Doctoral Dissertation

The Adoption of Sustainability Practices in Manufacturing: Barriers, Drivers, Enablers, and Impact

Author:
Zahra Ahmadi Ghobadbezani

Supervisor:
Alejandro Bello Pintado, Ph.D.

Ph. D. Program in Economics, Management and Organization (DEMO)

Facultad de Ciencias Económicas y Empresariales
Departamento de Gestión de Empresas
Universidad Pública de Navarra (UPNA)

Nov. 2023

https://doi.org/10.48035/Tesis/2454/47175

Acknowledgement

First and foremost, I would like to express my heartfelt appreciation to my PhD supervisor, Dr. Alejandro Bello Pintado. I am truly fortunate to have had you as my supervisor. Your supervisory talent as well as continual encouragement, guidance, generosity of sharing knowledge and sound advices have helped me to nurture this research work. I am deeply indebted to you for everything you taught me and all the stimulating support you gave to me throughout my doctoral journey.

I would also like to extend my thanks to my committee members and external reviewers. Your collective knowledge, insightful feedback, and constructive criticism have significantly contributed to the successful completion of this dissertation. Thank you all.

The Public University of Navarra and the Department of Business Management also receive my deep gratitude. Especially, this project would not have taken place without the scholarship support of the UPNA. I give my thanks to all involved.

I am also thankful to DEMO faculty members, organizing staff and fellows at UPNA, UAB and UIB for their untiring effort, support and academic advice that encourage the PhD students including me to pursue professional growth in their academic research.

As I have reached to this stage in my life and reflect on all the moments I have passed, I am overwhelmed with a deep sense of gratitude and love to my parents. You are always my unwavering support system, always there to guide me, uplift me, and cheer me on. Your belief in me and your unconditional love have given me the strength to pursue my dreams and overcome any obstacles that came my way.

I would like to thank my sisters, and my nieces. This endeavor would not have been possible without the tremendous love, support, and hope you had given to me.

I'd like to mention Reyhaneh, for your true friendship, sisterly love, and constant encouragement.

In the end, I would like to extend my thanks to my friends and colleagues who have accompanied me on the long journey of friendship. We have shared laughter and tears and created unforgettable memories together. And lastly, to Bita for your hearty friendship, sincere guidance, and generous support from the very first day we met. Thank you.

ABSTRACT

This thesis deals with the adoption of sustainability practices in manufacturing. The primary objective is to shed light on the current literature by presenting compelling evidence that not only underscores the benefits of embracing sustainability and the value of pursuing sustainable practices but also illuminates the underlying reasons for the observed heterogeneity in the adoption of such sustainability measures. To achieve this goal, the thesis is structured across four distinct studies, with each study aimed at addressing specific inquiries pertinent to the subject under investigation. The first study is dedicated to examining the competitiveness of firms. This involves a detailed investigation into the potential range of sustainability outcomes that may arise from the adoption and implementation of diverse bundles of sustainability practices. Furthermore, the study provides insight on how these outcomes can play a pivotal role in enhancing the competitive advantage of manufacturing firms. The second study explores the national culture framework to explain the heterogeneous response of manufacturing firms toward the adoption of sustainability practices in different context. This analysis intricately examines the interplay between three national culture dimensions with different internal/external sustainability drivers in influencing the adoption of different environmental sustainability practices. Shifting the focus to the third study, an investigative endeavor seeks to establish the necessary conditions enabling manufacturing focal firms to effectively address sustainability challenges that extend beyond their organizational boundaries while considering the moderating influence of supply chain leadership. The aim of this study is to analyze how focal firm influence sustainability performance of suppliers from the perspective of institutional theory. Finally, the fourth study delves into the connection between sustainability practices and the operational achievement of manufacturing firms. This involves an assessment of how the adoption of diverse sets of sustainability practices by manufacturing firms contributes to the advancement of success in new product development, encompassing both operational and market success.

RESUMEN

Esta tesis aborda la adopción de prácticas de sostenibilidad en la manufactura. El objetivo principal es arrojar luz sobre la literatura actual presentando evidencia convincente que no solo resalta los beneficios de abrazar la sostenibilidad y el valor de seguir prácticas sustentables, sino que también ilumina las razones subyacentes de la heterogeneidad observada en la adopción de dichas medidas de sostenibilidad. Para lograr este propósito, la tesis se estructura en cuatro capítulos distintos, siendo que cada capítulo tiene como objetivo abordar preguntas específicas pertinentes al tema en investigación. El primer capítulo se dedica a examinar la competitividad de las empresas. Esto implica una investigación detallada en el rango potencial de resultados de sostenibilidad que pueden surgir de la adopción e implementación de diversos conjuntos de prácticas de sostenibilidad. Además, el capítulo proporciona información sobre cómo estos resultados pueden desempeñar un papel fundamental en el mejoramiento de la ventaja competitiva de las empresas manufactureras. El segundo capítulo explora el marco de la cultura nacional para explicar la respuesta heterogénea de las empresas manufactureras hacia la adopción de prácticas de sostenibilidad en diferentes contextos. Este análisis examina minuciosamente la interacción entre tres dimensiones de la cultura nacional con diferentes impulsores de sostenibilidad internos/externos en la influencia sobre la adopción de diferentes prácticas de sostenibilidad ambiental. Centrándose en el tercer capítulo, un esfuerzo investigativo busca establecer las condiciones necesarias que permiten a las empresas manufactureras abordar de manera efectiva los desafíos de sostenibilidad que se extienden más allá de sus fronteras organizativas, considerando la influencia moderadora del liderazgo en la cadena de suministro. El objetivo de este estudio es analizar cómo la influencia de la empresa focal en la sostenibilidad afecta el desempeño de los proveedores desde la perspectiva de la teoría institucional. Finalmente, el cuarto capítulo explora la conexión entre las prácticas de sostenibilidad y el logro operativo de las empresas manufactureras. Esto implica una evaluación de cómo la adopción de diversos conjuntos de prácticas de sostenibilidad por parte de las empresas manufactureras contribuye al avance del éxito en el desarrollo de nuevos productos, abarcando tanto el éxito operativo como el éxito en el mercado.

List of Original Articles:

1. **Why is manufacturing not more sustainable? The effects of different sustainability practices on sustainability outcomes and competitive advantage.**
   Authors: Zahra Ahmadi-Gh, Alejandro Bello-Pintado
   Research Paper

   - Status: Published in the Journal of Cleaner Production (2022)

2. **The adoption of environmental sustainability practices: Institutional drivers and national culture.**
   Authors: Zahra Ahmadi-Gh, Alejandro Bello-Pintado, Thomas Bortolotti, Stefania Boscari
   Research Paper

   - Presented in the 30th European Operations Management Association (EurOMA) International conference, Leuven (Belgium), 1-6 July 2023.
   - Status: Under the second review– Journal of European Business Review

3. **Sustainability isomorphism in buyer–supplier relationships: The impact of supply chain leadership.**
   Authors: Zahra Ahmadi-Gh, Alejandro Bello-Pintado
   Research Paper

   - Presented in the 29th European Operations Management Association (EurOMA) International Conference, Berlin (Germany), 1-6 July 2022.
   - Presented and awarded as finalist for the best paper award in the Operation and Technology Management Section in the XXXI international ACEDE conference, Barcelona on 19-21 June 2022.
   - Status: Under the second review – Journal of Business Strategy and the Environment

4. **The Effect of Sustainability on New Product Development in Manufacturing—Internal and External Practices.**
   Authors: Zahra Ahmadi-Gh, Alejandro Bello-Pintado
   Research Paper

   - Presented in the 28th IPDMC: Innovation and Product Development Management Conference, held in Online, Milan (Italy), June 6-8, 2021.
   - Presented in the 6th World Conference on Production and Operations Management – P&OM (2020), held in Online, Osaka (Japan), 23-25 August 2022.
   - Presented and warded as the best paper in the PhD Workshop in Business and Management at Universitat Internacional de Catalunya, Barcelona on 15-16 June 2021. The award included the publication of the article by the sponsor journal of workshop (the Journal of Administrative Science).
   - Status: Published in the Journal of Administrative Science (2021).

Contents

PART I: INTRODUCTION

1. Sustainability in Operation Management

Subsequent to the Paris Agreement and the launching of 2030 agenda for sustainable development goals (known as SDGs) by UN in year 2015, the mitigation of green-house gas emission from industrial production and supply chain activity has become a growing concern on the global scale (Singh et al., 2022). According to the latest statistics, industrial activities consumes 25% of global energy demand and 40% of global material demand and produces 20% of global CO2 emissions (Jayawardane et al., 2023). Hence, industrial sustainability is in the core of attention of practitioners, policymakers, and operations management scholars (Cagno et al., 2019). In light of these imperatives, a pressing appeal resonates across the spheres of government, corporate entities, and society at large, necessitating expeditious measures and substantial investments to propel the attainment. In this regard, EU, with the adoption of the European Green Deal Industrial Plan, desires to "create a more supportive environment for scaling up the EU's manufacturing capacity for the net-zero technologies and products".

This strategic endeavour aligns with the overarching ambition of fulfilling Europe's formidable climate objectives (e.g., The Green Deal Industrial Plan). This resonant development underscores the pivotal role that academia assumes in the realm of advancing sustainable practices. Beyond its traditional educational role, academia emerges as a beacon of influence, diligently disseminating invaluable knowledge and propounding innovative solutions that are poised to address the multifaceted challenges currently confronted. In doing so, academia forges an indispensable alliance with the broader societal and industrial landscapes, thereby contributing substantively to the holistic realization of sustainable aspirations.

Under the prevailing circumstances, the impetus to undertake research into sustainability within manufacturing context pushed this Doctoral Theiss in 2019, driven by the escalating recognition of its burgeoning significance within academic circles. Since that juncture, the prominence of this subject matter has experienced exponential growth, currently establishing itself as one of paramount relevance across the broader landscape of management, particularly within the realm of operations management. Scholars have substantially enriched the knowledge into production and operations management and its

linkage to environmental sustainability from different lenses, encompassing paradigms such as green/sustainable manufacturing, green/sustainable supply chain management, eco(environmental)-design and innovation, high-tech technologies among others. Within this context, some scholars have examined existing research to discover the main sub-topics and research questions involved and to identify the areas of current research interests and potential directions for future research (e.g., Pang & Zhang, 2019; Sarkis & Zhu, 2018). Their literature review showed that despite the increasing relevance and interest in sustainability, developing models to guide decisions towards achieving the sustainability goals is still the main challenge of academia (Giannakis et al., 2020). Moreover, the extant literature offers contradictory results on the motivation behind sustainability adoption (Jun Dai et al., 2021) as well as its consequences (Jinfeng Wang et al., 2023). Thus, a need exists to advance the research on the factors that drive sustainability and its impact on performance (Magon et al., 2018; Vidal et al., 2022).

In the context of manufacturing companies, there raises a requirement for them to develop their organizational capabilities to minimize the negative impact of their production process on the environment and society, all while ensuring the generation of returns and values (Hermundsdottir & Aspelund, 2022). Nevertheless, many firms encounter difficulties in fully realizing the inherent advantages of sustainability adoption, leading an ongoing debate concerning whether to embrace sustainability practices or not (Cousins et al., 2019).

In addition, focal manufacturing firms increasingly are also holding responsible for the performance of the supply chain actors, particularly suppliers (M. Jia et al., 2021) whose misconducts may have adverse effect on the focal firm' performance as well as their market values (Kim et al., 2019). In this sense, the research in the field posits that the integration of sustainability goals into supply chain management (known as SSCM) may help to manage sustainability concerns with suppliers (Seuring & Müller, 2008). Within this perspective, different managerial/organizational sustainability practices are proposed to the focal firms to develop suppliers´ sustainability capability (Dubey et al., 2019). Even more, the literature suggests the convenience of distinguishing between monitoring and collaborative approaches for managing sustainability with external supply chain actors (Danese et al., 2019; Gimenez & Tachizawa, 2012). However, a persistent question continues to cast a shadow of uncertainty: how can focal firms adeptly navigate sustainability challenges that extend beyond the borders of their own organizational domains? This issue becomes even more intricate when considering the imperative of extending sustainability mandates to encompass

their networks of suppliers (Allenbacher & Berg, 2023). Moreover, those practices are expected to enhance sustainability performance of both suppliers and focal firms, but their consequences are not clear yet, with mixed results on suppliers sides (Bai & Satir, 2022).

In this regard, the adoption of sustainability by a focal manufacturing firm is referred to intra- and inter- organizational practices in supply chain targeted to address environmental and social problems (Ahi & Searcy, 2013) where the sustainability behaviours of a focal firm is not only affected by several strategies and actions at firm level, but also is influenced by several factors at industry and national level (Azadegan et al., 2018). Hence, a comprehensive analysis is an essential step in the identification of the antecedents and outcomes, and it should cover different internal and external considerations at multiple levels.

