit associated with lean manufacturing (Huson and Nanda, 1995; Naylor *et al.*, 1999; Fullerton and McWatter, 2001). In support of this assertion, various empirical studies have demonstrated the positive link between lean manufacturing and cost efficiency (e.g. Lawrence and Hottenstein, 1995; Huson and Nanda, 1995; Nakamura *et al.*, 1998; White *et al.*, 1999; Callen *et al.*, 2000; Cua *et al.*, 2001; Fullerton and McWatter, 2001; Swink *et al.*, 2005). For instance, it was found that pull-production systems and machine set-up time reduction are positively associated with cost improvement (Cua *et al.*, 2001). Callen *et al.* (2000) found that JIT plants outperformed non-JIT plants in aspects such as work-in-process, finished good inventories, variable costs and total costs. Accordingly, it is hypothesized that:

H2d: ILP are positively associated with cost reduction

2.3.3 Supplier partnership, customer relationship, ILP and operational performance

Hitherto, the above research evidence suggests that both supplier partnership and customer relationship positively associate with ILP, and that ILP are positively associated with operational performance. This implicitly suggests that ILP may mediate the association between supplier partnership and customer relationship, and operational performance (Baron and Kenny, 1986); however, this assumption has not been tested explicitly in the literature. In order to theoretically explain the possible mediating effect of ILP, we have adopted RDT, which, in the context of SCM, emphasizes supply chain relationships, particularly buyer-supplier cooperation and coordination in reducing uncertainty (demand and supply) (Paulraj and Chen, 2007). Furthermore, cooperation and coordination are associated with benefits such as information sharing, the creation of channels of communications for information sharing, and commitment of support between the parties involved (Handfield, 1993). With regard to the lean notion, it has been argued that lean manufacturing depends on coordination, and coordination in the supply chain is associated directly with supply chain relationships (Simpson and Power, 2005). Furthermore, ILP require close supplier and customer coordination in order to achieve operational performance improvement (Levy, 1997; Wu, 2003). Accordingly, based on RDT, we expect that, in lean manufacturing environments, close interaction between buyers and suppliers will translate into implicit relational benefits such as information sharing, which are prerequisite for ILP such as JIT (Handfield, 1993), and, through that permanent interaction process, to achieve important benefits in the form of operational performance.

Furthermore, there is mixed support in the literature for the direct relationship between supply chain relationships and operational performance (e.g. Ettlie and Reza, 1992; Shin *et al.*, 2000; Swink *et al.*, 2007; Devaraj *et al.*, 2007), which may suggest a possible mediation effect. For instance, Shin *et al.* (2000) tested the association between supplier management orientation - supplier base reduction, supplier involvement in product development, quality focus in selecting suppliers, and long-term buyer-supplier relationships – and various operational performance dimensions. While their findings suggest that supplier management orientation efforts are significantly associated with quality and delivery, no significant association was found with flexibility and cost. Including key aspects of customer relationship, Ettlie and Reza (1992) found partial support for the association between customer integration and flexibility since customer integration was not significantly associated with any internal flexibility measures such as change in capacity. More recently, Swink *et al.* (2007) and Devaraj *et al.* (2007) found no significant association between customer integration and relational aspects, and quality, delivery, flexibility and cost. In view of the above argument, we include a holistic theoretical framework, which explicitly incorporates an indirect relationship (through ILP) between supplier partnership and customer relationship, and multiple operational performance dimensions. Accordingly, it is hypothesized that:

H3: ILP mediate the relationship between supplier relationship and (a) quality, (b) delivery, (c) flexibility and (d) cost.

H4: ILP mediate the relationship between customer relationship and (a) quality, (b) delivery, (c) flexibility and (d) cost.

