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Innovativeness and Lean Practices for Triple Bottom Line: Testing of Fit-as-Mediation versus Fit-as-Moderation Models

Abstract

Purpose – This paper examines whether the fit between innovativeness and lean practices (LPs) can affect triple bottom line (TBL) performance. Two types of fit are tested: fit-as-mediation in which innovativeness creates TBL performance through the mediation of LPs and fit-as-moderation whereby the effects of innovativeness on TBL performance are moderated by LPs.

Design/methodology/approach – Structural equation modelling and moderated regression are used to test the fit-as-mediation and fit-as-moderation models using survey data collected from 241 manufactures in China.

Findings – The results show that innovativeness is positively associated with LPs that emphasize operational excellence. Innovativeness indirectly affects all three TBL dimensions through the mediation of LPs, and LPs do not moderate the effects of innovativeness. The applicability of fit-as-mediation model suggests directing attention toward integrating innovation and LPs within same organizational units to achieve improved TBL performance.

Practical implications – The findings suggest manufacturers should involve employees within the same organizational unit embrace an integrated culture of innovativeness and LPs and avoid separate attention to innovativeness and LPs.

Original/value – This is the first study of which we are aware developing and empirically testing both fit-as-mediation and fit-as-moderation models within the same study to understand how innovativeness and LPs work together to influence TBL performance. This study extends the boundaries of current understanding by examining how, when, and why the innovativeness–LPs–TBL relationship arises between constructs central to our theories.

Keywords Sustainability; Innovativeness; Triple bottom line; Lean practices; China

Paper type Research paper

1. Introduction

The triple bottom line (TBL – economic, environmental, and social performance) proposed by Elkington (1998) is arguably achievable via breakthrough change, disruption, asymmetric growth in sustainable sectors, and the scaling of next-generation market solutions. Thus, many management scholars (e.g., Hart, 1995; Porter and van der Linde, 1995) argue for the importance of a culture of innovativeness. Innovativeness is a culture open to generating and accepting new ideas (Hult et al., 2002, 2007). Innovativeness is a condition that drives innovation efforts rather than an outcome of innovation process. Innovativeness is an impetus for new knowledge to develop new sustainable materials, cleaner production processes, and green products (Pagell and Shenvchenko, 2014). A study shows innovativeness can support the development of sustainable processes especially for creating social benefits (Gualandris and Kalchschmidt, 2014). However, another study fails to find a significant effect of green product design on environmental performance (Zhu et al., 2007). Additionally, Liu et al. (2018) contend green product innovation did not reduce the cost of material inputs or environmental management and ultimately profit.

Meanwhile, another stream of literature argues lean practices (LPs) are effective for improving the environmental dimension of TBL (Buer et al., 2018; King and Lenox, 2001). Due to its focus on operational excellence and waste reduction, LPs act as a systematic approach to realizing both environmental innovation and reduce waste (Wu et al., 2015). LPs with a reliance on TQM principles such as customer focus and process management has been shown to positively affect innovation performance (Long et al., 2015; Prajogo and Sohal, 2003; Zeng et al., 2015); specifically, incremental innovation (Biazzo et al., 2016; Chen and Taylor, 2009; Francis and Bessant, 2005; Ghobadian et al., 2018; Hoerl and Gardner, 2010). Other studies suggest a focus on managing process quality leads to both incremental and radical innovation (Kim et al., 2012). So, LPs appear to create incremental innovation, while an innovativeness culture is needed for radical innovation. Still, the joint effects of LPs and innovativeness culture remain puzzling. The main question is whether an organizational should embrace both LPs and an innovativeness culture to gain the "best of both worlds"?

Past studies show there are cases where it is possible to retain innovative activities while applying lean concepts to achieve operational excellence (Lewis, 2000). LPs focus on eliminating waste or non-value-added activity to achieve the efficient use of resources (Shah and Ward, 2003, 2007) or eco-innovation. Arguably, a reliance on continuous improvement (*Kaizen*)

means LPs can lead to routinization and standardisation of work (Conti et al., 2006). Workers in such standardised and routinized settings tend to focus on harvesting and protecting existing practices rather than focusing on developing new ones (Van de Ven, 1986). Thus, LPs can drive managerial attentions toward a focus on refining and extending existing technologies, competencies and paradigms (March, 1991), while innovativeness promotes openness, generation, experiments with new ideas, and a focus on changing the existing practices and product designs (Ojha et al., 2016).

This paper argues LPs that emphasize operational excellence and a culture of innovativeness fit or complement each other. The abundant evidence about the positive link between lean and innovation suggest LPs and innovativeness may fit with or complement each other and it is these synergetic effects that improve performance (Kim et al., 2012). Fit is plausible because LPs can serve as a platform for implementing innovative ideas; it can sharpen the distinction between idea generation and development (BCG, 2009). The openness to accept new technologies increases due to the robust continuous improvement practices applied by firms with matured LPs (Rossini et al., 2019).

To test whether innovativeness (Elkington, 1998; Hart, 1995; Porter and van der Linde, 1995) and LPs (King and Lenox, 2001) can both contribute to TBL because of the fit between innovativeness and LPs, we consider two models of fit (Venkatraman, 1989). In the first model (i.e., fit-as-mediation), innovativeness is modelled to impact TBL through the implementation of LPs. In empirical terms, that means manufacturers implement LPs as an intervening mechanism to transform new ideas generated by innovativeness into innovation required for TBL. Such an argument is consistent with emerging evidence that it is an innovation orientation that helps LPs achieve radical innovation (Adballah et al., 2019). In the second model (i.e., fit-as-moderation), we hypothesize innovativeness impacting TBL directly and moderated by LPs. This second model implies manufacturers may use different teams to implement innovation and LPs and workers practicing LPs complement the innovative ideas created by the innovation team.

The sustainability literature calls for explanations of how TBL can be achieved and yet the topic remains under-researched (Chavez et al., 2020; Glavas and Mish, 2017). While previous studies examine the effect of LPs on individual dimensions of TBL (e.g., Eroglu and Hofer, 2011; Jayaram et al., 2008; Wong and Wong, 2014; Yang et al., 2011), this study investigates the effects of LPs and innovativeness on individual as well as aggregated performance. While

managers readily grasp the benefits of LPs (King and Lenox, 2001), the effects of fit between LPs and innovativeness are less understood. The lack of a positive impact of innovativeness on TBL (Liu et al., 2018; Zhu et al., 2007) may be explained by including LPs. The present study thus provides a more holistic understanding of the sources of TBL and as such contributes to the understanding of how TBL can be achieved in an emerging economy context.

2. Theoretical background

2.1. Triple bottom line (TBL), innovativeness and lean practices (LPs)

When Elkington (1998) introduced the concept of TBL he focused on three performance dimensions: economic, environmental, and social. The *environmental dimension* refers to the efficient and sustainable use of energy and natural resources and reducing the negative externality such as pollution caused by the inefficient use of the resources (Chavez et al., 2020; Hall et al., 2010; Zhu and Sarkis, 2004). The *social dimension* refers to corporate social responsibility, equitable treatment, diversity, opportunity, health and safety, and any other aspects promoting social wellbeing (Berg et al., 1996; Nikolaou et al., 2013; Wu et al., 2015). The *economic dimension* refers to sustained financial performance of the firm such as profitability, return on investment, return on assets, and return on sales (Cochran and Wood, 1984; Flynn et al., 2010; Martinez-Jurado and Moyano-Fuentes, 2014). In 2018, Elkington highlighted that his original intention was to demonstrate that TBL cannot be achieved without breakthrough change, disruption, asymmetric growth in sustainable sectors, and the scaling of next-generation market solutions (Elkington, 2018). Hence innovation is important for achieving TBL performance.