2. Research Questions and Dissertation Approach

The term sustainability is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their needs" (World Commission on Environment and Development, 1987, p. 8). The broadly accepted approach, known as the Triple Bottom Line (TBL) perspective, considers sustainability as the simultaneous consideration of the environment, society, and the economy (Elkington, 1998). Within this perspective, the integration of sustainability into supply chain management, known as SSCM, is defined as "the management of material, information, and capital flows, as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development—economic, environmental, and social—into account, which are derived from customer and stakeholder requirements" (Seuring and Müller, 2008).

Based on the TBL (Triple Bottom Line) perspective, SSCM also comprises three pillars: environmental sustainability, social sustainability, and economic sustainability. However, as a holistic and multidimensional construct, SSCM is measured from different perspectives. Identifying the practices and mechanisms for implementing SSCM is challenging due to different authors emphasizing different dimensions of sustainability (Jia et al., 2018).

In our perspective, sustainability is considered in its broadest sense, encompassing economic, social, and environmental aspects. Given our focus on the managerial and organizational aspects of sustainability, we adopt the idea of distinguishing between

sustainability practices from a methodological perspective (i.e., internal practices vs. external practices) throughout this doctoral thesis. This approach has been suggested and followed by other scholars, including Vachon and Klassen (2006), Tachizawa and Gimenez (2012), and Tachizawa et al. (2015).

Similarly, regarding driving forces of sustainability, we maintain a general view of sustainability drivers rather than specific drivers for each pillar of sustainability. These drivers are considered relevant to sustainability with its three pillars.

Considering the dynamic essence of sustainability, comprehending the drivers behind the adoption of sustainability practices, and assessing the potential impact of these adoption behaviours for achieving sustainable outcomes becomes a matter of paramount significance. Thus, the overarching goal of this dissertation is to dissect the intricate interplay of different influential factors on the adoption of sustainability practices in manufacturing. Furthermore, this study seeks to analyze the effect of adopting these practices on sustainability outcomes, and firm performance at a cross-cultural/cross-national level. In line with this holistic perspective, this approach considers not only focal firms but also the supplier's side by evaluating the impact of those practices on the sustainability performance of suppliers.

Despite the growing body of literature in operations management that has made an effort to provide insight into different aspects of the sustainability adoption process and sustainability performance, there are some unresolved issues that merit further investigation (Allenbacher & Berg, 2023). In its entirety, this thesis undertakes the task of casting illumination upon these persisting debates, seeking to discern their nuances and complexities. The primary purpose herein is to address and engender a resolution to the following critical research questions:

RQ1: How and to what extent do different sets of sustainability practices improve sustainability outcomes?

RQ2: How does the implementation of sustainability practices advance the attainment of competitive advantage?

RQ3: How do the driving forces of sustainability operate in the adoption of sustainability practices at a cross-cultural level?

RQ4: How does national culture moderate the relationship between sustainability drivers and the adoption of sustainability practices?

RQ5: How can manufacturing firms enhance the sustainability performance of their suppliers?

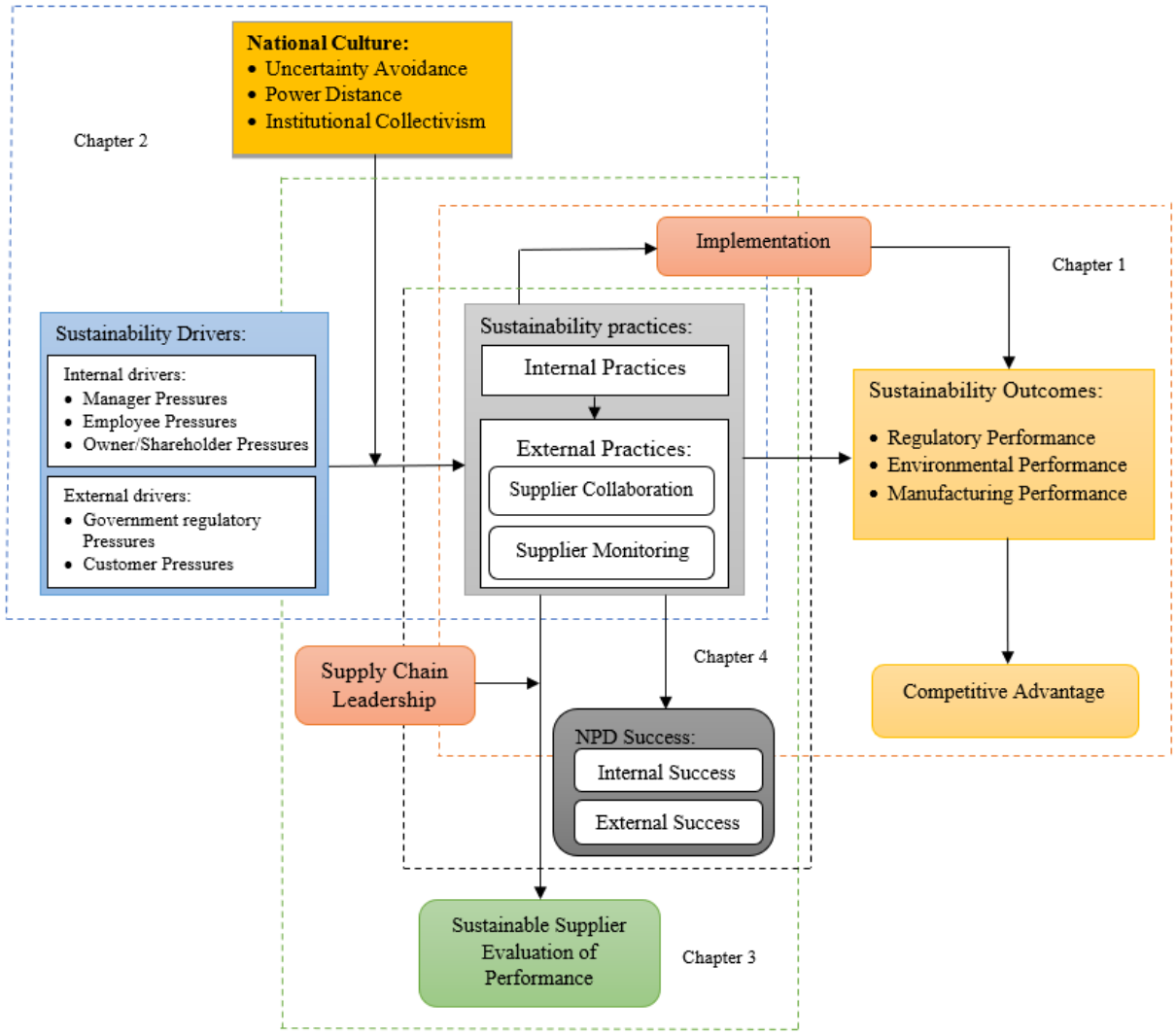
RQ6: What role does supply chain leadership (SCL hereinafter) play in moderating the relationship between a manufacturing firm´s sustainability practices and the sustainability performance of suppliers?

RQ7: Do different bundles of sustainability practices contribute to corporate success in terms of new product development (NPD hereinafter) success?

In order to tackle these issues and make valuable contribution to the realm of knowledge within these domains, a multifaceted approach underpins this endeavor, employing diverse theoretical frameworks to fortify propositions, assertions, arguments and hypotheses. Specifically, this thesis delves into the examination and integration of several prominent theories, including the theory of resource-based view (Barney, 1991) and its extension to the natural resource-based view (Hart, 1995), the theory of social capital (Granovetter, 1992), the theory of social exchange (Emerson, 1976), the transaction cost theory (Williamson, 1981), and the institutional theory (DiMaggio and Powell, 1983). Moreover, the incorporation of the most relevant empirical evidence has not only facilitated the elaboration of cogent arguments but also serves as a guiding principle in advancing the field of study.

On this promise, these research questions are organized around four different studies (Study 1 to Study 4). For clarifying the dissertation approach, Figure 1.1 presents the linkage of these four empirical studies with the adoption-performance association. While the second study accounts for how sustainability practices emerge and addresses the questions RQ3 and RQ4, the other three studies account for if it is worth to be green/sustainable and address the rest of questions (RQ1, RQ2, RQ5, RQ6 and RQ7). In this way, we consider that this dissertation allows us to analyze sustainability adoption-sustainability performance association comprehensively.

Figure 1.1: Structural model of dissertation approach



2.1. First study: Why is manufacturing not more sustainable? The effects of different sustainability practices on sustainability outcomes and competitive advantage

Despite increasing awareness on sustainability issues and its consequences, yet companies debate how to be sustainable. Specifically, evidence regarding the link between the adoption of different sustainability initiatives and the performance/competitiveness of firms is far from conclusive (Nguyen & Adomako, 2021). In the background, companies look for competitiveness and managerial attention generally is on short term impacts while sustainability requires to shift the attention to long-term impacts (Carter et al., 2020). They

are motivated to adopt a proactive sustainability strategy only if it helps to enhance their competitive positioning (Paulraj et al., 2017).

While some studies confirm that the adoption of environmental strategies has a positive impact on sustainability outcomes (Jing Dai et al., 2017), many others were unable to fully support this association (S. Zhang et al., 2019). Evidence connecting the adoption of sustainability initiatives to competitive advantage also provides controversial results (Chacón Vargas et al., 2018; Das, 2018; Mishra & Yadav, 2021). These controversies make it difficult to answer the question of whether sustainability is beneficial or not for companies in terms of value creation (Cornejo-Cañamares et al., 2021) and left the debate open whether it is worth to be sustainable (Micheli et al., 2020).

These gaps in the literature enable us to derive the first two research questions (RQ1 and RQ2) with the aim that this study could contribute to the literature by determining the most effective sustainability practices in terms of sustainability outcomes and competitiveness of manufacturing firms. Furthermore, by taking sustainability-focused measures of sustainability outcomes (i.e., regulatory, environmental, and manufacturing performance), distinguishing between different sustainability practices (i.e., internal, external monitoring and external collaboration with suppliers) and considering the role of implementation, the second objective of this study is to portrait a comprehensive picture of this phenomena.

Following the model proposed by Cantele and Zardini (2018), in this study we consider a broad perspective on exploring the impact of sustainability practices on competitive advantage by defining two intermediate goals. First, we analyse how different sustainability practices can lead to improvement in sustainability outcomes (as a first level intermediate goal) and then examine how those improved sustainability outcomes can result in enhancement of competitive advantage through the implementation of sustainability initiatives (which are a second level intermediate goal).

Building upon theoretical frameworks of transaction cost theory, natural resource-based view theory as well as social exchange theory, we evaluate the impact of different sustainability practices undertaken by manufacturing focal firms to manage sustainability issues inside of their companies as well as along with their suppliers on the sustainability outcomes and competitive advantage of the firm. We theorize and hypothesize that sustainability outcomes can be obtained, and competitiveness can be enhanced in virtue of the

implementation of sustainability practices. However, the effect of different sustainability practices on different sustainability outcomes differs depending on the type of the practices. Additionally, different sustainability outcome does not equally contribute to the competitive advantage, the impact is greater for manufacturing performance than environmental and regulatory performances.

2.2. Second study: The adoption of environmental sustainability practices: Institutional drivers and national culture

While the first study underscores the benefits of sustainability adoption for manufacturing firms, the second study intends to augment our understanding of the underlying mechanisms of sustainability practices, particularly the connection between sustainability drivers and the adoption of sustainable practices. Previous scholarly research has attempted to provide insight into this relationship, but without providing a final conclusion. More precisely, drawing on institutional theory and the concept of isomorphism (DiMaggio and Powell, 1983), it has been theorized in the literature that different institutional pressures compel firms to exhibit similarities in terms of sustainability adoption and practices. However, a globally heterogeneous response has been observed concerning the sustainability drivers (Jun Dai et al., 2021). While most previous studies have focused on a single country for empirical analysis (Z. Wang et al., 2018), limited attention has been given to the role of these driving forces in the adoption of specific (internal and external) sustainability practices (Dubey et al., 2019).

In this vein, the influential role of firms´ contextual attribute such as national culture in the adoption of sustainability has received a wider scholarly attention (Horak et al., 2018; Tate et al., 2011). Despite their contributions, it has not yet been established a consistent framework on how national culture can be related to the sustainability adoption. Taking national culture as an antecedent of sustainability adoption/performance report mixed results (Miska et al., 2018; F. (Sophie) Song et al., 2018). It rises the attention on the moderating role of national culture (Chwialkowska et al., 2020; Tata & Prasad, 2015). So far, very few studies consider the moderating role of national culture to explain the heterogeneity in adoption of sustainability practices.

Identifying these gaps in the literature induces us to propose two research questions (RQ3 and RQ4). By considering different sustainability drivers and distinguishing between

different sustainability practices, this study aims to explore the factors that lead to the emergence of sustainability practices within manufacturing firms. By incorporating the moderating effect of national culture to this association, we expect that our study contributes to tackling the challenges of linking sustainability drivers-sustainability adoption at cross-national/cross-cultural level.

Given the interrelation among national culture and institutional environment (Horak et al., 2018), we argue that the observed heterogeneity in the adoption of sustainability across the world might be explained through norming and conforming effects of national culture to institutional environment of the firms (Caprar & Neville, 2012; Miska et al., 2018). Building upon this argument, we theorize that the interaction between national culture and sustainability drivers can moderate the relationship between institutional pressures and sustainability behaviour (adoption practices). We also claim that the interaction effect of national culture and sustainability drivers varies depending on the type of sustainability practices, the type of drivers as well as the type of cultural dimension.