3. Research methodology

3.1 Sampling and data collection

The data was collected through a postal survey. Our main population was the top 2,500 companies (turnover, profitability, and size) in the Republic of Ireland. However, only manufacturing companies were selected since the different activities incorporated in the survey focused on manufacturing practices. An initial listing of 705 manufacturing companies were selected; however, some companies had gone into liquidation or moved abroad, and thus were excluded from the sample. This resulted in a final sampling frame of 655 manufacturing companies. An important reason for focusing on manufacturing firms in the Republic of Ireland is that there has been a growing trend to outsource labour intensive activities to lower cost countries due to Ireland’s high cost basis (Huber and Sweeney, 2007). Accordingly, this justifies the need for an efficient use of resources, and thus the use of lean manufacturing can secure savings across the supply chain (Cua *et al.*, 2001).

To ensure the accuracy and completeness of the responses, managers in relevant areas such as supply chain and operations management were identified in each company as the key informants of this study (Malhotra and Grover, 1998). In order to increase the response rate, each respondent was contacted directly to obtain his or her consent to participate in the study (Ward *et al.*, 1998; Dillman, 2000). Further, a benchmark score of each company's practices and performance relative to their industry sector was offered as an incentive. A copy of the questionnaire was finally sent to the production plant of each company. After three follow-up contacts, a total of 236 questionnaires were received, 228 of which were usable. This gives an overall response rate of 36 percent, which is above the minimums considered to be satisfactory in this type of survey-based studies (Malhotra and Grover, 1998; Frohlich, 2002). Table 1 provides details of the sample characteristics.

--Table 1--

3.2 Non-response bias and common-method bias

To examine possible non-repose bias and the generalizability of findings to the population (Miller and Smith, 1983), we compared the early and late responses following the approach suggested by Armstrong and Overton (1977). Five items used in the questionnaire were randomly selected to compare the first and last twenty returned questionnaires using the chi-square test. All the significance values of the selected items were above 0.01, which implies an absence of non-response bias. Common-method bias has been regarded as another concern since the data for this study were obtained from single respondents (Podsakoff *et al.*, 2003). Some statistical techniques can be employed to identify the potential effects of common-method bias such as Harmans single factor (one-factor) test (Boyer and Hult, 2005; Podsakoff *et al.*, 2003). Following this approach, all the variables were loaded into an exploratory factor analysis (EFA). The results of EFA show seven distinct factors with eigenvalues above 1.0, explaining 65.333% of total variance. The first factor explained 26.383% of the variance, which is not majority of the total variance. The corresponding results indicate that common method bias is not a threat in this study. As a second test of common method bias, confirmatory factor analysis (CFA) was applied to Harman's single-factor model (Flynn *et al.*, 2010; Podsakoff *et al.*, 2003). The model fit indices of χ^2/df (1108.585/252) = 4.399, CFI = 0.536, IFI = 0.542, and RMSEA = 0.122 were unacceptable and significantly worse than those of the measurement model. This suggests that a single factor model is not acceptable and that common method bias is unlikely. To further assess common method bias, a latent factor representing a common method was added to the measurement model, which is the strongest test of common method bias (MacKenzie, *et al.*, 1993; Podsakoff *et al.*, 2003; Zhao *et al.*, 2011). The resulting fits were not significantly different from those of the measurement model (RMSEA = 0.060 vs. 0.051 for the model with the common method factor; CF1 = 0.898 vs. 0.935; IFI = 0.900 vs. 0.937). Also, the item loadings for their factors are still significant in spite of the inclusion of a common latent factor. Therefore, we conclude that common method bias is not an issue in this study.

3.3 Validation and measurement scales

The validation process for the survey instruments was completed in three steps: content validity, construct validity and reliability (Carmines and Zeller, 1979, O'Leary-Kelly and Vokurka, 1998; Zhou and Benton Jr., 2007). For content validity a draft questionnaire was pre-tested with academic experts in SCM and practitioners (executive MBA students). Following their suggestions, the questionnaire’s layout and wording were modified and pilot-tested with the target population to verify its suitability for this group. For this, a total of thirty questionnaires were sent to randomly selected companies in our sampling frame and ten were returned. Terminology was again adapted to better suit the target population. For instance, target respondents suggested that the term “Pull” in one of the ILP items should be changed to “our firm produces only what is demanded by customers when needed (e.g. JIT)”, since the term “Pull” was not very clear for some of the respondents. Apart from these changes, no difficulty in completing the questionnaire was reported.