This study considers innovativeness in the supply chain context. Innovativeness is different from innovation performance. Innovation is often treated as a performance outcome (e.g., product/process innovation) while innovativeness is a culture fostering these outcomes. Following previous research (e.g., Hult et al., 2002, 2007; Ojha et al., 2016), we define *innovativeness* as a culture open to generating and accepting new ideas, processes, or new modes of operation to facilitate the introduction of new products/services, processes, and technologies within the supply chain. Innovativeness in a supply chain is a cross-organizational, cultural, and relational phenomenon (Ojha et al., 2016) whereby supply chain members are open to innovative ideas distributed across the supply chain. Highly innovative supply chains "consider what they

do not know and cultivate internal and external partners who can be trusted to provide needed resources and expertise" (De Tienne et al., 2015, p. 13). Firms with innovativeness in a supply chain are more likely to access the resources needed to be creative and innovative (Hult et al., 2002).

Innovativeness is a culture supportive of generating ideas for and developing new products, services, or processes. Innovativeness can challenge existing technologies and production methods, consider adapting renewable energy solutions, ethical sourcing and standards, replace hazardous substances, and eliminate unnecessary packaging and waste disposal (Porter and van der Linde, 1995). Innovativeness drives a focus on exploring and developing new ways of thinking and working. Innovation can be incremental, architectural, modular, or radical in nature (Henderson and Clark, 1990), all of which may impact TBL. Innovativeness has been shown to stimulate product and process innovation and sustainable operations and supply chain processes in the construction sector (Gualandris and Kalchschmidt, 2014). The few studies on the relationship between innovativeness and TBL (Bamgbade et al., 2017; Gualandris and Kalchschmidt, 2014; Liu et al., 2018; Zhu et al., 2007) have reached mixed conclusions and they have not considered the roles of LPs.

LPs are manufacturing practices focused on reducing variability and non-value-added activities (Shah and Ward, 2003, 2007). Lean techniques such as pull-production systems, variability reduction, continuous improvement (*kaizen*), total quality management, and total people involvement are used to reduce waste in the transformation process (Li et al., 2005; Shah and Ward, 2003) and achieve operational excellence. Pull-production systems reduce waste by producing only what is needed by the customer (Chavez et al., 2020; Shah and Ward, 2007). Process variability reduction employs statistical techniques, set-up time reduction, and total productive maintenance (Karlsson and Åhlström, 1996). Quality management entails proactive continuous improvement processes with the goal of zero defects (Chavez et al., 2020; Womack and Jones, 1994). Finally, total employee involvement is at the heart of lean manufacturing and includes communication and teamwork, employee motivation and empowerment, and problem detection and problem solving which have been described as the glue that binds LPs together (Azadegan et al., 2013; Martinez-Jurado and Moyano-Fuentes, 2014).

There is abundant evidence of the positive effects of LPs on environmental performance (Cherrafi et al., 2017; Kumar and Rodrigues, 2020). The ability to achieve lean and green

products is shown to lead to financial benefits (Wong et al., 2018). LPs can improve the social dimension of TBL by reducing stress, improving teamwork, providing more varied work, and increasing autonomy at work (Chavez et al., 2020), but in some cases such an approach can be seen as a lack of freedom (Martinez-Jurado and Moyano-Fuentes, 2014). LPs directly improve operations performance and several studies suggest innovation and LPs are positively related (Biazzo et al., 2016; Chen et al., 2009; Francis et al., 2005; Ghobadian et al. 2018; Hoerl et al., 2010; Tortorella et al., 2019). Collectively these studies suggest LPs and innovativeness are potentially complementary.

2.2. Fits between LPs and innovativeness

It is important to acknowledge that some literature argues innovation and lean practices rely on contradicting principles (Vonti et al., 2006; Van de Ven, 1986). The main principle of LPs is continuous improvement (*Kaizen*) with a focus on routinization and standardisation of work after a satisfactory improvement is achieved (Conti et al., 2006). Given that LPs focus on refining and extending existing technologies, competencies and paradigms (March, 1991), there might be a tendency to protect existing practices instead of radically developing new ones (Van de Ven, 1986). Meanwhile, innovativeness emphasizes searching for new ideas that could lead to radically changing the existing practices (Ojha et al., 2016). Hence the observation that few firms, e.g., Toyota, can be lean and yet innovative. However, such an argument is challenged by evidence of a positive link between lean and innovation performance (Biazzo et al., 2016; Chen et al., 2009; Francis et al., 2005; Ghobadian et al., 2018; Hoerl et al., 2010).

Many scholars argue innovation and LPs may be complimentary. LPs are known to help reduce waste and contribute to the environmental dimension of TBL while driving operational excellence (Cherrafi et al., 2017; King and Lenox, 2001; Kumar and Rodrigues, 2020; Chavez et al., 2020). Lean is more related to incremental rather than radical innovation (Abdallah et al., 2019); though in some cases it can drive radical innovation (Kim et al., 2012). Thus, LPs might not be adequate to achieve the transformative changes required to achieve all three dimensions of TBL. For example, evidence suggests the social dimension of TBL requires a radical transformation of sustainable processes (Gualandris and Kalchschmidt, 2014) and achieving improvements in the financial dimension of TBL through the development of inimitable resources demands new technologies (Hart, 1995).

The fit between LPs and innovation is manifested by the integration of innovative manufacturing automation technologies aimed at inventory and waste reduction (Kolberg et al., 2017). Tus the use of innovative technologies can help manufacturers advance towards Industry 4.0 and develop a cyber-physical system that increases elements important to becoming more lean such as real-time visibility and autonomous operations (Buer et al., 2018). To achieve TBL, many different types of innovation may be required and originate outside of an organization. Thus, it is important to consider a culture open to new ideas.

This study argues new ideas encouraged by a culture of innovativeness must be transformed, by LPs, into new product/service and processes to achieve TBL. New ideas help lean teams actively engage in creative and innovative activities (Porter and van der Linde, 1995). New ideas are required to ameliorate tensions between economic and social/environmental dimensions. While innovativeness is required for generating new ideas, there is also a need for a structured process to exploit the new ideas. LPs can be such a process (BCG, 2009). For example, LPs can be used to exploit environmental innovations, especially when it comes to reducing waste (Wu et al., 2015). The structured continuous improvement approach of LPs can be extended to address social and financial dimensions as well. Another reason why LPs can facilitate innovation adoption is that it relies on a learning culture or routine (such as the use of PDCA cycle) and an emphasis on using collaborative networks for problem solving (Solaimani et al., 2019). Learning requires openness to new knowledge, which implies innovativeness can serve as a channel for accessing new ideas and for learning to take place during LPs related activities.

One may argue LPs should be treated as the antecedent of TBL. However, prior arguments reveal that LPs alone are inadequate to achieve TBL and suggest the role of innovativeness as the key. Moreover, it could be challenging to break the inertia created by the lean culture (i.e., to standardise and routinize work) and transition to an innovativeness mindset. For example, structured routines used to tackle complexity in supply chains have been shown to slow the rate of product introduction (Jacobs, 2013). Thus, the fit between LPs and innovativeness is more about how LPs enhance or facilitate the effects of innovativeness on TBL than otherwise. Since fit or complementarity can exist in differing functional forms (Venkatraman, 1989), this study investigates the fit between LPs and innovativeness in two theoretical models: fit-as-moderation versus fit-as-mediation in the following sections.