Through this approach, three sets of hypotheses are proposed regarding that both external drivers and internal drivers positively affect the adoption of both internal and external environmental sustainability practices. In addition, each dimensional culture has its own influential impact because of different characteristics and prevailing. While cultural dimensions of uncertainty avoidance (UVI) and power distance (PDI), because of their controlling natures, positively moderate the relationship between sustainability drivers with the adoption of environmental sustainability practices, institutional collectivism (ISC) negatively moderates those relationships.

2.3. Third study: Sustainability isomorphism in buyer–supplier relationships: The impact of supply chain leadership

Continuing with the first study that addresses the effectiveness of sustainability practices for manufacturing firms, in this study the focus is on supplier´s side, aiming to discover how the adoption of sustainability by manufacturing focal firms is beneficial for suppliers in terms of supplier sustainability performance. In doing so, this article deals with the complexities and challenges of managing sustainability issues beyond a firm´s level, specifically in the buyer-supplier relationship.

The prior research have struggled to arrive at a conclusion regarding how the sustainability practices of focal (buying) firms can be translated to supplier´s development of capabilities to adopt sustainability initiatives and improvement of their sustainability performance (Allenbacher & Berg, 2023; Sancha et al., 2019). Insofar as a gap exists in the literature, less attention has been paid on the factors affecting the supplier's capabilities to acquire tools/practices that make their sustainability performance to be improved (Liu et al., 2019). Some scholars guided by concepts from leadership theory, have explored the conditions of SCL to be taken up by focal firms that promote superior capabilities in suppliers (Gosling et al., 2016; F. Jia et al., 2019). However, very few studies empirically examined how SCL would interplay with manufacturing firms´ proactiveness in terms of supplier sustainability performance (Mokhtar et al., 2019b).

These gaps suggest two research questions (RQ5 and RQ6) for this study. Hence, the aim is to empirically probe those less understood relationships in the literature. As a result, this study contributes to the current understanding of the complex process of suppliers´ sustainability performance through buying firm´s adoption of sustainability practices and the moderating role of SCL. Additionally, the insights gained from these questions will enable us to evaluate the extent to which the sustainability vision of buying firms enhances supplier sustainability performance.

Drawing on institutional theory and supply chain leadership theory, we theorize and argue that supplier's sustainability performance is enhanced if a buying firm has proactiveness in terms of the adoption and implementation of sustainability practices. In other words, besides power, the buying firm´s sustainability vision exerts pressures on suppliers motivating them to be sustainable. Moreover, undertaking the role of leadership in supply chain promotes the diffusion of sustainability values across supply chain facilitating the development of sustainability competency in suppliers, which in turn, improve their sustainability performance. Within these perspectives, we develop hypotheses that the buying firm´s adoption of different sustainability practices (internal, external monitoring and external collaboration) is positively associated with sustainability performance of suppliers. In addition, SCL moderates the relationship between buying firms´ sustainability practices and suppliers´ sustainability performance.

2.4. Fourth study: The effect of sustainability on new product development in manufacturing- Internal and external practices

Finally, the fourth study serves as a complement to the first study, expanding the efficacy of sustainability practices to NPD. It seeks to elaborate how manufacturing firms can strengthen the success of their new product by operationalizing sustainability practices.

Other streams of research have relied on the notion of resource-based view theory (Barney, 1991) and its extension, natural resource-based view theory (Hart, 1995), to explain the outcome of environmental strategies. According to those frameworks, "green/sustainable NPD", referring to the integration of environmental (sustainability) concerns into NPD through eco-innovation, eco-design, and other mechanisms, is assumed to create value for manufacturing firms and their stakeholders (Katsikeas et al., 2016; Mitra & Datta, 2014). Manufacturing firms are therefore encouraged to develop and implement sustainable-oriented innovation strategies. However, as practitioners and policymakers, they don't consider sustainability in their NPD unless there is clear evidence that through the implementation of sustainability practices during new product development, companies can achieve returns and values (Zheng & Iatridis, 2022). But, it is still far from establishing well-examples of commercial tools for industrial application of such strategies (Ahmad et al., 2018; Zheng & Iatridis, 2022). In addition, there is a lack of academic investigations on how manufacturing firms can effectively leverage sustainability in NPD (M. Zhang et al., 2021). It confirms that operationalizing sustainability practices and its impact on NPD is still one of the least understood areas in sustainability management (Cheng, 2020; Claudy et al., 2016), with very limited empirical evidences (Adams et al., 2016; Neutzling et al., 2018; W. Song et al., 2019).

These underexamined relationships in the literature brings us to propose the final research question (RQ7). The main aim of this study is to uncover the benefits associated with the adoption of sustainability practices. In particular, the focus is on how the engagement in sustainability leads to the success for manufacturing firms. Since the success of firms is realized and measured by developing a new product, then this study intends to address the questions of how and to what extent the adoption of sustainability practices may enhance the success of NPD. Through this approach, this study contributes to the current understanding of the benefit of operationalization of sustainability in manufacturing. The answers to these questions will enable us to assess the extent to which sustainability practices reinforce the success of manufacturing firms in term of NPD.

By drawing on transaction cost theory, natural resource-based view theory, and social capital theory, we posit and formulate hypotheses that manufacturing firms through the internalization and externalization of sustainability practices (via approaches such as supplier monitoring and supplier collaboration) can positively enhance the operational and market success of NPD.

3. Empirical Analysis

3.1. Database

The research questions proposed in this thesis have been approached both theoretically and empirically. In order to empirically test the proposed hypotheses, we have used the data from the fourth round of High-Performance Manufacturing (HPM) project database.

The HPM is as an international meta-framework database. More specifically, the HPM project is a large-scale, multi-country, and multi-industry project which collected the data through a survey-response method from manufacturing plants with at least 100 employees involved in industries includes mechanics, electronics and transportation equipment (S. Zhang et al., 2019). The three industries integrating the database have been chosen because they are in continuous transition and face intense global competition (Morita et al., 2018). They include a large number of plants around the world and face different competitive environments and competitive conditions (Acevedo Amaya et al., 2020; Schroeder & Flynn, 2001). The information collected by the HPM project is cross-sectional by nature providing comparable and consistent cross-country/cross-industry information on different operation management areas.

The first round collected date from the year it started in 1989, involving two countries (USA and Japan). New countries were added every round until current (4th round). The primary mission of the project was to investigate the manufacturing plants' operations and their associated performance. The former organizers of the HPM project believed that "although each plant should set out its own path to global high performance manufacturing depending to its contingencies or firm´s context (i.e., industry, country, size, strategy and situation), but linking practices together is necessary to global high performance manufacturing" (Schroeder & Flynn, 2001). While the idea of integration is critical and challenging, the HPM project aimed "to set a new standard for the way manufacturing

practices are viewed in today´s world" (Schroeder & Flynn, 2001). Accordingly, it considers variety of operation programs such as Lean Manufacturing, Technology Management, Total Quality Management, Information Systems and others, with the hypothesis that leveraging of these practices should lead to superior performance for manufacturing firms (Acevedo Amaya et al., 2020). Hence, it allows researchers to develop numerous hypotheses on performance causes and effect studies (Okoshi et al., 2019).

The fourth Round of HPM project was carried out by 25 international research teams since 2012 to 2016 which includes information about manufacturing firms from Austria, Brazil, China, Finland, Germany, Italy, Spain, Israel, Sweden, Switzerland, South Korea, Japan, Taiwan, the UK, USA, and Vietnam. The sample was selected randomly from a master list of plants in each country and was visited by HPM project members of each country to conduct a translated-back-translated survey (Danese et al., 2019).

Table 1.1: Sample distribution according to sector and country.

Country	Industry			Total
	Electronics	Mechanical	Transportation Equipment	
Austria	1	6	1	8
Brazil	5	7	12	24
China	10	17	3	30
Spain	8	7	10	25
Finland	6	6	5	17
Germany	6	13	9	28
Israel	21	5	0	26
Italy	7	17	5	29
Japan	6	7	9	22
South Korea	8	5	13	26
Sweden	4	4	1	9
Switzerland	2	0	1	3
Taiwan	19	10	1	30
UK	4	5	4	13
USA	5	7	3	15
Vietnam	10	7	8	25
Total	122	123	85	330

To ensure standard statistical representativeness of the collected data, the HPM database has been built so as to fulfill three criteria: (1) obtaining a desired number of plants for each country-industry combination by using a stratified sample in each country (2) the

availability of an adequately large-scale dataset through a series of questionnaire (3) a minimum response rate of 65% in each country. The total sample of the fourth round includes 330 individual observations. The table 1.1 presents the sample distribution according to sector and country.

The current Round provides unique information on plant-level activities though designing twelve sets of questionnaires sections. Those questionnaires dedicated to each area of operations strategy and plant management (i.e., Accounting, Downstream supply chain management, Upstream supply chain management, Environmental Affairs, Human resources management, Information system management, Plant management, Process engineering, Product development, Production control, Quality, and Supervision). Except accounting section, for the other eleven sections more than one relevant knowledgeable informants were requested to respond (Danese et al., 2019). This is the first round that includes a specific questionnaire regarding sustainability in manufacturing. The main block of the sustainability section consists of the questionnaires about environmental sustainability practices (initiatives), sustainability drivers, sustainability barriers, sustainability enablers, sustainability outcomes, sustainable competitive advantage, environmental performance and environmental practices (implementation). Having a specific section for sustainability scales along with other operation management practices convinced us to consider it appropriate for the purpose of this dissertation. Therefore, we were able to apply various measures to develop factors affecting high performance manufacturing as well as to analyze different aspects of sustainability adoption within manufacturing in our empirical models.

As observed, the HPM collects internal and external firm data, which, together, provides a broad panoramic view of the circumstances in which manufacturing firms are involved. For the purposes of this dissertation, we have drawn mainly from section related to environmental affairs- but also considered information from other sections, including supply chain management and new product development. Accordingly, we have created the following dependent variables to capture a firm's sustainability adoption and performance: (1) in the first article, internally implementation of sustainability practices, sustainability outcomes including regulatory, environmental and manufacturing performance, and competitive advantage; (2) in the second article, environmental sustainability adoption: internal sustainability practices and external sustainability practices; (3) in the third article, supplier evaluation of sustainability performance; (4) in the fourth article, NPD success: internal (operational) success and external (market) success.

Similar comments are applied to the measures related to the independent variables used in our studies. Accordingly, different sustainability practices including internal, supplier monitoring, and supplier collaboration practices have been developed as independent variables for the first, third and fourth articles. As for the second article, different sustainability drivers (both internal and external drivers) have been developed for measuring independent variables. Additionally, a measure for SCL has been created based on the data from supply chain management scale. This construct later has been used as a moderator in the third article.

It is worth saying that all the constructs used in the four studies of this dissertation are multi-items and based on 5-point Likert-type scales from 1 (No extent whatsoever) to 5 (Very great extent). Annex 1 presents the questionnaire for sustainability scale of environmental practices/initiatives. Moreover, the HPM dataset have been used by other researchers in the field of operations management (e.g., Bortolotti et al., 2015; Morita et al., 2018; Okoshi et al., 2019). Even some of the measures that developed in our studies, have been adopted and validated in a number of previous scholarly works (e.g., Bello-Pintado et al., 2023; Danese et al., 2019; Miras-Rodríguez et al., 2018; Z. Wang et al., 2018; S. Zhang et al., 2019), however, using them for other purposes.

Regarding control variables, in all four articles, three dummy variables representing the industry to which the sample plant belongs and firm´s size as logarithm of the number of employees are common. In the first, third and fourth articles, the level of development of the country in which the sample manufacturing firm is located is also controlled by creating a dummy variable (developed and developing countries). Because NPD requires high organizational capabilities, in the fourth article, more control variables have been used including the percentage of plant sales from products introduced in the last five years labelled as R&D_Intensity and the number of employees work in R&D for new product design/redesign development practices labelled as R&D_Size. All these variables have been created based on the data of HPM project.

In addition to the data from the HPM project, our second paper incorporates three dimensions of national culture, i.e., Uncertainty avoidance (UVI), Power distance (PDI) and Institutional Collectivism (ISC). These dimensions were sourced from the Global Leadership and Organizational Behavior Effectiveness (The project GLOBE) Phase 2 using the 2004 dataset as presented by House et al. in 2004. Furthermore, the second and third articles leverage data on greenhouse gas (GHG) emissions per capita and gross domestic product

(GDP) per capita for the year 2013, aligning with the time of the fourth round of HPM data collection. These variables serve as control factors allowing us to test our hypothesized relationships. The information was taken from the webpage of Wikipedia (List of countries by greenhouse gas emissions per capita - Wikipedia) as well as of the world bank (http://data.worldbank.org/data-catalog/world-development-indicators).