Construct validity was established through the unidimensionality of the constructs. The implicit condition that a measure should satisfy in order to be considered unidimensional is that the measure must be associated with only one latent variable (O'Leary-Kelly and Vokurka, 1998). Unidimensionality was established through the use of EFA with principal axis factoring, varimax rotation and extracting factors with eigenvalues greater than 1.0 (Tabachnick *et al*., 2001). All items were analysed together following the approach adopted by Carey *et al.* (2011), and results of the EFA suggested a seven-factor solution. The factor loadings for the items ranged from 0.403 (flexibility) to 0.814 (delivery) (see Table 2), which are above the commonly used cut-off value of 0.40 (Nunnally, 1978). Some items displayed low factor loading and cross-loadings (e.g. “Our firm has continuous quality improvement programs” for the ILP construct), which were not considered for further analysis to ensure the quality of the measures (Costello and Osborne, 2005). Overall, our results provide evidence for the validity of our constructs. Further, a Kaiser-Meyer-Olkin (KMO) statistic of 0.830 confirmed the suitability of the items for factor analysis since KMO values greater than 0.60 can be considered as adequate for applying such analysis (Hair *et al.*, 2006). In order to estimate reliability, the Cronbach’s alpha coefficient was used, as it is a common method for assessing reliability in the empirical literature (Carmines and Zeller, 1979). All the scales show alpha values above or marginally below 0.7, which indicates that the scales are reliable for further analysis (Nunnally, 1978). Table 2 shows factor loadings and reliability of supplier partnership, customer relationship, ILP and operational performance. Comments are offered on these results in the following paragraphs.

---Table 2--

3.4 Questionnaire development

Supplier partnership was measured using a four-item scale, based on items developed by Li *et al.* (2006). The scale included questions on continuous improvement programmes for key suppliers and their involvement in planning activities and new product development programmes. *Customer relationship* was measured with scales based on Li *et al.* (2006), and included five questions on customer interaction, information sharing and the evaluation of customer expectations and changing needs. *ILP* scales are based on those developed by Li *et al.* (2005), and included questions on the implementation of JIT and process set-up time reduction. The above scales items asked respondents to evaluate the extent to which they agree or disagree with respect to their business using a five-point Likert scale (being 1 = strongly agree and 5 = strongly disagree). *Operational performance* was measured by scales developed by Ward *et al.* (1998), who focused on a production line, and thus on internal operational performance measures. We included scales addressing four internal operational performance dimensions: quality, delivery, flexibility and cost. The latter scales asked respondents to evaluate how their firm compares to their major industrial competitor using a five-point Likert scale (being 1 = superior and 5 = poor or low end of the industry). This study includes industry type as a *control variable*. It has been suggested that firms in some industries are more likely to improve performance from the implementation of SCM practices (e.g. Meijboom *et al.*, 2005), and thus we decided to include it as a control variable. Three dummy variables were used to control for the impact of different industries (manufacturing of food, machinery and pharmaceuticals).

4. Data analysis and results

Ordinary least square (OLS) analysis was used to formally test our hypotheses. However, prior to carrying out the regression analysis, the data was tested for linearity and multicollinearity. Firstly, linearity and equality of variables were assessed and confirmed through plotting the standardized residuals against the standardized predicted values (Field, 2009). Secondly, to test for multicollinearity, it has been argued that a threshold of 0.70 for correlation coefficients between independent variables is an acceptable level that indicates absence of multicollinearity (Anderson *et al.*, 2002). Table 3 shows that the correlation coefficients are below this level. Furthermore, the variance inflation factor (VIF) has been calculated. Multicollinearity can be concluded if the maximum VIF exceeds ten as the common cut-off point (O’Brien, 2007). All variables in the model were consistently within this value (Max VIF = 1.236 in Table 4), which indicates that multicollinerity did not influence our independent variables.