2.3. The fit-as-mediation model

The fit-as-mediation model suggests that the effects of innovativeness on TBL are mediated by LPs. When fit is treated as a mediation process, we assume there exists an intervening mechanism between an antecedent variable (i.e., innovativeness) and the outcome variable (i.e., TBL) (Venkatraman, 1989). Intervention mechanisms (e.g., organizational structure) are often used to enable a strategy to produce an outcome (Venkatraman, 1989). In this case, we treat LPs that emphasize operational excellence as the intervention mechanism that transforms output from the innovation activities into TBL (see Figure 1). As argued, it is the structured continuous improvement approach of LPs that helps manufacturers to absorb and choose innovations to achieve performance. Take Toyota for example, the innovation of hybrid engines represents a focus on using LPs to refine existing engine design and production practices while simultaneously incorporating innovation in battery energy.

---------- Insert Figure 1 ----------

Innovativeness in the supply chain is critical because the development of new products/processes involve the supply base at greater levels than the past (Blackhurst et al., 2015). Studies reveal competitive advantage accrues from improved time to market, quality, and productivity that arise from supplier involvement in new product development projects (e.g., Womack and Jones, 1994). The theorized (fit-as-mediation) model suggests innovative ideas spurred by a culture of innovativeness can be transformed by the continuous improvement cycles under the LPs, and it is the systematic approaches to continuous improvement and waste reduction offered by the LPs that transform such ideas into TBL performance.

While innovativeness encourages new ideas, LPs help incorporate them into systems and processes (Panayides and Lun, 2009). When firms realize the need for repeated adjustments to production processes to cope with changes in mix, volume, and sustainability requirements they need LPs (Smeds, 1994). LPs act as the transformation process (i.e., the intervention mechanism) that enhances resource productivity (Porter and van der Linde, 1995). Hence, as innovations flow through the supply chain, innovativeness encourages their adoption and LPs function as the executor of ideas. Thus, we hypothesize:

H1: Innovativeness has a significant positive effect on LPs.

Achieving TBL means firms need not only create value for shareholders, but also protect the environment around and the lives of the people they serve (Wu et al., 2015). While LPs can decrease cost by reducing waste, it must reduce impacts to both the environment and society (Chavez et al., 2020; Dhingra et al., 2014). It has been suggested that synergies can be obtained by simultaneously addressing all three TBL dimensions using innovative ideas (Pagell and Wu, 2009). The ability of LPs to affect TBL is significantly aided by new ideas generated by innovativeness. This claim can be verified by testing the synergistic effects of innovativeness and LPs on the three dimensions of TBL in a single model. In addition, the literature on the relationship between LPs and environmental performance (e.g., Hajmohamad et al., 2013) and social performance (e.g., Brown and O'Rourke, 2007) has reached mixed conclusions. The inconclusive and sometimes contradictory empirical results require further investigation of the LPs–TPL performance relationship (Chavez et al., 2020; Yang et al., 2011).

The *economic performance* dimension of TBL includes financial measures capturing the long-term performance of firms (Martinez-Jurado and Moyano-Fuentes, 2014). The literature suggests that LPs translate into higher financial performance (Fullerton et al., 2003). For example, LPs can reduce inventory and waste which in turn reduce material cost and working capital requirements (Azadegan et al., 2013). Also, the reduction of inventory exposes potential problems such as process bottlenecks and product defects which influence efficiency, costs, and profitability (Fullerton et al., 2003). There is extensive empirical evidence (e.g., Eroglu and Hofer, 2011; Fullerton et al., 2003; Jayaram et al., 2008) suggesting the impact of LPs on financial performance (such as profitability, return on investment, and return on assets).

Environmental performance can be influenced by LPs. LPs and good environmental practices are complimentary because waste reduction is associated with an efficient use of resources (Dhingra et al., 2014). LPs can reduce energy and water consumption, hazardous materials utilization, waste, and environmental pollution (Vinodh and Somanaathan, 2011). LPs have been associated with resource reduction, pollution prevention, and lower emissions (e.g., King and Lenox, 2001; Yang et al., 2011). Some suggest the focus of LPs is on eliminating all types of waste (e.g., inventory, overproduction, waiting time, and faulty products) at the point of origin (Martinez-Jurado and Moyano-Fuentes, 2014).

Social performance refers to aspects of wellbeing such as health, safety, stress levels, and ergonomics (Martinez-Jurado and Moyano-Fuentes, 2014). Previous studies suggest the

implementation of LPs enables firms to boost employee motivation (e.g., Wong and Wong, 2014) and reduce employee stress (e.g., Conti et al., 2006). This may be attributable to LPs' promotion of a total-people-involvement culture where every employee is empowered and actively involved in improvement initiatives (Martinez-Jurado and Moyano-Fuentes, 2014). Factors such as involving people in problem solving groups, acknowledging people's efforts, and incorporating people's suggestions for improvement are recognised characteristic of LPs (Chavez et al., 2020; Hines et al., 2004) that can improve the health and psychological wellbeing of employees (Cullinane et al., 2014). Thus, we hypothesize a positive relationship between LPs and TBL.

H2: LPs have a significant positive effect on a) financial performance, b) environmental performance, and c) social performance.

It has been suggested that firms with a high level of innovativeness might perform better on sustainability (Gualandris and Kalchschmidt, 2014; Pagell and Wu, 2009). Innovation capability is becoming critical for the management of social and environmental issues in supply chain operations (Klassen and Vereecke, 2012). Social and environmental sustainability require a departure from existing technology and practices (Bamgbade et al., 2017). Pagell and Wu (2009) further argue that innovative firms leverage their ability to gather useful and valuable information concerning stakeholders' needs and concerns with the aim of developing new sustainability strategies and practices. Innovativeness creates an environment in which firms can implement sustainable supply chain management practices more easily (Gualandris and Kalchschmidt, 2014). However, there is mixed empirical evidence. For instance, Gualandris and Kalchschmidt (2014) report that innovativeness is positively and significantly related to sustainable process management, but not directly related to sustainable supply management, whereas Bamgbade et al. (2017) report a positive effect on the social sustainability performance of construction firms. As such it can be concluded that green product innovation does not always lead to financial and environmental benefits (Liu et al., 2018; Zhu et al., 2007).

Based on the notion of fit-as mediation we argue innovativeness needs LPs as an intervention mechanism (Venkatraman, 1989) to systematically transform ideas into TBL because resource productivity is required to make ideas into feasible and affordable innovations. Firms can use LPs when adopting new environmental technologies and realize improved environmental performance through eliminating waste or non-value-added activities (King and Lenox, 2001).

Similarly, LPs could be used as an intervening mechanism to address not only improvement of manufacturing processes but also worker wellbeing (Martinez-Jurado and Moyano-Fuentes, 2014). At the same time, there is a need to become more innovative because societal sustainability might require structural and radical changes in the ways people are managed (Klassen and Vereecke, 2012); such changes can be of a structured and systematic approach like that offered by LPs. Thus, we expect that innovativeness *indirectly* affects TBL performance through implementing LPs.

H3: LPs mediate the relationships between innovativeness and a) financial performance, b) environmental performance, and c) social performance.