3.2. Statistical analysis

Regarding the methodology used in this research study, we have employed principal component analysis technique of exploratory factor analysis, as a multivariate data analysis method, to produce information on how factors are organized and could be classified (Hair et al., 2010). This technique, by creating static variables (factors) through clustering a large number of observed variables into a set of smaller statistical variables, reduces variables complexity allowing researchers to have sound interpretations about the interrelationship between variables (Okoshi et al., 2019).

In the first, third and fourth articles, we have applied partial least squares structural equation modeling (PLS-SEM) for testing our hypothesis models. According to Hair Jr. et al., (2016), PLS is an appropriate tool for complex structural models with cause–effect characteristics having an advantage over CB-SEM as it tests the strength relationship of each component rather than testing the overall fit by observed covariance among all variables. It allows to report not only direct effects, also indirect effects in complex models including mediation-moderation relationships. Similarly, PLS is recommended to be applied for studies with exploratory characteristics, small size of sample, high correlations among predictor variables, non-normally distributed data as well as given conditional process models including mediation and moderation relationships (D. X. Peng & Lai, 2012; Sarstedt et al., 2020). Specifically, the complexity of the structural models analyzed in the first article due to the inclusion of both intermediate goals (outcomes and implementation) as well as in the fourth article due to the incorporation of both reflective and formative constructs (sustainability practices and NPD success, correspondingly), provides appropriate justification for the use of PLS method. Additionally, variance inflation factors (VIF) collinearity in PLS-SEM modelling is more sufficient to realise the problem of common method variance (Kock, 2015).

In the second article, the hypothesized relationships were tested based on multiple regression analysis through Stata software. Multiple regression analysis is widely accepted as a useful method by scholars in order to examine the causal links between one single dependent variable (i.e., each set of environmental sustainability practices) and multiple independent variables (i.e., different internal and external sustainability drivers) (Hair et al., 2010). Additionally, we have had multiple moderator variables (i.e., three dimensions of national culture) that needed to enter the model individually. To have more meaningful interpretation of the interaction effect in multiple regressions, we have complemented our analysis by plotting the marginal effect of the significant interactions following a methodology by Jaccard & Turrisi, (2003).

4. Summary of Main Empirical Findings

The seven research questions proposed in this doctoral thesis have revolved around two core themes: the benefits associated with being green/sustainable and how sustainability practices emerge. Detailed answers to these seven questions are provided in their respective studies. In what follow, a cross-comparison of the main findings of these studies are provided in order to characterize sustainability within manufacturing, encompassing its determinants and consequences.

The first study attempts to answer the questions about the advantages associated with adopting a green (sustainable) approach by providing reasons to be green/sustainable. The findings suggest that successful internal implementation of sustainability practices as well as collaboration with suppliers are effective ways to enhance sustainability outcomes and reinforce the competitive positioning. More precisely, the results reveal that each sustainability practice has its own effect on sustainability outcomes, and the effectiveness of these practices in terms of competitive advantage depends on how well they are implemented. Although some sustainability outcomes (regulatory and environmental performance) are attainable independently from supply chain actors, but to augment manufacturing performance, focal firms is required to collaborate with their key suppliers. When, sustainability concerns are integrated into collaborative projects with suppliers such as NPD, competitive advantage will be boosted. In other words, sustainability outcomes must be harmonized with manufacturing paradigms such as quality, lean production, and efficiency if competitive advantage is to be achieved.

Addressing the questions about how sustainability practices emerge and what role is played by the context (i.e., national culture), the findings of the second study show that sustainability drivers are not equally successful in driving different sustainability practices. Apart from the prominent role of customer in greening the supply chain, managers hold a central role in perceiving, comprehending and translating institutional pressures to managerial actions, infusing sustainability concerns, shaping sustainability orientation and creating sustainability culture within their boundaries and along with their suppliers. The results, furthermore, affirm the important of employees who place those strategies inside of their organizations and disseminate manager´s sustainability values across suppliers through monitoring and collaborative mechanism. In addition, this finding provides sufficient evidence to support our arguments that national culture moderates the effect of sustainability drivers on sustainability adoption differently, depending on which sustainability practices is willing to be adopted and which cultural setting is prevailing.

The findings of the third study which delved into the intricate nature of sustainability management in supplier relationships, support our earlier prediction that the application of monitoring and collaborative mechanisms by sustainability-oriented focal firms would effectively disseminate sustainability concerns to suppliers, resulting in an enhancement of the sustainability performance of their suppliers. In this regard, the results outline that taking up the role of SCL by focal firms assists suppliers in aligning their strategies with the sustainability goals of their buying (focal) firms. This alignment, thereby, reinforces suppliers´ sustainability performance by advancing their sustainability competencies.

Finally, the fourth study examines the benefit associated with sustainability in terms of NPD success. The results highlight the correlation between various sustainability practices and NPD success, however, with different impacts. Notably, involving suppliers in sustainability issues, whether through evaluating and monitoring their performance (referred to as supplier monitoring) or developing co-projects with them (referred to as supplier collaboration), enables the success of NPD. While the adoption of internal practices can indirectly be effective for NPD success, the true efficacy lies in internalizing sustainability initiatives. This facilitates companies to diffuse sustainability orientations to suppliers via inter-organizational teams for NPD, which in turn fosters the success of NPD. This finding leads us to the conclusion that a manufacturing focal firm´s sustainability orientation is indeed positively linked to NPD success.

PART II: ORIGINAL ARTICLES

Study 1: Why is manufacturing not more sustainable? The effects of different sustainability practices on sustainability outcomes and competitive advantage

Abstract

Over the last decades, there has been growing worldwide concern for the notable contribution of manufacturing activities to environmental damages. In this context, there is an open debate regarding the incentives of companies to move from mere compliance strategies towards voluntary adoption of environmental responsibility strategies, simultaneously considering economic, environmental and social objectives. This paper aims to analyse the effect of different sets of sustainability practices on sustainability outcomes and the competitive advantage of manufacturing firms. The study distinguishes between internal, external monitoring and external collaborative sustainability practices and considers their effect on regulatory, environmental and manufacturing sustainability outcomes in order to identify their contribution to the competitive advantage of firms. Drawing on natural resource-based view theory, social exchange theory and transaction cost theory, and recent evidence in the field, the study tests several hypotheses using data from the fourth round of the High-Performance Management (HPM) project. Through structural equation modelling with partial least square methodology (PLS-SEM), this study shows the existence of differential effects of sustainability practices on sustainability outcomes and competitive advantage using a sample of 263 manufacturing plants located in 15 countries from three industry sectors. The findings of this study indicate that there are many reasons to be more sustainable. The adoption and effective implementation of both internal sustainability practices and external collaborative approaches boost sustainability outcomes. Manufacturing sustainability outcomes contribute the most to competitive advantage of manufacturing companies compared with regulatory or environmental ones. For practitioners, this study highlights the challenge of well-implemented internal sustainability practices that give support for effective collaborations, both determinants to achieve operational performance and competitive advantage. For the academia, this study shows that the interplay of different theories helps to understand the differential effects of sustainability in manufacturing.

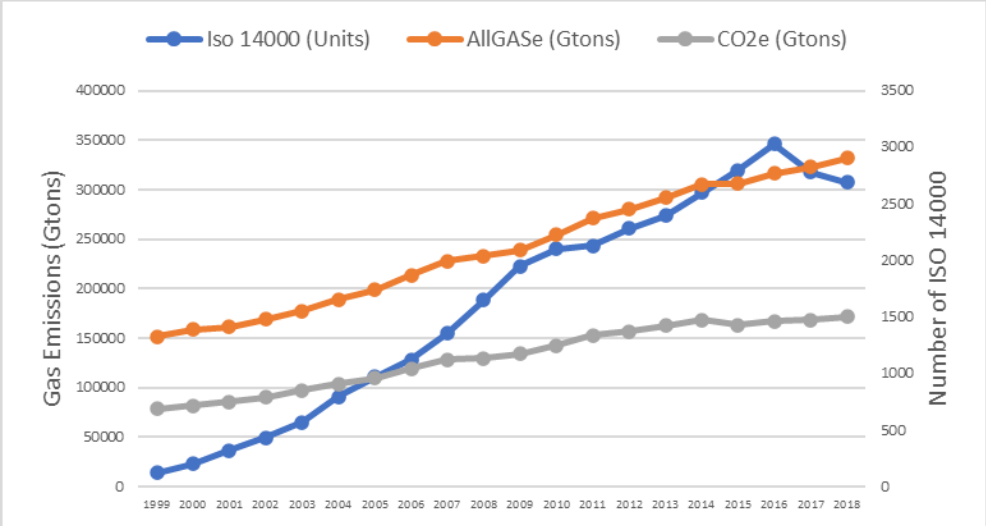
Keywords:
internal sustainability practices; external supplier monitoring; external supplier collaboration; sustainability outcomes; competitive advantage.

1. Introduction

Over the last decades, there has been growing worldwide concern for the environmental damages related to economic activities (Laari et al., 2017). As presented in Figure 1, industrial activity has contributed to a constant rise in CO_2 emissions despite the increasing

adoption of environmental policies and standards applied to production processes (Tang et al., 2020) . However, the result is still far from the target of the 2030 Agenda for Sustainable Development and the achievement of the United Nation's 17 Sustainable Development Goals (SDGs), which represent a huge challenge in manufacturing today. The paper aims to contribute to the field by addressing the questions of whether the adoption and implementation of distinctive sustainability practices have different effects on different sustainability outcomes and what they contribute to the competitive positioning of companies. By providing additional insight on this link, this study seeks to help the managers of manufacturing firms to make better decisions on investment in sustainability. In the background, adopting sustainability practices aligned with the SDGs requires significant transformations and technological changes (Gusmão Caiado et al., 2018), and companies are therefore motivated to implement those practices if they will help them to enhance their competitive positions (Paulraj et al., 2017) and satisfy stakeholders' pressures (D. Yang et al., 2019).

Figure 1: Global historical gas emissions from industrial processes and Number of ISO 14000 applications (Sources: ClaimateWatch; Iso.org)



In this context, previous studies analysing the impact of sustainability initiatives on sustainability outcomes report mixed results. For instance, Inman and Green (2018) showed a positive link between green practices (e.g. green product development, green design, green procurement, green collaboration with suppliers) and environmental sustainability outcomes (e.g. waste reduction, emission reductions). Similarly, Shah and Soomro (2021) showed that collaboration with suppliers in recycling and remanufacturing reduces pollution and

strengthens the reputation of companies. In contrast, Sancha et al. (2019) reported that green monitoring of suppliers through formal selection and evaluation or environmental and social audits negatively impact on sustainability outcomes, which highlights the potential negative effects of assessments for environmental purposes. Yildiz Çankaya and Sezen (2019) could not find any significant links between different green supply chain management practices (such as green purchasing) and sustainability performance. This lack of agreement means that the debate regarding incentives for the adoption of proactive environmental strategies remains open (S. Li et al., 2016), so further analysis is needed (Nguyen and Adomako, 2021).

Most previous studies have failed to distinguish between different types of sustainability practices and their effects on different sustainability outcomes. While the effects of some internal sustainability practices (e.g., energy consumption and/or green product design) are easily observed and quantified (Gupta & Gupta, 2020; S. Li et al., 2016), those involving third parties (through monitoring or collaboration) are less clear (Laari et al., 2016; Sancha et al., 2019; Jing Wang & Dai, 2018). Given this, Brulhart et al., (2017) pointed that to promote sustainability initiatives, manufacturers must identify practices that are more deserving of investment (in terms of time and money) and explain why they are effective (in terms of superior performance).

Also, the link between sustainability outcomes and competitive performance is not clear. Previous studies have failed to identify the individual contribution of sustainability outcomes on the competitive positioning of firms, and the empirical evidence is mixed (e.g., Das, 2018; Mitra & Datta, 2014; Qorri et al., 2021). Mishra and Yadav (2021) reported that eco-design and recycling practices may be a source of cost competitiveness for Indian firms. By contrast, Cantele and Zardini (2018) analysing small and medium-sized enterprises in Italy, could not find any significant direct effect between different sustainability supply chain management (SSCM) practices and competitive advantage. They argue that the environmental responsibility is considered as a cost and not a competitive edge for Italian firms. Similarly, Chacón Vargas et al. (2018) could not find any evidence to support a positive association between environmental sustainability practices and competitiveness in a sample of Colombian companies. These controversies make it difficult to answer the question of whether investment in sustainability is a threat or an opportunity for companies trying to create value (Cornejo-Cañamares et al., 2021).

This paper aims to contribute to the field in several ways. First, the paper examines the individual and joint effect of a broad set of sustainability practices on different

sustainability outcomes and competitive performance. The breadth of both sustainability practices and sustainability outcomes suggests that understanding their association requires the joint consideration of different theoretical lenses as well as their potential trade-offs (Mardani et al., 2020). In doing so, the present study builds on previous research (Das, 2018) by developing a theoretical argument that takes advantage of transaction cost theory (TCT), the natural resource-based view (NRBV), and social exchange theory (SET). It provides theoretical and empirical arguments so that the link between sustainability practices, sustainability performance, and competitive advantage can be better understood.