--Table 3--

In order to test whether ILP mediate the relationship between supplier partnership and customer relationship, and operational performance (quality, delivery, flexibility and cost), four different models were used, one for each operational performance dimension (Ray *et al.*, 2005). For each model, three steps were carried out (Carey *et al*., 2011). In the first step, our control variables and independent variables (supplier partnership and customer relationship) were regressed against the mediator variable (ILP). In the second step, the independent variables were regressed against each dependent variable (quality, delivery, flexibility and cost). In the third step, we regressed the independent variables and mediator variable against the dependent variables. All these effects must be significant to indicate a mediation effect, with the significance of each association between the independent and dependent variables reduced by adding the mediator variable (Baron and Kenny, 1986). Table 4 presents the results of the OLS regression analyses.

--Table 4--

The first step of the analysis reveals that both supplier partnership and customer relationship are significantly and positively associated with ILP (β = 0.299, $p \leq 0.01$ and β = 0.228, $p \leq 0.001$ respectively), which gives full support to H1a and H1b. Next, the results of the second step of the analysis indicate that supplier partnership is significantly associated with cost (β = 0.181, $p \leq 0.01$), but not with quality (β = -0.046, ns), delivery (β = 0.083, *ns*) and flexibility (β = 0.018, ns). This indicates that there is only an effect to be mediated between supplier partnership and cost, and thus H3a-c are not supported. The second step of the analysis also reveals that customer relationship is positively associated with quality (β = 0.356, $p \leq 0.001$), delivery (β = 0.287, $p \leq 0.001$), flexibility (β = 0.316, $p \leq 0.001$) and cost (β = 0.163, $p \leq 0.05$), which indicates that there is an effect to be mediated between customer relationship and all operational performance dimensions. In the third step of the analysis, the quality model shows that, upon the inclusion of the mediator (β = 0.169, $p \leq 0.05$), customer relationship continued to be significantly associated with quality (β = 0.306, $p \leq 0.001$), which provides evidence of partial mediation and thus partial support for H4a, and full support for the relationship between ILP and quality (H2a). The delivery model shows that the association between customer relationship and delivery continued to be significant (β = 0.251, $p \leq 0.001$) once the mediator was included (β = 0.120, $p \leq 0.05$), which indicates partial support for H4b and full support for H2b (ILP and delivery). With regard to the flexibility model, the association between customer relationship and flexibility continued to be significant (β = 0.285, p ≤ 0.001) upon the inclusion of the mediator. However, the lack of significance in the association between ILP and flexibility (β = 0.101, ns) indicates that ILP cannot mediate the relationship between customer relationship and flexibility, and thus that neither H4c nor H2c are supported. The cost model provides evidence of ILP fully mediating the relationships between both supplier partnership and customer relationship, and cost (H3d and H4d respectively), since the associations between supplier partnership and cost and customer relationship, and cost became non significant (β = 0.120, ns and β = 0.082, ns respectively) by adding the mediator variable (β = 0.269, $p \leq 0.001$). Also in the cost model, the significance in the positive association between ILP and cost provides full support for H2d. Finally, our control variable (type of industry) showed no significant association on the relationships described above.

To further test mediation, the Sobel test was used as it has been described as superior in terms of power and intuitive appeal (Mackinnon *et al.*, 2002). The Sobel test lends additional support for the mediated relationships through a change in significance of the indirect effect (Mackinnon *et al.*, 2002). Using the interactive tool provided by Preacher and Leonardelli (2003), we found support for ILP fully mediating the relationship between supplier partnership and cost (t =2.940 $p \leq 0.01$) and customer relationship and cost (t

=3.522 $p \leq 0.001$). We also found support for ILP partially mediating the relationships between customer relationship and quality (t = 3.033, $p \leq 0.01$), and customer relationship and delivery (t = 2.854, $p \leq 0.01$).