2.4. The fit-as-moderation model

Figure 2 illustrates a competing model; fit-as-moderation. The fit-as-moderation model suggests that the effects of innovativeness on TBL are moderated by LPs. In this case, LPs are treated as the environment in which the antecedent innovativeness affects TBL as the outcome variable (Venkatraman, 1989). Such a fit reflects an empirical scenario whereby manufacturers may use different loosely coupled organizational units to perform innovation activities and lean practices separately (Gupta et al., 2006). For example, R&D departments perform innovation activities while a lean production team (as the environment) provides input to the R&D activities to help develop a more sustainable production system. The main benefit of such an organization structure is that it allows each function to focus on activities consistent with its strengths. The use of separate teams allows the manufacturers to reap benefits from both teams, but it creates additional costs of resourcing and coordination. A concrete example of this is an implementation of design for manufacturing where an engineering design group is relying upon input from the factory floor for information about the benefits or drawbacks of various design choices.

There may also be inherent complementarities between LPs and innovativeness. For example, significant creativity may be required to attain reduced set-up times. The novel solutions proffered would require an openness to their acceptance. Additionally, while much of process variability control may be routine, this is an area that also may require out of the box thinking to reach the root cause of the variability found from the application of statistical tools. These complementarities may be picked up by an interaction term.

---------- Insert Figure 2 ----------

It is important to acknowledge the evidence suggesting lean and innovation are positively associated (Biazzo et al., 2016; Chen et al., 2009; Francis et al., 2005; Ghobadian et al., 2018; Hoerl et al., 2010). However, the fit-as-moderation model reflects a scenario wherein manufacturers dedicate an organizational unit to develop innovative solutions that are expected to impact TBL, while other teams focused on implementing LPs are used to supplement such efforts. It is therefore important to test whether this potential moderating effect exists.

H4: LPs moderate the relationships between innovativeness and a) financial performance, b) environmental performance, and c) social performance.

3. Research methodology

3.1. Sample and data collection

We studied manufacturing firms in China because they face tremendous pressures to improve societal and environmental performance. A survey-based study was necessary due to the absence of a comprehensive database covering innovativeness, LPs, and TBL. To increase generalizability, we surveyed firms from major geographical regions representing different stages of economic development in China. Consistent with prior studies, seven regions were selected as a sample pool including Pearl River Delta, Yangtze River Delta, Bohai Sea Economic Area, Northeast China, Central China, Southwest China, and Northwest China (Zhao et al., 2006). A random sample of 1,000 manufacturing firms was drawn from government directories of firms in China's manufacturing industry provided by Provincial Economic and Information Technology Commission in the seven regions (Li et al., 2010). Before sending out the questionnaires, key informants in the selected firms were identified and contacted by phone and email to obtain agreement to participate in the research. The survey questionnaires were then sent to 890 firms that agreed to take part.

After several reminders by email and telephone a total of 257 questionnaires were returned. Of these, 16 were discarded due to missing data resulting in 241 completed and useable questionnaires. The effective response rate was approximately 27%. Table 1 provides a summary of the demographic characteristics of the respondents, most of whom held high-level managerial positions with titles such as CEO, president, vice president, director, or manager and had been in their current position for more than five years. Thus, it is reasonable to expect that the informants have sufficient knowledge to respond to the questionnaires (Jacobs et al., 2007). The survey data

were obtained from heterogeneous groups of people and firms in terms of industry types, number of employees and annual sales. The survey data have been used in a prior research (Yu et al., 2019) to investigate topics unrelated to this present study.

---------- Insert Table 1 ----------

3.2. Questionnaire design

To improve content validity and reliability several approaches were adopted (Churchill, 1979). First, content validity of the measurement scales was established through a comprehensive literature review. Second, the questionnaire was developed in English and then translated into Chinese followed by a back-translation to ensure conceptual equivalence. In addition, to further ensure the validity of the questionnaire, the back-translated English version was checked against the original English version (Brislin, 1970). Third, even though the measurement scales adopted from previous studies were demonstrated to be valid, extra steps were taken before the survey was administered. Because of the unique characteristics of China's manufacturing industry (Zhao et al., 2006), the existing measurement scales developed for Western countries were modified to account for language and cultural differences. Several questions were reworded to improve the accuracy of the translation and relevance to business practices in China. Fourth, content validity was further established with a pilot test using academics and practitioners. The questionnaire and its measurement instruments were reviewed by four academic researchers which helped increase the relevance and clarity of the questionnaire. Further, a pilot test was conducted with senior executives from four manufacturing firms using semi-structured interviews. Based on the feedback from both academics and industry experts, redundant and ambiguous items were eliminated or modified. For example, during the pilot test, we reworded the item of "a enterprise's environmental situation" to "improve a company's green image", which both academics and practitioners suggested better reflects the environmental performance measures.

3.3. Measures and control variable

The measurement items used in this study are reported in Table 2. The measures for innovativeness as a culture of openness to new ideas were adapted from Hult et al. (2002, 2007), and include five items on innovation and technical innovation in the supply chain, innovative supply chain ideas, and innovation encouragement in the supply chain process. The measures for

LPs were adapted from Azadegan et al. (2013) and Shah and Ward (2007), using seven items that included questions on employee collaboration to diagnose and solve problems, equipment maintenance, statistical techniques for variability reduction, pull production systems, feedback from customers on quality and delivery performance, and equipment grouped to produce families of products. We did not include supplier and customer-related scales from the lean production measures developed by Shah and Ward (2007) because our theory focuses on LPs that emphasize internal operational excellence. All these items were measured using a seven-point Likert scale, ranging from 1 "strongly disagree" to 7 "strongly agree".

While it is possible to obtain some objective measures for performance and financial dimensions, few firms in China measure environmental performance in a reliable manner and publicly publish financial data (Singh et al., 2016). Moreover, our intention was to measure competitive performance, which relied on respondents' knowledge instead of public financial data. As noted above, TBL comprised three dimensions: the financial performance scale was adapted from Flynn et al. (2010), the environmental performance scale was adapted from Zhu and Sarkis (2004), and the social performance scale was adapted from Berg et al. (1996) and Nikolaou et al. (2013). The TBL dimensions were measured by asking respondents to evaluate their recent performance relative to their major industrial competitors using a seven-point scale (1 = much worse than your major competitors and 7 = much better than your major competitors).

Firm size was used as a control variable in the research model. Firm size, measured by the number of employees (see Table 1), was controlled because larger firms may have more resources for managing innovation in the supply chain process and implementing LPs, and thus may achieve better business performance than small firms.

3.4. Non-response bias and common-method bias

A non-response bias test was conducted by comparing the early and late respondents over several parameters (Armstrong and Overton, 1977). It is the most widely applied method to test for non-response bias (Gefen et al., 2011). The t-tests for differences between early and late responses across number of employees and annual sales indicate no significant differences at the 5% significance level. Thus, non-response bias is not likely to be a significant problem in this study.

Since data for this study were collected from single respondents using the self-reported questionnaire survey, common method bias may exist. Common method bias was assessed using

two different approaches in this study. First, confirmatory factor analysis (CFA) was applied to Harman's single-factor model. The CFA results indicate that the overall model fit (χ^2/df (2830.999/299) = 9.468, CFI = 0.459, IFI = 0.462, TLI = 0.412, and RMSEA = 0.188) was unacceptable (Hair et al., 2010) and significantly worse than those of the measurement model (see Table 2). Although Harman's single-factor test has been considered as the most widely used approach to test for common method bias, it does not eliminate the possibility of common method bias (Podsakoff et al., 2003). Second, two measurement models were tested and compared: one model included only the traits and the other model includes both the traits and a latent factor (Podsakoff et al., 2003). The results indicate that the model with a latent factor only marginally improved the model fit indices (CFI and IFI by 0.017 and TLI by 0.012). Therefore, since responses included strategy, operations, and environment domains and were answered by a single senior executive, the study could be subject to error or bias. However, the bias checks performed suggest that common method variance bias has minimized in this study.