In the background, companies that adopt and implement different sustainability practices (internal vs. external; monitoring vs. collaboration) face transaction costs (Vachon and Klassen, 2006) and significant technological and organizational changes (Gusmão Caiado et al., 2018). These practices may affect the sustainability outcomes categorized as environmental, social, regulatory and operational as well as the response to the pressures and expectations of both internal and external stakeholders (Gianni et al., 2017). Accordingly, and as stated by the NRBV, when implementing sustainability actions and outcomes, firms develop unique competitive resources and capabilities that may lead them to be more competitive (McDougall et al., 2021). Hence, distinguishing between practices helps to determine the effects of each type of sustainability practice on different outcomes with the aim of identifying their individual contribution to companies' competitive advantage by considering both the interactions and the trade-off between practices.

In addition, this study considers the existence of mediating factors between sustainability and performance. Cantele and Zardini (2018) suggested more in-depth steps when investigating the impact of sustainability practices on competitive advantage by defining intermediate goals. The study, therefore, responds to the call for further research on the link between sustainability and competitiveness by considering implementation as a mediator (Chacón Vargas et al., 2018). Furthermore, by considering the more sustainability-focused measures of sustainability outcomes (regulatory, environmental and manufacturing performance), this study seeks to develop a comprehensive assessment of the effectiveness of SSCM strategies called by Mardani et al., (2020) and Ni and Sun (2019).

Finally, empirical evidence for this study uses information from a database of 263 manufacturing plants from three major industries (electronics, mechanical and transportation equipment) and 15 countries in Europe, Asia and America that participated in the fourth round of the High Performance Manufacturing (HPM) project. Most previous empirical

studies close to this paper were limited to a specific country or industry, making it difficult to generalize the results (Chacón Vargas et al., 2018; Mishra & Yadav, 2021; Sardana et al., 2020).

The present study is organized as follows. The next section explains the main theories regarding the effects of sustainability practices in manufacturing. In Section 3, four sets of hypotheses are developed. They explain the individual effect of different sustainability practices on different measures of sustainability outcomes and competitive advantage. The methodology, the statistical treatment, and the measures are outlined in Section 4. The results, which confirm that different sets of practices make different contributions to sustainability outcomes and competitive advantage, are presented and discussed in Section 5. Section 6 summarizes the implications of the findings for practitioners and academics, and Section 7 comprises the main conclusions, the limitations of the study, and suggestions for future research.

2. Theoretical Framework

Sustainability in manufacturing can be defined as "the creation of manufactured products that use processes that minimize negative environmental impacts, conserve energy and natural resources, are safe for employees, communities, and consumers and are economically sound" (US. Department of Commerce, 2009). Promoting sustainability in manufacturing requires a holistic view covering practices related to the products and the production process, the scope of which varies from the plant to the firm and finally to the supply chain (Huang & Badurdeen, 2018). These practices are very different and include uncertainties, new efforts, information sharing with asymmetries of information and potential opportunistic behaviours (Wang and Dai, 2018), which justify the distinction between different sets of practices and approaches (Danese et al., 2019).

In this sense, according to the TCT, sustainability practices can be divided into three categories: internal, external monitoring and external collaborating (Vachon and Klassen, 2006). While internal sustainability practices (ISPs) include aspects such as waste reduction, pollution prevention and improvement of the workforce's environment solely at the firm level, external sustainability practices (ESPs) involve other stakeholders, particularly suppliers, to enhance the whole supply chain's performance with regard to sustainability issues (Gimenez and Tachizawa, 2012).

Different sets of sustainability practices can lead to the attainment of different outcomes because sustainability practices are implemented differently (Geng et al., 2017). Sustainability outcomes can be categorised as operational (e.g. quality, cost, flexibility and delivery), environmental (e.g. waste, elimination of pollution, a decrease in the usage of resources and energy and a reduction of air emissions), social (labour conditions and living wage) and economic/financial performance (Gianni et al., 2017). Regulatory performance focuses on how firms adjust to and comply with new laws and environmental regulations that affect them (Wagner, 2015).

According to the resource based-view theory (RBV), firms can create competitiveness from heterogeneous competitive valuable, rare, inimitable and not substitutable (VRIN) resources (Barney, 1991). The NRBV, an extension of the RBV suggests that a firm can efficiently leverage competitive resources and develop environmental capabilities by aligning its sustainability practices with proactive approaches, resulting in increased competitive advantage (Hart, 1995; S. Zhang et al., 2019). In light of this theory, Cornejo-Cañamares et al. (2021) showed that through adopting advanced proactive strategies related to pollution prevention, product stewardship and clean technology, Spanish firms achieve compliance with environmental standards, reduction in costs and environmental damage and reinforce their competitive positioning. Companies can also achieve differentiation advantage through eco-friendly products, satisfying the demand of green customers as stated by Zameer et al. (2020) in China and by Mishra and Yadav (2021) in India. In this vein, as stated by social exchange theory, extending the sustainability focus to the supply chain enables partners to be involved in social responsibility practices through the promotion of intangible assets, such as buyer–supplier relationships, trust and mutual learning about sustainability (Wang and Dai, 2018), which help firms to overtake their competitors (Um and Kim, 2019).

3. Hypotheses Development

3.1. Internal sustainability practices and sustainability outcomes

The adoption and implementation of ISP is usually driven by the requirement of compliance with environmental regulations (Mardani et al., 2020). Yang et al. (2019) stated that plants implement pollution prevention and sustainable development initiatives to avoid contravening the law. From a social perspective, labour practices, health systems and educational programmes are very valuable initiatives for employees and society and go

beyond demands of national laws and regulations (Chacón Vargas et al., 2018). In addition, the voluntary adoption of environmental standards (e.g. ISO 14000) pushes plants to adopt sustainability initiatives, allowing firms to signal unobservable features to external stakeholders in a credible way (Tang et al., 2020).

With regard to environmental outcomes, Inman and Green (2018) showed a positive association between the adoption of in-house sustainability practices and environmental performance through management commitment with sustainability and the use of envirnomental management systems for the reduction of emissions, waste and environmental accidents. In line with this, Li et al. (2016) reported that applying ISP, such as pollution prevention and sustainable product development, improves environmental performance.

As for sustainability manufacturing outcomes, it should be noted that the effect of adopting ISP is not immediately observed because it depends on effective internalization (Erauskin-Tolosa et al., 2020) and successful implementation (Khan and Qianli, 2017). Implementing ISP reduces the consumption of raw materials and energy, thus improving the cost and quality of products (Inman and Green, 2018). Jabbour et al. (2016) indicated that the application of technologies to reduce input consumption (e.g., water) and the generation of waste, enhances quality, flexibility and the creation of green value in manufacturing.

H1a: The adoption of internal sustainability practices has positive effects on sustainability outcomes.

H1b: The adoption of internal sustainability practices is mediated by the effective implementation of practices.

3.2. External sustainability practices and sustainability outcomes

3.2.1. External monitoring and sustainability outcomes

Sustainability management with suppliers includes transaction cost related with uncertainty, asymmetry of information and, therefore, possible opportunistic behaviour by suppliers (Wang and Dai, 2018). In this context, adopting monitoring practices allow firms to control whether their suppliers' products are environmentally friendly and produced through environmentally sustainable processes (Laari et al., 2016). Monitoring influences suppliers to adopt environmental standards (e.g. ISO 14000) and reporting systems, which help to ensure an alignment with environmental regulations as well as to adopt an environmentally committed manner in their routine operations (Laari et al., 2017). Enhanced manufacturing

outcomes sometimes occur only when buying firms interact with suppliers who have already implemented their internal environmental management practices or obtained ISO 14000 certificates (Qorri et al., 2021) as well as green human resource management practices (S. Zhang et al., 2019).

In contrast, assessment-based mechanisms do not necessarily lead to better environmental performance for either focal firms or suppliers (Sardana et al., 2020; Wang and Dai, 2018). Controlling includes transaction costs related to the great effort and time needed to monitor suppliers (Gualandris et al., 2015). Furthermore, the existence of environmentally related information asymmetries in buyer–supplier interactions may be higher under this approach, which does not provide the necessary motivation for suppliers to achieve the sustainability goals of environmental regulations (Jiang, 2009), which , in turn, negatively affect environmental performance (Tachizawa et al., 2015). Tang et al. (2020) observed a reduction in the productivity of suppliers when they were obliged to allocate resources to ensure compliance with the buying firm's code of conduct or with regulations.

In sum, the expected effect of the adoption of monitoring depends on the balance between the influential vs the transaction-cost effect.

H2a: The adoption of supplier monitoring practices is positively associated with sustainability outcomes (influential effect).

H2b: The adoption of supplier monitoring practices is negatively associated with sustainability outcomes (transactional effect).

H2c: The effect of the adoption of supplier monitoring practices is mediated by the effective implementation of practices.

3.2.2. External collaboration and sustainability outcomes

Collaborative sustainability practices are relational practices (Sancha et al., 2019), typically performed in terms of information and knowledge sharing, joint training, or supplier development programmes to overcome sustainability issues (Jiang, 2009). Trust, commitment, reciprocity and power are social exchange antecedents of information sharing and collaboration that guide interactional behaviours for the expectation of a reward from partners (Um and Kim, 2019).

Collaboration facilitates the identification of environmental inefficiencies within a supply chain leading to improved environmental performance (Feng et al., 2018; Tachizawa

et al., 2015). Shah and Soomro (2021) showed how manufacturers reinforce their environmental performance (e.g. reduction in pollution and strengthening of their reputations) by collaborating with suppliers in recycling and remanufacturing. It is remarkable, however, that environmental performance requires a long period of time to yield the benefits of collaborative approaches (Laari et al., 2016), because it takes time to accumulate intangible assets and capabilities through routines (Wang and Dai, 2018).

On the other hand, involving partners in joint initiatives is in the core of advanced practices in operations management (e.g., lean manufacturing). With regard to sustainability, collaborating in product stewardship or sustainable product development promotes trustable relationships contributing to higher product quality and innovatively sustainable life cycle design (D. Yang et al., 2019). Dai et al. (2017) showed that implementing green collaboration with suppliers enhances manufacturing outcomes in terms of quality, delivery and cost.

H3a: The adoption of supplier collaboration practices has positive effects on sustainability outcomes.

H3b: The effect of the adoption of supplier collaborative practices is mediated by the effective implementation of practices.

3.3. Sustainability outcomes and competitive advantage

Competitive advantage is obtained when a firm implements a value-creating strategy that is not implemented by other competitors (Barney, 1991; Cantele and Zardini, 2018). Developing unique resources and capabilities by integrating sustainability objectives into corporate and operational strategies in manufacturing helps companies to achieve competitiveness through the reinforcement of operational efficiency and cost reductions (Laari et al., 2017). In line with NRBV, the competitive value of this strategy lies in how firms can implement different sets of practices, building a unique and difficult to imitate strategy. For instance, Shah and Soomro (2021) showed how manufacturing industries in Pakistan use and allocate specific resources related to sustainability to enhance their external sustainability approach, which supports their competitive advantage. Through internal tangible and intangible resources firms can reduce environmental impacts and enhance sustainability outcomes (Jing Dai et al., 2017). In addition, through collaborations, firms share knowledge, experience, resources and technology in buyer–supplier relationships, creating unique social capital that enhances supply chain performance (S. Y. Lee, 2015).

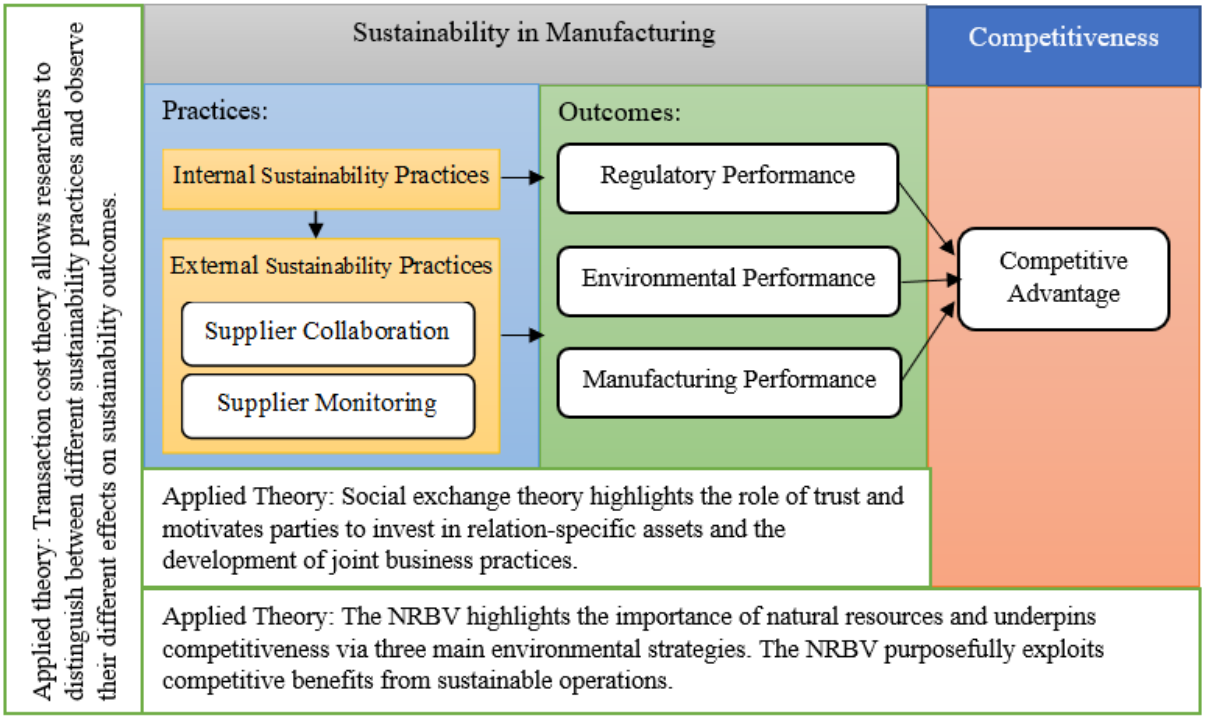
Closely linked to this view, and aligned with NRBV, reputation through enhanced environmental performance strengthens the competitive positioning of manufacturing firms (Nguyen and Adomako, 2021). Likewise, Brulhart et al. (2017) showed that the reputation obtained from the implementation of sustainability initiatives plays as a strategic resource to foster the competitive position of the firm. Evidence is available affirming the positive link between operational and environmental outcomes and competitiveness (Feng et al., 2018). However, the connection between regulatory performance and competitive advantage is more difficult to support. Complying with regulations and standards can be imitated. Thus, enjoying market positioning and differentiation potentiality requires firms to go beyond regulatory performance (Laari et al., 2017).