5. Discussion

This study empirically tests the association between both supplier partnership and customer relationship, and ILP. Our results supported these hypotheses, providing valuable insights into the strategic role of relationship building for ILP. Secondly, this study also investigates the mediating role of ILP on the relationship between both supplier partnership and customer relationship, and multiple operational performance dimensions (quality, delivery, flexibility and cost). While partial support was found for some of the hypothesized relationships, our findings contribute to the theoretical development of RDT in the SCM and lean manufacturing literature. The significance of these contributions will be discussed in the following paragraphs.

5.1 Theoretical implications

Despite the importance of close coordination and synchronization with suppliers and customers for lean manufacturing (Levy, 1997; Wu, 2003), few empirical studies have investigated the association between these constructs (Jayaram *et al.*, 2008). As an exception, So and Sun (2010) found support for the association between some aspects of supplier relationship and ILP; however, their work did not consider customer relationship as another potential enhancer of ILP. In contrast, our study extends and complements the existing work by incorporating an integrated model that includes both supplier partnership and customer relationship (considering both the upstream and downstream sides of the supply chain), and provides strong confirmation of their positive association with ILP. The findings are consistent with the expectations of RDT, which assert that firms will attempt to engage in inter-organizational relationships to obtain access to unique and valuable resources (Pfeffer and Salancik, 1978). Specifically, in the context of SCM and lean manufacturing, cooperation and coordination efforts between buyers and supplier are required for ILP synchronization (Handfield, 1993). Overall, our findings provide empirical support for the argument that lean manufacturing is impacted directly through relational foundation in the supply chain (Levy, 1997; Simpson and Power, 2005), namely supplier partnership and customer relationship.

Turning to the association between ILP and multiple operational performance improvement, our results are consistent with influential work such as Womack *et al.* (1990) and Narasimhan *et al.* (2006), who found that firms that implement lean practices appear to be associated with performance dimensions that emphasize efficiency, quality and reliability. Specifically, ILP were found to be positively associated with *cost* improvement. According to Huson and Nanda (1995), cost improvement is widely regarded as the most obvious benefit associated with ILP such as JIT. Accordingly, our finding supports the traditional view that ILP that aim to increase productivity and efficiency will minimize cost (Cua *et al.*, 2001). With regard to *delivery*, our results provided evidence that ILP are positively associated with this performance objective. It has been recognised that many problems facing manufacturing such as high production cycle times, are rooted in the lack of effective lean manufacturing practices (Taj and Berro, 2006). Therefore, our finding corroborates the view that implementing ILP such as set-up time reduction, which are meant to reduce variability, can be associated with improved delivery (Cua *et al.*, 2001). Our results also suggest that ILP are positively associated with *quality*. As noted by Zayko *et al.* (1997), expected results of lean practices are not only a reduction in human effort, manufacturing space, specific tool investment and lead-time, but also 200 to 500 percent quality improvement. With regard to *flexibility*, our results indicated that ILP are not significantly associated with this performance objective, which is an interesting finding in itself but not surprising. While it has been suggested that flexibility can be regarded as another benefit of ILP such as JIT (Gerwin, 1993), some authors have indicated that flexibility can be limited, especially when it comes to fast responses to demand variability (Cusumano, 1994; Naylor *et al.*, 1999; Mason-Jones and Towill, 2000; Christopher, 2000). For instance, it was found that in industries such as the textiles and clothing industry the use of lean practices such as slack capacity reduction could have a negative effect on flexibility (Naylor *et al.*, 1999; Bruce *et al.*, 2004). This finding is also consistent with the work Narasimhan *et al.* (2006), who found that flexibility is not a performance characteristic that tends to be in line with the lean manufacturing paradigm. Instead, flexibility abilities are more consistent with the agile manufacturing paradigm. In other words, differences in lean and agile performers are highly consistent with the tenets of the lean and agile manufacturing paradigms. From a theory development perspective, these results suggest that ILP can enable excelling through multiple operational performance dimensions instead of focusing on separate dimensions of performance, which tends to support the cumulative, or “sandcone” model (Ferdows and De Meyer, 1990) rather than the trade-off theory (Skinner, 1969). The cumulative model’s main rationale is that in current intense competitive times, it is necessary to excel through multiple (rather than separate) competitive priorities. For the cumulative model high performance is the result of simultaneous competitive priorities that plants should build, focusing first on quality and then on delivery, followed by cost and finally flexibility (Ferdows and De Meyer, 1990). Further, it has been suggested that plants move along an evolutionary path from one performance capability to another, and leanness could be regarded as a precursor or foundation of agility as the next logical step (Harmozi, 2001). Overall, our findings corroborate a cumulative and evolutionary view of operational capabilities in a lean manufacturing environment.