4. Data analysis and results

4.1. Reliability and validity of the measurement model

We conducted a CFA to assess the unidimensionality of scale items (Gerbing and Anderson, 1988). The CFA results reported in Table 2 indicate that the measurement model has a good fit (χ^2 / df = 2.207; RMSEA = 0.071; CFI = 0.925; IFI = 0.926; TLI = 0.916), which provides evidence of unidimensionality (Hair et al., 2010).

Cronbach's Alpha and composite reliability (CR) (Hair et al., 2010) were also calculated. Table 2 indicates that the Cronbach Alpha and CR values of all theoretical constructs are well above 0.70 which provides evidence of reliability (Nunnally, 1978). Thus, we conclude that the theoretical constructs used in this study exhibit adequate reliability.

---------- Insert Table 2 ----------

We evaluated construct validity using CFA (O'Leary-Kelly and Vokurka, 1998). The CFA results illustrated in Table 2 indicate that the model fit indices are acceptable (Hair et al., 2010), the item loadings are greater than 0.50 and statistically significant ($p < 0.001$), and that all t-values are greater than 2 suggesting convergent validity (Hair et al., 2010; O'Leary-Kelly and Vokurka, 1998). Additionally, convergent validity was further assessed by checking whether the average variance extracted (AVE) of theoretical construct is greater than the acceptable threshold

of 0.50 (Fornell and Larcker, 1981). Table 2 indicates that AVE values for three constructs exceeded the minimum of 0.50, and one (lean practices, 0.46) falls slightly below 0.50. Based on these results, we conclude that the constructs and scales have convergent validity (Fornell and Larcker, 1981).

In this study, we assessed discriminant validity by comparing the square root of the AVE for each construct with the correlations with all other theoretical constructs (Fornell and Larcker, 1981). Evidence for discriminant validity is indicated (see Table 3) as the square root of every AVE for each theoretical construct is much larger than any correlation among any pair of latent constructs (Fornell and Larcker, 1981). Table 3 also shows that LPs and innovativeness are positively related.

---------- Insert Table 3 ----------

4.2. Testing of the fit-as-mediation model

We compared the fit-as-mediation model (Figure 1) with the fit-as-moderation model (Figure 2) to ascertain which model best fits the data. Following the approach suggested by Baron and Kenny (1986) and Liu et al. (2012), we assessed the hypothesised links and mediating effect of LPs (see Figure 1) through testing (1) a direct model, (2) a full mediation model, and (3) a partial mediation model. Structural equation modelling (SEM) using AMOS 24.0 was used to test the models. All models manifest acceptable goodness-of-fit indices (Hair et al., 2010).

---------- Insert Table 4 ----------

Table 4 shows a direct model that includes only the direct links between innovativeness and each of the three dimensions of TBL performance. The results show that innovativeness is significantly and positively related to financial ($\beta = 0.280$, $p < 0.001$), environmental ($\beta = 0.563$, $p < 0.001$), and social performance ($\beta = 0.402$, $p < 0.001$). For the full mediation model where LPs mediate the relationships between innovativeness and the TBL, the results reveal that innovativeness has a significant positive effect on LPs ($\beta = 0.651$, $p < 0.001$), and that LPs are significantly and positively associated with financial ($\beta = 0.482$, $p < 0.001$), environmental ($\beta = 0.624$, $p < 0.001$), and social performance ($\beta = 0.591$, $p < 0.001$).

For the partial mediation model that includes both the direct paths between innovativeness and dimensions of TBL and the indirect paths through the mediator, the results reveal insignificant effects of innovativeness on financial ($\beta = -0.117$, *n.s.*) and social performance ($\beta =$

0.010, *n.s.*). Since these paths are significant in the direct model, full mediation by LPs of the relationships between innovativeness and financial and social performance is suggested. Lastly, the results also suggest that the significant effect of innovativeness on environmental performance under the direct model is reduced but remains significant (β = 0.241, $p < 0.01$) when the mediator is added, indicating a partial mediation of LPs on the relationship between innovativeness and environmental performance.

While model (2) and model (3) have very similar fit indexes, the results in Table 4 show that the partial mediation model (3) has slightly smaller AIC. Model 3 also has the highest explanatory power, in terms of R^2 which suggests the partial mediation model is the best model. Thus, it can be concluded that H1 and H2a-c are supported. LPs fully mediate the relationships between innovativeness and financial and social performance, which lends support to H3a and H3c. H3b is partially supported, with an additional direct effect between innovativeness and environmental performance. We note that in Table 4 (model c) high levels of variation in LPs (R^2 = 0.41) and environmental performance (R^2 = 0.40) are explained by innovativeness. Innovativeness also explains significant amounts of social performance (R^2 = 0.34). Financial performance, as expected, is explained by innovativeness less than other performance dimensions (R^2 = 0.25).

Even though SEM is a robust tool for testing mediation, additional robustness tests are recommended. Therefore, a commonly used bootstrapping test was performed using the PROCESS macro (Hayes, 2013). While Fairchild et al. (2009) suggest using K^2 as a measure of effect size for the mediating effect Preacher and Kelley (2011) recommended the use of R^2 med (R-squared mediation effect size) for the measurement of mediating effect. Wen and Fan (2015) showed the derivation of the maximum possible indirect effect described in Preacher and Kelley's (2011) study contains a mathematical error. Thus, to evaluate the effect size of the mediating effect, R^2 med (Wen and Fan, 2015) was calculated in this study. The results are reported in Table 5. Consistent with the SEM analysis the bootstrapping results confirm the effects of innovativeness on financial and social performance are fully mediated by LPs, while the effect of innovativeness on environmental performance is partially mediated by LPs.

---------- Insert Table 5 ----------

4.3. Testing of the fit-as-moderation model

Due to the relatively small sample sizes, we could not use SEM to test the fit-as-moderation model (Zhao et al., 2011). The fit-as-moderation model (Figure 2) was tested using moderated regression (Hair et al., 2010). Following Hair et al. (2010), the effect of the moderating variable was assessed using a three-stage regression: (1) control variable (firm size), (2) main effect variable (innovativeness), and (3) moderating variable (LPs). The three dimensions of TBL performance were dependent variables in the analyses. Results of the analysis are reported in Table 6. Variance inflation factors (VIF) are all less than 3 suggesting that multicollinearity is not a concern (Mason and Perreault, 1991). The coefficients of the interaction term (innovativeness × LPs) are not significant, which suggests that LPs do not moderate the relationship between innovativeness and TBL. Thus, we conclude that the interactions between innovativeness and LPs do not affect TBL, and H4 is rejected.

---------- Insert Table 6 ----------

4.4. Robustness tests

To assess the robustness of the findings, we conducted another analysis to compare the effects of TBL performance at the component and construct level. Table 7 reports results for TBL performance as a second-order construct. In the first (direct) model, we tested for a direct link between innovativeness and TBL as a second order factor of financial, environmental and social performance. The results show innovativeness is significantly and positively related to TBL ($\beta = 0.588$, $p < 0.001$). The second (full mediation) model suggests that LPs fully mediate the relationship between innovativeness and TBL. The result reveals that innovativeness has a significant positive effect on LPs ($\beta = 0.648$, $p < 0.001$), and that LPs are significantly and positively associated with TBL ($\beta = 0.772$, $p < 0.001$). The third (partial mediation) model checks whether there are direct paths between innovativeness and TBL and indirect paths through the mediator (i.e., LPs). The results indicate there is a significant effect of innovativeness on TBL performance ($\beta = 0.187$, $p < 0.05$) and on LPs ($\beta = 0.631$, $p < 0.001$) and the path from LPs to TBL performance is significant ($\beta = 0.635$, $p < 0.001$). Comparing the results of the three models, the partial and full mediation models have better fit indexes. There are significant paths between innovativeness and TBL performance in both the direct and partial mediation model, satisfying conditions for mediation (Baron and Kenny, 1986). As such, we

conclude that LPs partially mediate the relationship between innovativeness and the unified construct of TBL performance. The findings concur with our primary model results (see Table 4). Therefore, it can be concluded that our mediation model and findings are robust.