H4a: Different sustainability outcomes make different contributions to competitive advantage.

H4b: Both environmental and manufacturing sustainability outcomes are more likely to contribute to competitive advantage than are regulatory outcomes.

The structural model of this study is presented graphically in Figure 2.

Figure 2: Structural Model



4. Methodology

4.1. Sample and data collection

The data used in this study come from the fourth round of the High-Performance Manufacturing (HPM) project. The HPM is a large-scale, multi-country and multi-industry project that, in the fourth round, was conducted by 25 international research teams across Europe, Asia and America. The project started in 1998, the first round aiming to investigate manufacturing plants' operations and their associated performance. Round by round, the project has incorporated new countries and research groups that showed an interest in participating in the project until it reached the 15 countries that made up the last round. Table 1 reports the data distribution according to the sector and country.

Table 1: Sample distribution according to sector and country.

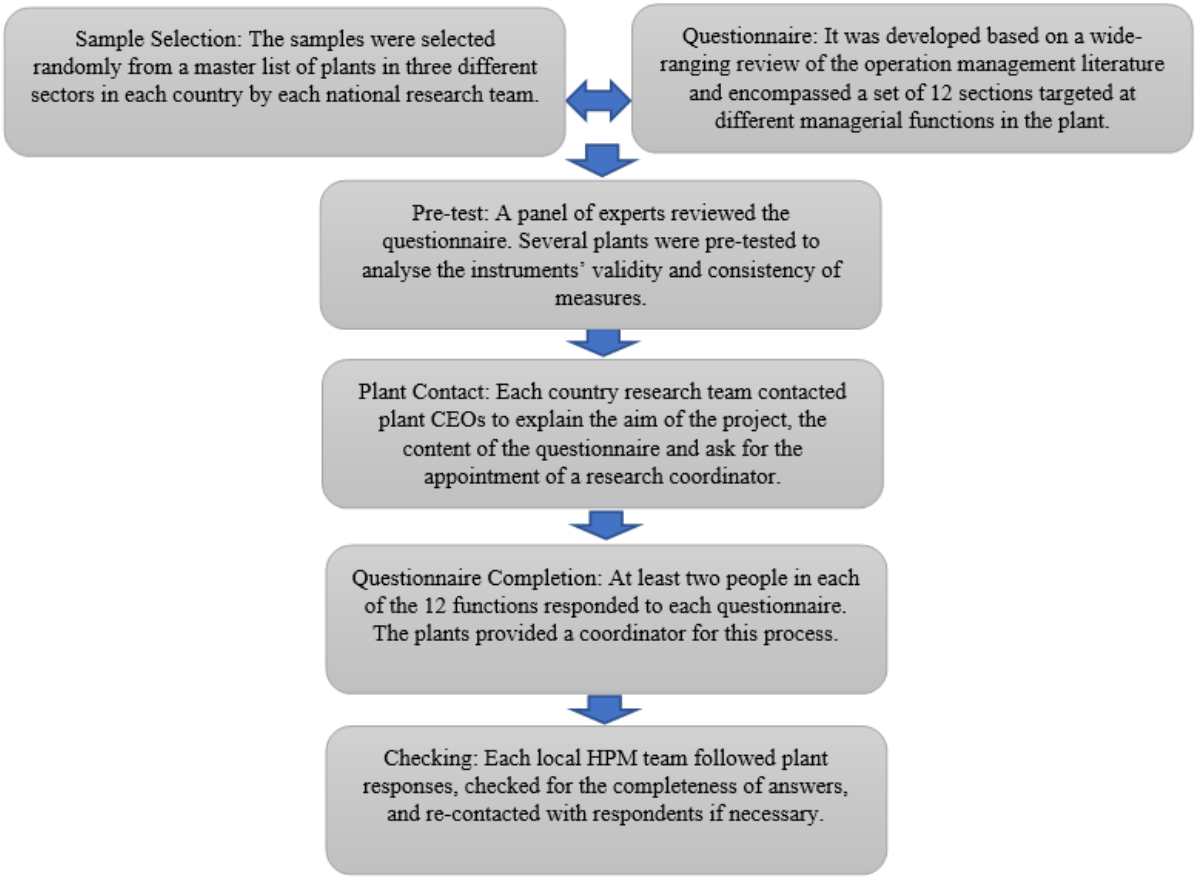
Country	Industry			total
	Electronics	Mechanical	Transportation Equipment	
China	10	14	3	27
Germany	6	10	8	24
Sweden	4	4	1	9
Switzerland	2	0	1	3
Korea	8	5	13	26
Spain	6	5	10	21
Italy	7	16	5	28
Israel	7	3	0	10
Brazil	3	5	7	15
Finland	6	6	4	16
Taiwan	19	10	1	30
UK	4	5	4	13
Vietnam	10	5	8	23
USA	3	5	3	11
Australia	1	5	1	7

Using a survey response method, data were collected from manufacturing plants involved in industries that include mechanics, electronics and transportation equipment (S. Zhang et al., 2019) by a local team of the HPM, as explained in Figure 3.

After applying methods to reduce the risk of common method bias and a clean-up of data by a global coordinator, the sample of 330 plants involved in three main industries include mechanics, electronics and transportation equipment was collected. These industries are in continuous transition (Morita et al., 2018) and face intense global competition

(Schroeder and Flynn, 2001). The response rate was approximately 65% in each country and there was no need to check for non-response bias (Danese et al., 2019). Finally, 263 companies who completed the sustainability section of the questionnaire were chosen as the data set of this paper. The adequacy of the sample was tested through the Keiser–Meyer–Olkin (KMO) test. Further, Harman's single factor test indicates that the total variance explained by a single factor was 0.3812 and all factor loading values are above the threshold value of 0.5, confirming that common method variance is not a problem in this study (Podsakoff et al., 2003).

Figure 3: Data Collection Process-Round 4 of the HPM project



4.2. Measures

The questionnaire related to environmental issues was answered by both environmental affairs managers and plant managers who were chosen to create three constructs for sustainability practices, namely: internal as ISP (Ni and Sun, 2019; Wang and Dai, 2018); external collaborative as ESPc; and external monitoring as ESPm (Danese et al., 2019; Vachon and Klassen, 2006). There was also one construct for an implementation labelled

IMPLT. The questionnaire also contains items to form the three sustainability outcomes (environmental, regulatory and manufacturing performance) and a scale for the construct of competitive advantage linked to sustainability, labelled CPADVN. The measurement properties of constructs are presented in Table 2.

Previous studies considered the effect of sector, firm size and country as control variables (Cantele and Zardini, 2018; Zhang et al., 2019). Likewise, the country where the plant is located, the manufacturing sector to which a firm belongs and the logarithm of the number of people employed by the sample plant, respectively, were taken into account as control variables in this study.

5. Data Analysis, Results and Discussion

The statistical treatment of the main constructs was carried out using the partial least squares (PLS) method as a variance-based approach to structural equation modelling. According to Hair Jr. et al., (2016), PLS is an appropriate tool for complex structural models with cause–effect characteristics having an advantage over CB-SEM as it tests the strength relationship of each component rather than testing the overall fit by observed covariance among all variables. Accordingly, PLS is well-suited to report the indirect effect of sustainability practices due to the involvement of intermediate goals. Specifically, the inclusion of both intermediate goals (outcomes and implementation) makes the model more complex.

The proposed model embraces two stages: the assessment of the measurement model and the evaluation of the path model. The former assesses the constructs, which establish the measurement model in terms of indicator reliability, internal consistency, discriminant validity and convergent validity. The latter involves the evaluation of hypothesized relationships between constructs in terms of sign, magnitude and significance.

5.1. Measurement model

The constructs were assessed to ensure the existence of internal consistency reliability as well as both convergent and discriminant validity. The internal consistency reliability of the constructs is evaluated through composite reliability (CR) and Cronbach's alpha (Sarstedt et al., 2016). Both values are above the criteria of 0.7, indicating strong reliability exists for the constructs (see Table 2).

Table 2: Measurement properties of constructs.

Variables	Description	Means	Std. Dev.	loading factor	Construct Reliability and Validity		
					Cronbach´s Alpha	Composite Reliability	AVE
ISP					0.893	0.913	0.539
	Water efficiency	3.699	0.884	0.698			
	Reducing waste in internal processes (e.g., improving yield or efficiency)	4.003	0.736	0.729			
	Improving the workforce environment (e.g., indoor air quality)	4.046	0.760	0.708			
	Pollution prevention (eliminating emissions or waste)	4.043	0.779	0.790			
	Pollution control (scrubbing, waste treatment)	4.130	0.897	0.648			
	Decreasing the likelihood or impact of an environmental accident	3.937	0.775	0.790			
	Complying with an industry-wide code of conduct	3.915	0.895	0.763			
	Environmental improvements in the disposition of your organization's scrap or excess material	4.032	0.766	0.728			
	Environmental improvements in the disposition of your organization's equipment	3.695	0.847	0.744			
ESPc					0.865	0.909	0.714
	Encouraging suppliers to improve the environmental performance of their processes	3.209	1.023	0.882			
	Providing design specification to suppliers in line with environmental requirements	3.268	1.095	0.770			
	Co-development with suppliers to reduce the environmental impact of the product	3.081	1.003	0.855			
	Involvement of suppliers in the re-design of internal processes	2.938	1.013	0.868			
ESPm					0.785	0.851	0.539
	Requesting that your suppliers sign a code of environmental conduct	3.015	1.240	0.783			
	Visiting suppliers' plants or ensuring that they are not using sweatshop labor	3.063	1.151	0.777			
	Ensuring that suppliers comply with child labor laws	3.359	1.314	0.783			
	Using a third party to monitor working conditions at supplier facilities	2.370	1.149	0.513			
	Incorporating environmental considerations in evaluating and selecting suppliers	3.328	0.992	0.773			
IMPLT					0.855	0.897	0.637
	Implementation of internal environmental management procedures	4.093	1.015	0.683			
	Use of cleaner technologies in the production process to reduce pollution emissions and/or resource use	3.816	0.937	0.809			
	Environment-friendly product design	3.549	1.051	0.863			
	Environmental improvement of packaging	3.538	0.988	0.831			
	Use of environment-friendly raw materials	3.525	0.954	0.794			
CPADVN					0.907	0.925	0.609
	Being environmentally conscious can lead to substantial cost advantages for our plant	3.575	0.965	0.812			
	Our plant can realize significant cost savings by experimenting with ways to improve the environmental quality	3.338	0.971	0.833			
	By regularly investing in research and development on cleaner products and processes, our plant can be a leader in the market.	3.689	0.985	0.680			
	Our plant can enter lucrative new markets by adopting environmental strategies.	3.248	1.052	0.845			
	Our plant can increase market share by making our current products more environmentally friendly.	3.354	1.006	0.837			
	Reducing the environmental impact of our plant's activities will lead to a quality improvement in our products and processes.	3.647	0.919	0.724			
	Better environmental performance can differentiate our plant from our competitors.	3.597	1.002	0.844			
	Being environmentally conscious can set us apart from the competition.	3.683	0.95	0.630			

As for convergent validity, the item loadings (except S-Int01=0.698, S-Int05=0.648, S-ExtM04=0.513, S-Empl01=0.683, Cpadvn03= 0.680 and Cpadvn08= 0.630) are higher than 0.7, significant at 0.000 and have a T-value higher than 2. Because the removal of those items with loading factors less than 0.7 could not contribute significant improvement to the composite reliability and average variance extracted (AVE) values, they were kept in the model (Hair Jr. et al., 2016). In this regard, AVE results show that all are above the minimum value of 0.5 (see Table 2). Accordingly, convergent validity exists at the indicator level (Peng and Lai, 2012).