Perhaps the most important contribution of this study is the full mediation effect of ILP on the relationships between supplier partnership and cost (H3d), and customer relationship and cost (H4d). For *cost* improvement, our model suggests that supplier partnership (e.g. continuous supplier development programmes and mutual planning and goal-setting activities) should need to be translated into the necessary levels of communication, coordination and synchronization required by ILP such as JIT and process set-up time reduction (Slack *et al.*, 2009). Working closely with suppliers could provide the relational means for on-time and stable schedules of materials, which are key to achieve higher levels of synchronization and low process variability (Wu, 2003). In turn, customer relationship (e.g. frequent interaction with customers and the measurement of the customer's need and future expectations) should need to be translated into a deeper understanding of the customer preferences and needs in order to produce only what is demanded by the customer when needed (e.g. JIT). Further, knowing the demand rate, through customer coordination, enables better synchronization of production activities such as machine set-up times; thus making small lot size production economically feasible (Jayaram *et al.*, 2008). Overall, these findings provide support for the RDT argument that strategic supply chain relationships (through relational aspects such as cooperation, coordination and information sharing) can generate the relational means required by ILP (Paulraj and Chen, 2007). Furthermore, this interaction process (between buyers and suppliers) in lean manufacturing environments will, in turn, enhance operational performance in the form of cost (Levy, 1997; Wu, 2003).

Another contribution of this research is the partial mediation effect of ILP on the association between customer relationship and delivery, and customer relationship and quality (partial support to H4b and H4a respectively). What can be inferred from these findings is that, when organizations want to pursue *quality* and *delivery* organizations can develop ILP before or in tandem with customer relationship. Although not hypothesised, our results also showed that supplier partnership is not significantly associated with quality, delivery and flexibility, which support the work of Shin *et al.* (2000) and Swink *et al.* (2007). RDT provides an interpretation of such finding suggesting that companies can become overexposed to the opportunistic behaviour of partner firms. As noted previously, in traditional supply chains members can take advantage of resource dependence, which often drives exploitation between chain members (Ketchen and Hult, 2007).

5.2 Managerial implications

Our study has also important managerial contributions. The results show that supplier partnership and customer relationship can be associated with ILP improvement, which reinforces the strategic importance of managing and developing strategic relationships along the supply chain (Porter, 1996). Further, our research has also demonstrated that ILP can be regarded as world-class manufacturing practices, adoption of which not only stimulate solutions to multiple objectives, but also eliminate trade-offs between performance objectives (Schonberger, 1995; Flynn *et al.*, 1999; Jayaram *et al.*, 2008). However, our findings have also demonstrated that the association between both supplier partnership and customer relationships and operational performance is fully and partially mediated by ILP. Specifically, if *cost* has been chosen to compete, managers would need to work in close relationship with both suppliers and customers, and translate those relationships into the resources (e.g. information sharing) or benefits required by ILP synchronization. If managers focus on *quality* and *delivery*, managers can work within their firm boundaries on implementing ILP before building customer relationships. Alternatively, managers can complement ILP with customer relationships for quality and delivery improvement. Overall, depending on the performance objective, managers can either work on exploiting external resources to enhance their internal lean operations (e.g. cost), or simply work on both ILP and develop resources found in their external customers (e.g. quality and delivery).