---------- Insert Table 7 ----------

5. Discussion and implications

Managers want to know whether they should embrace both LPs and an innovativeness culture to gain the "best of both worlds" in achieving TBL. Some might argue lean practices drive incremental innovation needed to make a firm lean and green. There is no widely available evidence that LPs alone can drive TBL. Many leading scholars argued the need for an innovativeness climate to achieve TBL performance (Elkington; 1998; Hart, 1995; Porter and van der Linde, 1995). The main contribution of the present study is to demonstrate that an innovativeness culture can complement LPs (operational excellence) to achieve TBL performance. Moreover, our study clarifies the nature of such complementarities or fit. This is because such a complementarity can be manifested in the form of fit-as-mediation where LPs transform innovation created by innovativeness into TBL performance; and alternately fit-as-moderation where LPs enhance the effects of innovativeness culture on TBL. These two forms of fit are significantly different theoretically and empirically and therefore the study makes an important contribution by verifying which of them influence TBL performance.

The study results support the fit-as-mediation model presented in Figure 1, which indicates a mediating effect of LPs on the innovativeness–TBL relationship. The findings also reject the competing fit-as-moderation model whereby LPs act as a moderator (see Figure 2). It is an important finding since this is the first study of which we are aware testing both mediation and moderation effects of innovativeness and LPs in the context of TBL. As such this study extends the boundaries of current understanding by examining how, when, and why relationships arise between constructs central to our theories (Calantone et al., 2017). Thus, the present study is unique in that it provides a new perspective for understanding how TBL can be achieved. The study also indicates using different organizational units to implement innovativeness and LPs may not be as effective for achieving TBL, while LPs can be an effective intervention mechanism for systematic transformation of new ideas that impact TBL. A culture of

innovativeness is key to promoting changes to organizational structures, processes and systems in the supply chain and when coupled with LPs can affect TBL.

5.1. Theoretical implications

This study provides evidence that theories about TBL ought to consider innovativeness. As indicated by Elkington (2018), TBL is not merely an accounting tool, but rather is purposed to stimulate significant changes in the organization through innovation. The study reveals a need for innovativeness in the supply chain for a firm to achieve all three dimensions of TBL performance. Our findings suggest TBL can be achieved through a culture of innovativeness whereby firms actively seek and readily accept innovative supply chain ideas and where managers are not penalized for making mistakes while testing new ideas. Where innovativeness in a supply chain is encouraged, managers are more open to the adoption of new ideas, processes, or products addressing sustainability issues. Innovativeness fosters ideas that challenge the fundamental architecture of products and/or supply chains so that firms can balance economic, environmental and social dimensions. To do so, managers must consider new ideas from the supply chain, rather than just from within the firms. That suggests the management field may better understand TBL by theorizing about innovativeness using supply network innovation.

However, the finding about the role of innovativeness creates a new challenge for theorizing the effect of lean on TBL (King and Lenox, 2001). A recent study shows entrepreneurship orientation can contribute to sustainable development through lean practices (Chavez et al., 2020). Thus, we argue, as an important element of entrepreneurship orientation, innovativeness could somehow complement lean practices. Theorizing the relationship between innovativeness and lean in the context of TBL is a new, and difficult challenge because lean and innovativeness can be contradicting in terms of their emphasis, one searching for radical innovation versus the other continuously improving existing practices. This leads to challenges in theorizing how firms may use the same or different organizational units to implement lean and innovativeness. We address this challenge by introducing the idea of fit between innovativeness and LPs. Testing fit-as-mediation and fit-as-moderation models has significant implications for understanding how the seemingly contradicting concepts of lean and innovativeness work together to achieve TBL.

The findings show innovativeness and LPs are indeed complementary in that they are positively related and reinforcing each other. By recognizing different functional forms of fits

(Venkatraman, 1989), this study shows it is possible to model the use of same organizational unit using both innovativeness and lean practices and there is no need for the use of different organizational units to separately engage in innovativeness and lean practices. The findings supporting the fit-as-mediation model instead of the fit-as-moderation model suggest firms may implement both LPs and innovativeness in the same organization units to achieve TBL. The idea is to promote openness to innovative ideas in the supply chain, and then use LPs as an intervention mechanism to implement selected ideas in a systematic and structured manner.

Another theoretical insight relates to the effects of innovativeness on lean practices, which then impact TBL. While lean has an emphasis on continuous improvement and a reliance on routinization and standardisation of work (Conti et al., 2006), it does not act as a hurdle for implementing new ideas as previously thought (Van de Ven, 1986). Capabilities can be path dependent and the continuous improvement mindset deeply embedded in an organization (McNamara and Baden-Fuller, 1999). The continuous improvement mindset can be used to gain access to and accept innovative ideas from the supply chain. This study shows it is possible and necessary to create the capacity to embrace an innovativeness culture and modify the ways LPs absorb and consider new ideas created by innovativeness in the supply chain, especially for achieving all the three dimensions of TBL. This means the TBL literature should consider organizational practices that integrate a focus on the search or use of new technologies and the refinement and extension of existing technologies (Gupta et al., 2006) instead of leaving the two streams of literature separate.

This study adds new insights that illuminate the link between lean and innovation performance. It is important to distinguish the difference between innovativeness and innovation. While past literature mainly shows the positive link between lean and innovation performance (Biazzo et al., 2016; Chen and Taylor, 2009; Francis and Bessant, 2005; Ghobadian et al., 2018; Hoerl and Gardner, 2010; Kim et al., 2012), the link between lean and innovativeness is different. Innovativeness is a culture of openness to new ideas; it is an input to the innovation process. Lean is a structured and systematic approach to transform new ideas engendered through innovativeness. Thus, innovativeness as a key input positively affects lean practices.

This study adds new knowledge about the sources of TBL. How firms achieve TBL performance is an area that remains underdeveloped (Chavez et al., 2020; Glavas and Mish, 2017). While most scholars would agree that lean is associated with green, our findings show

lean is also associated with the social aspect of TBL. Due to its structured continuous improvement approaches, lean is effective in transforming ideas generated from innovativeness into green and social practices. As such, promoting innovativeness in supply chain processes can stimulate a more balanced approach towards social performance through effective employee involvement and participation. As for financial performance, even though the R^2 med is low, we show that lean still marginally has a role in transforming the effects of innovativeness on financial performance. That means past knowledge about profit from innovation based on new products and services (Teece, 2006) needs modification when considering sustainability and TBL performance. Profit from sustainability innovation is not the same as profit from innovation in general. Profit from sustainability innovation is harder to achieve (Liu et al., 2018).

Finally, this study extends existing sustainability research by testing the proposed a theoretical model using survey data gathered from manufacturing firms in an emerging economy; China. Developing sustainable supply chains has become one of the most important environmental and social issues in China (Yu et al., 2014). Manufacturers have invested significantly in implementing lean but are now confronting sustainability and innovation challenges alongside increased regulatory pressure. Our study shows that emerging economies could achieve TBL by embracing innovativeness and lean within the same organizational units.