Finally, discriminant validity is examined through the Fornell–Larcker criterion by comparing the square root of AVE value of each construct with the correlation between all possible pairs of constructs in the model (Hair Jr. et al., 2016). Accordingly, the square root of the AVE values of all constructs is greater than their correlation with other constructs in the model. Hence, the results support discriminant validity among the constructs (see Table 3). [1]

In summary, the measurement model shows that all constructs are consistent, reliable and valid.

Table 3: Discriminant Validity.

	Forner-Larcker Criterion				
Constructs	ISP	ESPc	ESPm	IMPLT	CPADVN
ISP	0.734*				
ESPc	0.365	0.845*			
ESPm	0.582	0.768	0.735*		
IMPLT	0.719	0.737	0.636	0.798*	
CPADVN	0.225	0.407	0.385	0.361	0.780*

* Square root of AVE value. The numbers below the AVE values are the correlation between the relevant construct with another construct in the model.

5.2. Structural model

The structural model is evaluated through standard model estimations and relies on the bootstrapping procedure. The aim is to test the path model relationships in terms of statistical significance, sign and magnitude of the model parameters. Routine bootstrapping is recommended for the consideration of 5,000 resamples (Hair Jr. et al., 2016). To measure the model goodness of fit (GOF) the standardized root mean square residual (SRMR) is used

[1] A complementary CFA analysis using STATA was run. Indices of GOF: chi2, Standardized RMR, RMSEA, CFI, TLI indicates that model fitness is acceptable.

(Henseler et al., 2014). The SRMR value for both models 1 and 2 is 0.061 and 0.063, respectively, which is lower than the threshold value 0.08 indicating a satisfactory fit. In order to evaluate the quality of the structural model, a non-parametrical test can be applied. One is suggested to consider the multicollinearity issues through variance inflation factor (VIF) values for all sets of predictor constructs. Accordingly, all observed values including outer and inner VIF values were below the threshold of 3.3 (Shmueli et al., 2019), demonstrating that multicollinearity is not critical in the model.

Model 1 is established to test the effects of three sets of sustainability practices on sustainability outcomes and competitive advantage (Hypotheses H1a, H2a, H2b, H3a, H4a and H4b). Model 2 considers the mediating effect of the implementation on the relationship between sustainability practices and sustainability outcomes through Hypotheses H1b, H2c and H3b. Figure 4 represents the structural model of the study by showing the path co-efficient (β) and its significance. In both models, firm size and country development are included as two control variables.

The results of the structural evaluation are presented in Table 4. Estimations show that ISP have a significant effect on both environmental ($\beta=0.489$, $p<0.001$) and regulatory ($\beta=0.444$, $p<0.001$) outcomes. The effect is not significant for manufacturing outcomes. As a result, Hypothesis H1a is partially supported. Regarding ESPc, the model reveals a positive and significant effect on manufacturing performance ($\beta=0.293$, $p<0.01$). Nevertheless, the effect on environmental and regulatory outcomes is not significant. Therefore, H3a is partially supported. Finally, estimation results report an insignificant relationship between ESPm and all three sustainability outcomes ($\beta=-0.007$, $p>0.05$ for environmental performance, $\beta=-0.024$, $p>0.05$ for regulatory performance, $\beta=0.141$, $p>0.05$ for manufacturing performance). As a result, H2a and H2b are not supported.

Column 2 of Table 4 demonstrates the role of implementation in sustainability outcomes. On the one hand, the significant coefficients for the relationships between ISP ($\beta=0.407$, $p<0.001$) and ESPc ($\beta= 0.394$, $p<0.001$) with implementation provide sufficient evidence to support H1b and H3b. However, the result for ESPm is not statistically significant, hence H2c is not fulfilled. On the other hand, it can be observed that the results for the link between implementation and sustainability outcomes is consistent with the expectation ($\beta=0.370$, $p<0.001$ for environmental outcomes, $\beta=0.441$, $p<0.001$ for regulatory outcomes, $\beta=0.392$, $p<0.001$ for manufacturing outcomes).

Table 4: Results of mediation test using partial least square (PLS-SEM).

	MODEL 1			MODEL 2		
	Path Co-efficient	Confidence interval (2.5%, 0.97.5%)	Size of Effect (F2)	Path Co-efficient	Confidence interval (2.5%, 0.97.5%)	Size of Effect (F2)
Main Effect:						
ISP -> Environmental Performance	0.489***	(0.335, 0.634)	0.174			
ISP -> Regulatory Performance	0.444***	(0.276, 0.614)	0.139			
ISP -> Manufacturing Performance	-0.056	(-0.203, 0.068)	0.002			
ESPc-> Environmental Performance	-0.004	(-0.194, 0.168)	0.000			
ESPc-> Regulatory Performance	0.034	(-0.191, 0.245)	0.000			
ESPc-> Manufacturing Performance	0.293**	(0.090, 0.489)	0.035			
ESPm-> Environmental Performance	-0.007	(-0.162, 0.165)	0.000			
ESPm-> Regulatory Performance	-0.024	(-0.233, 0.189)	0.000			
ESPm-> Manufacturing Performance	0.141	(-0.056, 0.339)	0.009			
ISP-> IMPLT				0.407***	(0.303, 0.506)	0.265
ESPc-> IMPLT				0.394***	(0.267, 0.523)	0.154
ESPm-> IMPLT				0.103	(-0.021, 0.224)	0.011
IMPLT-> Environmental Performance				0.370***	(0.266, 0.474)	0.158
IMPLT-> Regulatory Performance				0.441***	(0.331, 0.542)	0.241
IMPLT-> Manufacturing Performance				0.392***	(0.311, 0.470)	0.181
Environmental Performance->CPADVN	0.027	(-0.117, 0.178)	0.001	0.027	(-0.124, 0.123)	0.001
Regulatory Performance->CPADVN	0.020	(-0.120, 0.167)	0.000	0.020	(-0.121, 0.167)	0.000
Manufacturing Performance->CPADVN	0.215***	(0.097, 0.325)	0.053	0.215***	(0.098, 0.328)	0.053
ISP -> ESPc	0.643***	(0.574, 0.709)	0.703	0.642***	(0.572, 0.708)	0.701
ISP -> ESPm	0.603***	(0.534, 0.675)	0.576	0.603***	(0.531, 0.674)	0.571

*p < 0.05; **p < 0.01; ***p < 0.001.

As for the effect of sustainability outcomes on competitiveness (H4a and H4b), only the manufacturing outcome–competitiveness link is positive and significant (β=0.215, $p<0.001$), while insignificant effects are observed for environmental (β=0.027, $p>0.05$) and regulatory outcomes (β=0.020, $p>0.05$). These results indicate that different sustainability outcomes have different contributions to competitiveness; thus, H4a is supported. Meanwhile, this result partially supports H4b.

Consistent with the percentile method, the confidence interval should not be included with the value of 0 to ensure significance. All the statistically significant path coefficients of both models have a statistically different effect from 0. Finally, as for the size of the effects

of the variables, the f^2 value (Cohen, 1988) shows that the effect of sustainability outcomes on competitive advantage is small compared to the size of the effect between sustainability practices and implementation as well as between implementation and sustainability outcomes (see Table 4).

With regard to the three control variables firm size and country development have significant effects in both models. While the effect for firm size is positive (β=0.194, $p<0.01$), the result for country development is negative (β=-0.260, $p<0.001$). Because no significant effect was reported for industry, it was excluded from both models. A summary of the results is presented in Table 5.

Table 5: Summary of the result.

Hypothesis	Result
H1a	Partially supported
H1b	Supported
H2a	Not Supported
H2b	Not Supported
H2c	Not Supported
H3a	Partially supported
H3b	Supported
H4a	Supported
H4b	Partially supported

Table 6: Structural Model R2 and Q2.

Endogenous Construct	Model 1		Model 2	
	R^2	Q^2	R^2	Q^2
Main Effect:				
ESPc	0.413	0.288	0.412	0.289
ESPm	0.365	0.187	0.363	0.187
IMPLT			0.650	0.404
Environmental Performance	0.232	0.210	0.137	0.126
Regulatory Performance	0.204	0.190	0.194	0.188
Manufacturing Performance	0.143	0.105	0.153	0.148
CPADVN	0.221	0.124	0.221	0.124

For the predictive power of the models, the coefficient of determination (R^2) as well as the Stone-Geisser's Q^2 value of endogenous dependent constructs were considered (Shmueli et al., 2019). The R^2 values show a good predictive power of the predictors on the predicted variables. Additionally, the Stone-Geisser's Q^2 values reporting cross-validated

redundancy values for all endogenous dependent constructs in both models are above zero, indicating all these constructs have predictive relevance (see Table 6).

5.3. Discussion of Findings

The empirical evidence of this study highlights the important role of internal practices affecting people, environment and input use on sustainability outcomes. Whereas the effect of ISP is different on diffferent outcomes, it is remarkable that their effective implementation plays a key role to explain outcomes. These practices improve both environmental and regulatory outcomes, while to strengthen quality, cost and other operational outcomes it depends on how practices are effectivelly implemented, as suggested by Khan and Qianli, (2017). Furthermore, the indirect effect of ISP on competitive advantage confirms that the adoption of these initiatives can ultimately reinforce competitivness when being implemented. Moreover, ISP plays a significant role in the implementation of external practices, allowing companies to succesfully adopt different sustainability approaches with external actors.

Results confirm the positive link of collaborative practices with sustainability outcomes. Model 2 underlines the importance of effective implementation, which fully mediates the effects of practices on outcomes. Aligned with NRBV and social exchange theories, ESPc enhances all measures of outcomes, indicating the importance of a collaborative approach in manufacturing to achieve competitive advantage.

According to the literature, the adoption of monitoring practices was expected to foster sustainability outcomes by virtue of the influential effect, but it also has a potentiality to suppress the outcomes because of transactional costs. Contrary to earlier studies (e.g. Laari et al., 2017), the result affirms that the application of an assessment approach is unable to contribute to better performance and improved competitive positioning for manufacturing firms, as previously suggested by Sardana et al. (2020).

Findings of this study highlight the joint effect of internal practices and an external collaborative approach to sustainability in manufacturing and, ultimately, serve as a guide to mobilize resources around the development of capacities and routines linked to sustainability objectives aligned with the SDGs and the 2030 Agenda for Sustainable Development. Well-implemented sustainability initiatives (internal and external collaborative) will foster competitiveness. In addition, the result for regulatory performance shows that adherence to regulations and conformity to sustainability standards and codes of conduct do not contribute

to competitive advantage. In sum, competitiveness is enhanced when plants improve the quality, cost and/or flexibility of their processes through the implementation of sustainability initiatives targeting responsible consumption and production (SDG12) in collaboration with suppliers (SDG17).

6. Implications

This study has implications for managers as well as the academia. Managers know that companies are increasingly concerned about the environment and therefore that managers' actions, including their compensation, are being evaluated according to the achievement of social, environmental and economic goals (Flammer et al., 2019). This study indicates that there are many reasons to be more sustainable, suggesting which sets of practices can enhance sustainability outcomes and thus satisfy stakeholders' expectations, and it emphasizes how sustainability can contribute to the achievement of a competitive advantage. The study highlights the importance of transactional costs when implementing monitoring approaches with supply chain partners. Despite the fact that some stakeholders may pressure companies to apply monitoring practices, this study shows that good internal implementation of practices as well as collaboration with partners is better for enhancing sustainability outcomes and reinforcing the competitive positioning.

Regarding SDG 17 (partnership for the goals), the evidence indicates that the establishment of trustful buyer–supplier relationships, with the possibility of training, knowledge and technology transfer in collaboration with suppliers, is a determinant of the achievement of the required outcomes, as suggested by Zimon and Sroufe, (2019). Along this line, as reported by Forbes in 2021, by applying intensive environmental practices and corporate social responsibility programmes in collaboration with suppliers, some companies increase their transparency and reduce their carbon footprint (e.g. the Allbirds Inc. case). Hence, approaches that are more aggressive, are less collaborative and involve greater control do not seem to contribute to sustainable performance or advanced production. In addition, taking limited responsibility only to conform to the regulations by acquiring environmental certificates does not boost competitiveness in today's competitive market.

This study also provides evidence regarding the achievement of the SGD 12 (responsible consumption and production) by stressing the implementation of environmentally friendly solutions in operation to eliminate inefficiency in manufacturing.

The involvement of focal firms in advanced practices and systems, such as lean practices, industry 4.0 support or strategic logistics management, which requires a high level of collaboration with suppliers and the mobilization of new resources, can be aligned with the accomplishment of sustainability goals, enhancing manufacturing firms' competitive positioning. The importance of implementation indicates that managers should support more proactive initiatives within their firms, such as green training or digitalization of internal processes, and in their joint practices with suppliers to improve the efficiency of their resources and manufacturing processes.