6. Conclusions

Our study contributes positively to theory by confirming empirically that supplier partnership and customer relationships are significantly and positively associated with ILP. Another contribution of our study is in its finding of the significant association between ILP and multiple operational performance dimensions, which further supports the cumulative model. Finally, as a novel contribution to the literature, our study provides an integrated model, which suggests a full and partial mediating role of ILP on the relationship between supplier partnership and customer relationships and operational performance. The results tend to support the RDT perspective.

While this study contributes to theory and practice, there are certain limitations that should be considered. One important limitation is the number of items that reflect the ILP construct. This was due to one item (i.e. our firm has continuous quality improvement programs) displaying low factor loading, which was not considered further in the analysis to ensure the quality of the measurement scale. However, we argue that the items we used to represent ILP (i.e. JIT and process set up-time reduction) are representative of the lean manufacturing literature since various studies have systematically included them as part of their lean manufacturing constructs (e.g. Shah and Ward, 2003; Li *et al.*, 2005; Jayaram *et al.*, 2008; So and Sun, 2010; Browing and Heath, 2009). Future research can expand the construct to include other related activities. Since the research methodology of this study is cross-sectional, it ignores the possible temporal effect of ILP. For example, it was suggested that timing, scale, and extent of lean implementation can be important determinants of its success (Browning and Heath, 2009). Alternative research designs such as a longitudinal design, ethnography, action research and triangulation could be used (Mangan *et al.*, 2004; Boyer and Swink, 2008). Another limitation lies in the responses from single key informants, which may cause common-method bias. While this research targeted key respondents holding relevant managerial positions, multiple respondents could have provided more accurate results. Nevertheless, this might have reduced the response rate and the associated cost was prohibitive. There have been recent calls to incorporate a more contingency perspective in the lean manufacturing literature (Shah and Ward, 2003; Browing and Heath, 2009). While our study has shown that ILP are not significantly associated with flexibility, this relationship may change when contingency variables are taken into consideration (e.g. type of product, stages of the product cycle time). Accordingly, the contingency framework should also be considered in future research. Finally, further research is called to investigate the association between ILP and other, less traditional, performance indicators such as environmental and social performance (Pagell and Wu, 2009).

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Table 1: Demographics of the sample

	Sample (%)		Sample (%)
Respondent's job title		**Industry sector**	
Production manager	32.6	Manufacturing of food	16.8
Operations manager	25.0	Machinery	12.8
Supply chain manager	18.4	Pharmaceuticals	12.0
General Manager/Director	17.0	Electronics	10.2
Other managerial areas	7.0	Medical devices	9.7
No. of Employees		Plastics	8.4
Under 100	44.1	Chemicals	7.5
100-299	33.9	Fabricated metal products	7.1
300-499	8.3	Motor vehicles and parts	4.4
500+	13.7	Wood/products of wood	4.0
Majority ownership		Basic metals and other minerals	3.5
Irish	43.0	Textiles and apparel	1.8
USA	29.0	Pulp, paper and paper products	1.8
Rest of Europe	17.9		
UK	5.4		
Other countries	4.7		

Table 3: Inter-factor correlations

Construct	Mean	S.D.	1	2	3	4	5	6
Supplier partnership (1)	2.358	0.658						
Customer relationship (2)	2.001	0.568	0.328**					
ILP (3)	1.861	0.637	0.371**	0.315**				
Quality (4)	1.895	0.595	0.342*	0.057	0.252**			
Delivery (5)	2.089	0.637	0.317**	0.200**	0.227**	0.409**		
Flexibility (6)	2.395	0.716	0.326*	0.155**	0.199**	0.374**	0.474**	
Cost (7)	2.590	0.701	0.222**	0.230**	0.336**	0.417**	0.476**	0.474**