5.2. Implications for managers and policy makers

The findings have several significant implications for practitioners. Our findings suggest the importance of both innovativeness in the supply chain as well as LPs in achieving TBL. Many organizations rely on LPs because they are already being implemented to achieve resource efficiency and societal benefits. However, innovation is required to make many existing unsustainable supply chain practices sustainable (Pagell and Shenvchenko, 2014). Our study suggests it is necessary for organizations to change their organizational structures and practices to allow the same organizational units to engage with the supply chain to generate innovative ideas and then use structured continuous improvement under LPs to make new sustainability practices financially viable. The findings suggest managers not to treat LPs and innovativeness separately or assign different organization units to engage in lean and an innovativeness culture separately. This calls for a new lean practice that integrates with innovativeness and establishes a new ability to embrace innovativeness within LPs.

The results apply to only China since we do not have data from other cultures. The results indicate Chinese firms that have implemented LPs could benefit from becoming more open to new ideas. Our findings reveal that relying only on LPs without openness to new ideas may limit TBL achievement. This study thus provides a new way for managers to understand the importance of LPs when faced with growing environmental and sustainability demands, i.e., openness. However, without having implemented the fundamental structure and process for LPs (that traditionally emphasize continuous improvement of existing practices or technologies), manufacturers might fail to allow innovative supply chain ideas to directly improve TBL. To improve TBL, manufacturers should ensure LPs are in place before emphasizing innovativeness in the supply chain. In the manufacturing context, workers may know best how a manufacturing process can be improved, but it is still important to have an innovativeness climate. Chinese cultural norms tend to favour punishment of failure. Meanwhile, trying new things also tends to create more failures. Thus, it might be a challenge for some Chinese firms to instil a climate of innovativeness while emphasising lean practices.

The results also yield several implications for policy makers. In China, environmental protection and sustainable development are pressing issues. The results of our study suggest government policy makers should increase efforts to inform manufacturers about the implementation of LPs. Policy makers should take a proactive role in developing relevant environmental regulations to encourage manufacturing firms to implement lean manufacturing principles and sustainable supply chains possessive of an innovativeness orientation. Regulations that restrict innovation should be avoided. Firms that have heavily emphasized LPs (cost) should consider encouraging innovativeness in order to reap the complementary benefits of innovativeness and LPs.

5.3. Future research

Although this study makes an important contribution to research and practice, it has several limitations. First, previous research (e.g., Azadegan et al., 2013; Shah and Ward, 2007) has identified various dimensions of lean operations, such as supplier feedback and development, lean purchasing, customer involvement, and total productive maintenance. Future research is highly encouraged to investigate how the dimensions of lean operations and the interaction between the lean dimensions influence TBL performance. Second, the conclusion about

organizational structure is indicative because of the lack of data. Hence future research may explore how LPs interact with innovativeness within the same unit over time. Third, our findings are based on survey data from China's manufacturing industry, and there are many different versions of LPs and innovativeness, which may limit the generalizability of our findings. Therefore, future research is encouraged to corroborate our theoretical model of innovativeness–LPs–TBL in other developing and developed country contexts. Fourth, another limitation of the study relates to the sampling frame. Our study tapped into one firm in a supply chain; the survey data were only collected from manufacturers; this limits our ability to fully capture our variables for entire supply chains (Hult et al., 2007). We recommend that future research broaden the scope by collecting data from all supply chain partners, and examine firm innovativeness, customer innovativeness and supplier innovativeness and their effects on sustainability.

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Table 1: Demographic characteristics of respondents (n=241)

	Percent (%)		Percent (%)
Industries		**Respondent location (geographical regions)**	
Automobile	30.7	Pearl River Delta	8.7
Chemicals and petrochemicals	10.4	Yangtze River Delta	8.7
Electronics and electrical	12.4	Bohai Sea Economic Area	20.7
Fabricated metal product	6.2	Northeast China	1.7
Food, beverage and alcohol	13.7	Central China	14.9
Rubber and plastics	2.5	Southwest China	38.6
Textiles and apparel	4.6	Northwest China	6.6
Others	19.5		
Number of employees		**Job titles**	
1 – 100	19.1	President / Chief executive officer (CEO)	5.4
101 – 200	15.4	Vice President	7.1
201 – 500	13.3	Director	4.6
501 – 1000	8.7	Manager	49.4
1001 – 3000	17.8	Other senior executive	33.6
> 3000	25.7		
Annual sales (in million Yuan)		**Years in current position**	
Below 10	10.0	≤ 5	45.2
10 – 50	15.8	6-10	24.5
50 – 100	10.4	> 10	30.3
100 – 500	17.0		
500 – 1000	12.9		
Above 1000	34.0		

Table 2: CFA results: reliability and validity analysis

Measurement items	Factor loadings	t-values	α	CR	AVE
1. Innovativeness			0.839	0.848	0.532
INN1: Technical innovation, based on research results, is readily accepted in the supply chain	0.729	–			
INN2: We actively seek innovative supply chain ideas	0.766	11.150			
INN3: Innovation is readily accepted in the supply chain process	0.818	11.838			
INN4: People are not penalized for new supply chain ideas that do not work	0.523	7.623			
INN5: Innovation in our supply chain process is encouraged	0.775	11.262			
2. Lean practices			0.848	0.854	0.458
LP1: Our employees are skilled at collaborating with each other to diagnose and solve problems	0.583	–			
LP2: We dedicate a portion of everyday to planned equipment maintenance related activities	0.640	7.820			
LP3: Extensive use of statistical techniques to reduce process variance	0.757	8.740			
LP4: We have low set up times of equipment in our plant	0.690	8.236			
LP5: We use a "pull" production system	0.583	7.313			
LP6: Our customers give us feedback on quality and delivery performance	0.726	8.514			
LP7: Equipment is grouped to produce a continuous flow of families of products	0.736	8.584			
3. Financial performance			0.952	0.953	0.771
FP1: Growth in return on sales	0.826	–			
FP2: Growth in profit	0.885	17.548			
FP3: Growth in market share	0.802	14.979			
FP4: Return on investment (ROI)	0.942	19.558			
FP5: Growth in ROI	0.935	19.281			
FP6: Return on assets	0.871	17.060			
4. Environmental performance			0.940	0.942	0.765
EP1: Reduction of total pollutant load of the waste water	0.872	–			
EP2: Reduction of solid wastes	0.910	20.607			
EP3: Reduction in the amount of hazardous substances in the solid waste stream	0.932	21.715			
EP4: Decrease of consumption for hazardous/harmful/toxic materials	0.897	20.001			
EP5: Improve a company's green image	0.751	14.419			
5. Social performance			0.834	0.866	0.689
SP1: Decrease in the amount of stress in the workplace	0.630	–			
SP2: Decrease in the amount of health and safety incidents	0.939	11.146			
SP3: Decrease in the number of standard injury and lost days	0.888	10.992			
Model fit statistics: χ^2 = 637.802; df = 289; χ^2 / df = 2.207; RMSEA = 0.071; CFI = 0.925; IFI = 0.926; TLI = 0.916					

Table 3: Descriptive statistics

	Mean	S.D.	1	2	3	4	5
1. Innovativeness	5.143	0.904	0.730[a]				
2. Lean practices	5.316	0.895	0.533**	0.677			
3. Financial performance	4.619	1.206	0.205**	0.440**	0.878		
4. Environmental performance	5.489	1.073	0.474**	0.515**	0.298**	0.875	
5. Social performance	5.303	1.076	0.347**	0.526**	0.384**	0.607**	0.830

Notes: [a] **Square root of AVE is on the diagonal.**
** **Correlation is significant at the 0.01 level (2-tailed).**

Table 4: Results of mediation test using SEM

	1. Direct Model *β* (*t*-value)	2. Full Mediation Model *β* (*t*-value)	3. Partial Mediation Model *β* (*t*-value)
Structural paths			
Innovativeness → Lean practices		0.651 (6.971) ***	0.637 (6.808) ***
Innovativeness → Financial performance	0.280 (3.886) ***		-0.117 (-1.282)
Innovativeness → Environmental performance	0.563 (7.583) ***		0.241 (2.886) **
Innovativeness → Social performance	0.402 (5.044) ***		0.010 (0.110)
Lean practices → Financial performance		0.482 (6.080) ***	0.566 (5.315) ***
Lean practices → Environmental performance		0.624 (7.456) ***	0.452 (4.915) ***
Lean practices → Social performance		0.591 (6.270) ***	0.576 (5.143) ***
Control variables			
Firm size → Financial performance	-0.039 (-0.603)	-0.059 (-0.986)	-0.053 (-0.898)
Firm size → Environmental performance	-0.032 (-0.547)	-0.034 (-0.625)	-0.044 (-0.821)
Firm size → Social performance	-0.073 (-1.173)	-0.089 (-1.545)	-0.088 (-1.521)
Model fit statistics			
χ^2	433.973	717.585	707.190
df	164	317	314
χ^2/df	2.646	2.264	2.252
RMSEA	0.083	0.073	0.072
CFI	0.929	0.914	0.916
IFI	0.930	0.915	0.917
TLI	0.918	0.905	0.906
AIC	525.973	839.585	835.190
R^2			
R^2 Lean practices		0.424	0.406
R^2 Environmental performance	0.314	0.387	0.398
R^2 Financial performance	0.077	0.231	0.250
R^2 Social performance	0.160	0.349	0.339

Notes: *** $p < 0.001$; ** $p < 0.01$.

Table 5: Bootstrapping results of mediation test using PROCESS

Hypotheses	Direct effects	Indirect effects					
	Direct effects β (p-values)	Unstandardized indirect effect	SE	95% CI	CSIE	R^2_{med}	Results
Innovativeness → LPs → Financial performance	-0.054 (0.556)	0.328	0.065	0.209–0.463	0.246	0.041	Full mediation
Innovativeness → LPs → Environmental performance	0.330 (0.000)	0.232	0.060	0.124–0.357	0.195	0.169	Partial mediation
Innovativeness → LPs → Social performance	0.111 (0.151)	0.302	0.058	0.198–0.426	0.254	0.114	Full mediation

Notes: 10,000 bootstrap samples; SE = bootstrap standard error; CI = bootstrap confidence interval; CSIE = completely standardized indirect effect; R^2_{med} = R-squared mediation effect size.

Table 6: Results of moderated regression analysis of fit-as-moderation model

	Dependent variables								
	Financial performance			Environmental performance			Social performance		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Control variable									
Firm size	0.002	-0.049	-0.051	0.048	-0.021	-0.019	-0.046	-0.111	-0.109
	(0.023[a])	(-0.836)	(-0.859)	(0.738)	(-0.386)	(-0.352)	(-0.707)	(-2.023)*	(-1.978)*
Independent variables									
Innovativeness		-0.038	-0.038		0.279	0.279		0.098	0.098
		(-0.559)	(-0.557)		(4.418)***	(4.409)***		(1.522)	(1.518)
LPs (moderator)		0.466	0.466		0.369	0.369		0.487	0.486
		(6.752)***	(6.742)***		(5.814)***	(5.802)***		(7.525)***	(7.510)***
Interaction effect									
Innovativeness × LPs			-0.021			0.022			0.026
			(-0.363)			(0.415)			(0.466)
R^2	0.000	0.197	0.197	0.002	0.322	0.322	0.002	0.295	0.296
Adjust R^2	-0.004	0.187	0.184	-0.002	0.313	0.311	-0.002	0.286	0.284
F-value	0.001	19.372***	14.508***	0.545	37.434***	28.021***	0.500	33.057***	24.765***

*** $p < 0.001$; * $p < 0.05$.

Note: [a] t-values. All variance inflation factors (VIF) are below 3 (not shown). Dependent variables are financial, environmental and social performance.

Table 7: Results of mediation test using SEM (2nd order factor for TBL)

	1. Direct Model *β* (*t*-value)	2. Full Mediation Model *β* (*t*-value)	3. Partial Mediation Model *β* (*t*-value)
Structural paths			
Innovativeness → Lean practices		0.648 (6.853) ***	0.631 (6.655) ***
Innovativeness → TBL	0.588 (4.322) ***		0.187 (1.975) *
Lean practices → TBL		0.772 (5.316) ***	0.635 (4.468) ***
Control variables			
Firm size → TBL	-0.050 (-0.753)	-0.077 (-1.261)	-0.082 (-1.348)
Model fit statistics			
χ^2	363.329	691.051	687.222
df	165	318	317
χ^2/df	2.202	2.173	2.168
RMSEA	0.071	0.070	0.070
CFI	0.948	0.920	0.921
IFI	0.948	0.921	0.922
TLI	0.940	0.912	0.912
AIC	453.329	811.051	809.222
R^2			
R^2 Lean practices		0.420	0.398
R^2 TBL	0.341	0.592	0.583
R^2 Environmental performance	0.742	0.587	0.615
R^2 Financial performance	0.146	0.227	0.215
R^2 Social performance	0.502	0.579	0.563

Notes: *** $p < 0.001$; * $p < 0.05$.

Figure 1: Fit-as-mediation model

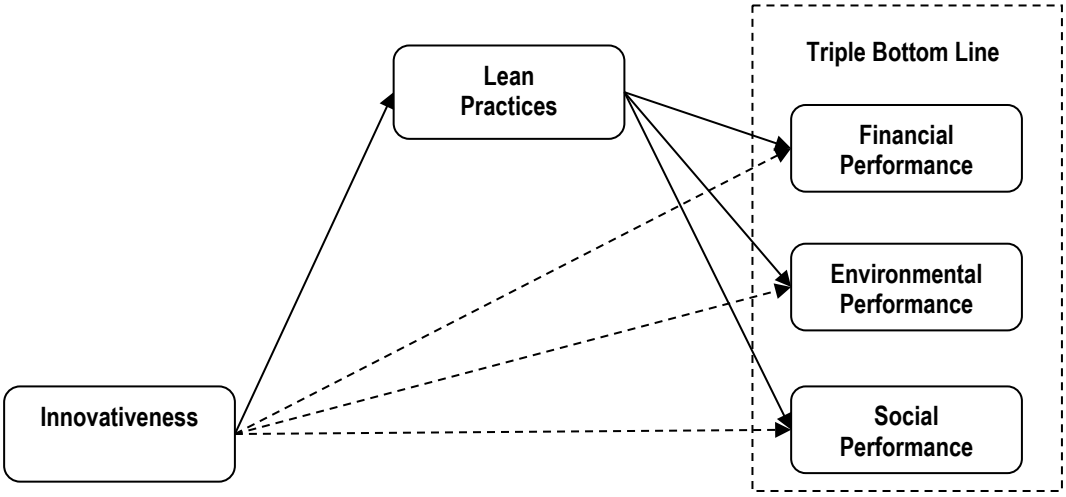

Figure 2: Fit-as-moderation model