** Sign. at the 0.01 level
* Sign. at the 0.05 level

Table 2: Factor analysis for supplier partnership, customer relationship, ILP and operational performance

Construct	F1	F2	F3	F4	F5	F6	F7
Supplier partnership							
We have helped our suppliers to improve their product quality	0.578						
We have continuous improvement programmes that include our key suppliers	0.639						
We include our key suppliers in our planning and goal-setting activities	0.805						
We actively involve our key suppliers in new product development processes	0.571						
Customer relationship							
We frequently interact with this customer to set reliability, responsiveness, and other standards for us		0.602					
We frequently measure and evaluate this customer satisfaction		0.587					
We frequently determine this customer future expectations		0.466					
We inform this customer in advance of changing needs		0.656					
This customer shares proprietary information with us		0.583					
ILP							
Our firm reduces process set-up time (time required to prepare or refit equipment/workstations for production)			0.490				
Our firm produces only what is demanded by customers when needed (e.g. JIT)			0.669				
Quality							
High product performance				0.575			
High product reliability				0.698			
Conformance of final product to design specifications				0.571			
Delivery							
Short delivery time					0.576		
Delivery on due date (ship on time)					0.729		
On-time delivery (range of days/hours before and after due date/time)					0.814		
Flexibility							
Ability to introduce new products into production quickly						0.700	
Ability to adjust capacity rapidly within a short time period						0.613	
Ability to make design changes in the product after production has stared						0.403	
Cost							
Production cost							0.545
Labour cost							0.768
Capacity utilization							0.498
Productivity							0.802
Eigen value	6.332	2.518	1.982	1.428	1.234	1.111	1.075
% of variance	26.383	10.493	8.260	5.949	5.141	4.629	4.479
Reliability (α)	0.756	0.751	0.721	0.704	0.706	0.682	0.810

Table 4: Results of OLS analyses

	Standardised coefficients													
	ILP		**Model 1 - Quality**			**Model 2 - Delivery**			**Model 3 - Flexibility**			**Model 4 - Cost**		
Variables		**Step 1**		**Step 2**	**Step 3**		**Step 2**	**Step 3**		**Step 2**	**Step 3**		**Step 2**	**Step 3**
Control														
Industry type														
Food	-0.040	-0.007	0.055	0.047	0.048	-0.115	-0.111	-0.110	-0.029	-0.031	-0.031	0.045	0.059	0.061
Machinery	-0.111	-0.044	0.101	0.092	0.100	0.090	0.087	0.092	0.062	0.056	0.060	-0.016	-0.013	-0.001
Pharmaceutical	-0.063	-0.076	-0.030	-0.032	-0.019	0.099	0.079	0.088	0.113	0.100	0.119	0.041	0.008	0.029
Direct effects														
Supplier partnership		0.299**		-0.046	-0.085		0.083	0.056		0.018	-0.005		0.181**	0.120
Customer relationship		0.228***		0.356***	0.306***		0.287***	0.251***		0.316***	0.285***		0.163*	0.082
Mediating effect														
ILP					0.169*			0.120*			0.101			0.269***
ΔR^2	0.003	0.187***	0.014	0.132***	0.155***	0.036	0.140***	0.152***	0.042	0.145***	0.153***	0.004	0.081**	0.140***
R^2	0.003	0.187	0.014	0.132	0.155	0.036	0.140	0.152	0.042	0.145	0.153	0.004	0.081	0.140
Adjusted R^2	-0.011	0.168	0.001	0.113	0.133	0.023	0.121	0.129	0.029	0.126	0.130	-0.010	0.060	0.116
F	0.214	10.184***	1.051	6.763***	6.780***	2.752	7.231***	6.593***	3.234	7.535***	6.671***	0.277	3.906**	5.984***
Max VIF = 1.236														

*$p \leq 0.05$
**$p \leq 0.01$
***$p \leq 0.001$