For the academy, this paper goes further in linking sustainability practices–competitive advantage in manufacturing considering the individual and joint effect of different sets of sustainability practices on sustainability outcomes and competitive advantage. Thus, a comprehensive view of the phenomenon needs to consider the trade-offs between distinctive practices (internal practices, monitoring and collaboration approaches with suppliers) as well as to consider more sustainability-focused measures of outcomes (regulatory, environmental and manufacturing performance) rather than the traditional sustainability performance measures (i.e. environmental, social and economic performance) per recent calls in the literature (Mardani et al., 2020; Ni & Sun, 2019). In doing so, this study advances the previous studies in this area by examining the mediating effect of implementation and analysing multi-country multi-industry datasets (Chacón Vargas et al., 2018; Das, 2018). By applying NRBV, TCT and SET, the study improves our understanding of the reasons behind sustainability in manufacturing. Further research should be carried out into other complex manufacturing paradigms using the same approach. The study also demonstrates the importance of mediating factors when attempting to understand the link between sustainability and performance.

7. Conclusion and Future research

How to make manufacturing companies more sustainable and which types of sustainability practices can be more beneficial are open questions in green manufacturing. Companies look for competitiveness and are open to the adoption of proactive strategies if it helps to satisfy stakeholders' expectations and enhance their competitive positioning. This study provides empirical insight on the role of focal firms for achieving long-term sustainability goals and supports the idea that SSCM is an effective approach to accomplish SDGs. By using the

PLS-SEM method and a sample of 263 manufacturing plants from the fourth round of the HPM project, the results demonstrate the benefits of investing in sustainability to be more 'green' (Brulhart et al., 2017; Ni and Sun, 2019). It has been stated that the implementation of sustainability practices, both internally and collaboratively with suppliers, improves sustainability outcomes as a response to stakeholders' pressures and expectations. However, it is remarkable that only manufacturing sustainability outcomes are relevant to improve the competitive positioning of firms indicating that sustainability outcomes must be harmonized with manufacturing paradigms such as quality, lean production, and efficiency if competitive advantage is to be achieved. This highlights the strategic value of internal and external collaborative practices as resources and capabilities to support competitive advantage, aligned with the statements of NRBV.

This study has some limitations, which is suggested should be improved upon in future research. Based on a survey-based cross-sectional data set, this study reports the positive link between sustainability practices and competitive advantage. Longitudinal research could provide more understanding about this relationship, especially as the effect of SSCM on performance may not be immediate and varies over time. Second, the negative or insignificant results, particularly for the role of environmental performance in the achievement of competitiveness or the link between monitoring practices and implementation, need further exploration. One reason might be the disregarding of mediating factors, particularly those drivers pushing firms to implement different sustainability practices. For example, the leadership style of management or organizational culture, which influence the choice of sustainability strategies, may contribute to undesirable results. Therefore, future research is suggested to consider the role of these mediators. Finally, this study suggests the need for advancement in identifying stakeholders' pressures and the managers´ perceptions of these pressures to improve the understanding of sustainability in manufacturing.

8. References

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Brulhart, F., Gherra, S., & Marais, M. (2017). Are environmental strategies profitable for companies? The key role of natural competences from a resource-based view. *Management Decision*, *55*(10), 2126–2148. https://doi.org/10.1108/MD-12-2016-0893

Cantele, S., & Zardini, A. (2018). Is sustainability a competitive advantage for small

businesses? An empirical analysis of possible mediators in the sustainability–financial performance relationship. *Journal of Cleaner Production*, *182*, 166–176. https://doi.org/10.1016/j.jclepro.2018.02.016

Chacón Vargas, J. R., Moreno Mantilla, C. E., & de Sousa Jabbour, A. B. L. (2018). Enablers of sustainable supply chain management and its effect on competitive advantage in the Colombian context. *Resources, Conservation and Recycling*, *139*(September), 237–250. https://doi.org/10.1016/j.resconrec.2018.08.018

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences. Abingdon*. United Kingdom: Routledge.

Cornejo-Cañamares, M., Medrano, N., & Olarte-Pascual, C. (2021). Environmental objectives and non-technological innovation in Spanish manufacturing SMEs. *Journal of Cleaner Production*, *296*. https://doi.org/10.1016/j.jclepro.2021.126445

Dai, J., Cantor, D. E., & Montabon, F. L. (2017). Examining corporate environmental proactivity and operational performance: A strategy-structure-capabilities-performance perspective within a green context. *International Journal of Production Economics*, *193*(August), 272–280. https://doi.org/10.1016/j.ijpe.2017.07.023

Danese, P., Lion, A., & Vinelli, A. (2019). Drivers and enablers of supplier sustainability practices: a survey-based analysis. *International Journal of Production Research*, *57*(7), 2034–2056. https://doi.org/10.1080/00207543.2018.1519265

Das, D. (2018). The impact of Sustainable Supply Chain Management practices on firm performance: Lessons from Indian organizations. *Journal of Cleaner Production*, *203*, 179–196. https://doi.org/10.1016/j.jclepro.2018.08.250

Erauskin-Tolosa, A., Zubeltzu-Jaka, E., Heras-Saizarbitoria, I., & Boiral, O. (2020). ISO 14001, EMAS and environmental performance: A meta-analysis. *Business Strategy and the Environment*, *29*(3), 1145–1159. https://doi.org/10.1002/bse.2422

Feng, M., Yu, W., Wang, X., Wong, C. Y., Xu, M., & Xiao, Z. (2018). Green supply chain management and financial performance: The mediating roles of operational and environmental performance. *Business Strategy and the Environment*, *27*(7), 811–824. https://doi.org/10.1002/bse.2033

Flammer, C., Hong, B., & Minor, D. (2019). Corporate governance and the rise of integrating corporate social responsibility criteria in executive compensation: Effectiveness and implications for firm outcomes. *Strategic Management Journal*, *40*(7), 1097–1122. https://doi.org/10.1002/smj.3018

Geng, R., Mansouri, S. A., & Aktas, E. (2017). The relationship between green supply chain management and performance: A meta-analysis of empirical evidences in Asian emerging economies. *International Journal of Production Economics*, *183*(December 2015), 245–258. https://doi.org/10.1016/j.ijpe.2016.10.008

Gianni, M., Gotzamani, K., & Tsiotras, G. (2017). Multiple perspectives on integrated management systems and corporate sustainability performance. *Journal of Cleaner Production*, *168*, 1297–1311. https://doi.org/10.1016/j.jclepro.2017.09.061

Gimenez, C., & Tachizawa, E. M. (2012). Extending sustainability to suppliers: A systematic literature review. *Supply Chain Management*, *17*(5), 531–543. https://doi.org/10.1108/13598541211258591

Gualandris, J., Klassen, R. D., Vachon, S., & Kalchschmidt, M. (2015). Sustainable

evaluation and verification in supply chains: Aligning and leveraging accountability to stakeholders. *Journal of Operations Management*, *38*, 1–13. https://doi.org/10.1016/j.jom.2015.06.002

Gupta, A. K., & Gupta, N. (2020). Effect of corporate environmental sustainability on dimensions of firm performance – Towards sustainable development: Evidence from India. *Journal of Cleaner Production*, *253*, 119948. https://doi.org/10.1016/j.jclepro.2019.119948

Gusmão Caiado, R. G., Leal Filho, W., Quelhas, O. L. G., Luiz de Mattos Nascimento, D., & Ávila, L. V. (2018). A literature-based review on potentials and constraints in the implementation of the sustainable development goals. *Journal of Cleaner Production*, *198*, 1276–1288. https://doi.org/10.1016/j.jclepro.2018.07.102

Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, *20*(4), 986–1014.

Henseler, J., Ringle, C. M., & Sarstedt, M. (2014). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Huang, A., & Badurdeen, F. (2018). Metrics-based approach to evaluate sustainable manufacturing performance at the production line and plant levels. *Journal of Cleaner Production*, *192*, 462–476. https://doi.org/10.1016/j.jclepro.2018.04.234

Inman, R. A., & Green, K. W. (2018). Lean and green combine to impact environmental and operational performance. *International Journal of Production Research*, *56*(14), 4802–4818. https://doi.org/10.1080/00207543.2018.1447705

Jabbour, C. J. C., De Sousa Jabbour, A. B. L., Govindan, K., De Freitas, T. P., Soubihia, D. F., Kannan, D., & Latan, H. (2016). Barriers to the adoption of green operational practices at Brazilian companies: Effects on green and operational performance. *International Journal of Production Research*, *54*(10), 3042–3058. https://doi.org/10.1080/00207543.2016.1154997

Jiang, B. (2009). The effects of interorganizational governance on supplier's compliance with SCC: An empirical examination of compliant and non-compliant suppliers. *Journal of Operations Management*, *27*(4), 267–280. https://doi.org/10.1016/j.jom.2008.09.005

Khan, S. A. R., & Qianli, D. (2017). Impact of green supply chain management practices on firms' performance: an empirical study from the perspective of Pakistan. *Environmental Science and Pollution Research*, *24*(20), 16829–16844. https://doi.org/10.1007/s11356-017-9172-5

Laari, S., Töyli, J., & Ojala, L. (2017). Supply chain perspective on competitive strategies and green supply chain management strategies. *Journal of Cleaner Production*, *141*, 1303–1315. https://doi.org/10.1016/j.jclepro.2016.09.114

Laari, S., Töyli, J., Solakivi, T., & Ojala, L. (2016). Firm performance and customer-driven green supply chain management. *Journal of Cleaner Production*, *112*, 1960–1970. https://doi.org/10.1016/j.jclepro.2015.06.150

Lee, S. Y. (2015). The effects of green supply chain management on the supplier's performance through social capital accumulation. *Supply Chain Management*, *20*(1), 42–

55. https://doi.org/10.1108/SCM-01-2014-0009

Li, S., Jayaraman, V., Paulraj, A., & Shang, K. C. (2016). Proactive environmental strategies and performance: Role of green supply chain processes and green product design in the Chinese high-tech industry. *International Journal of Production Research*, *54*(7), 2136–2151. https://doi.org/10.1080/00207543.2015.1111532

Mardani, A., Kannan, D., Hooker, R. E., Ozkul, S., Alrasheedi, M., & Tirkolaee, E. B. (2020). Evaluation of green and sustainable supply chain management using structural equation modelling: A systematic review of the state of the art literature and recommendations for future research. *Journal of Cleaner Production*, *249*(xxxx). https://doi.org/10.1016/j.jclepro.2019.119383

McDougall, N., Wagner, B., & MacBryde, J. (2021). Leveraging competitiveness from sustainable operations: frameworks to understand the dynamic capabilities needed to realise NRBV supply chain strategies. *Supply Chain Management*, *January*. https://doi.org/10.1108/SCM-11-2018-0393

Mishra, P., & Yadav, M. (2021). "Environmental capabilities, proactive environmental strategy and competitive advantage: A natural-resource-based view of firms operating in India." *Journal of Cleaner Production*, *291*. https://doi.org/10.1016/j.jclepro.2020.125249

Mitra, S., & Datta, P. P. (2014). Adoption of green supply chain management practices and their impact on performance: An exploratory study of Indian manufacturing firms. *International Journal of Production Research*, *52*(7), 2085–2107. https://doi.org/10.1080/00207543.2013.849014

Morita, M., Machuca, J. A. D., & Pérez Díez de los Ríos, J. L. (2018). Integration of product development capability and supply chain capability: The driver for high performance adaptation. *International Journal of Production Economics*, *200*(March), 68–82. https://doi.org/10.1016/j.ijpe.2018.03.016

Nguyen, N. P., & Adomako, S. (2021). Environmental proactivity, competitive strategy, and market performance: The mediating role of environmental reputation. *Business Strategy and the Environment*, *December 2020*, 1–13. https://doi.org/10.1002/bse.2729

Ni, W., & Sun, H. (2019). The effect of sustainable supply chain management on business performance: Implications for integrating the entire supply chain in the Chinese manufacturing sector. *Journal of Cleaner Production*, *232*, 1176–1186. https://doi.org/10.1016/j.jclepro.2019.05.384

Paulraj, A., Chen, I. J., & Blome, C. (2017). Motives and Performance Outcomes of Sustainable Supply Chain Management Practices: A Multi-theoretical Perspective. *Journal of Business Ethics*, *145*(2), 239–258. https://doi.org/10.1007/s10551-015-2857-0

Peng, D. X., & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, *30*(6), 467–480. https://doi.org/10.1016/j.jom.2012.06.002

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Qorri, A., Gashi, S., & Kraslawski, A. (2021). Performance outcomes of supply chain

practices for sustainable development: A meta-analysis of moderators. *Sustainable Development*, *29*(1), 194–216. https://doi.org/10.1002/sd.2140

Sancha, C., Wong, C. W. Y., & Gimenez, C. (2019). Do dependent suppliers benefit from buying firms' sustainability practices? *Journal of Purchasing and Supply Management*, *25*(4), 100542. https://doi.org/10.1016/j.pursup.2019.100542

Sardana, D., Gupta, N., Kumar, V., & Terziovski, M. (2020). CSR 'sustainability' practices and firm performance in an emerging economy. *Journal of Cleaner Production*, *258*, 120766. https://doi.org/10.1016/j.jclepro.2020.120766

Sarstedt, M., Hair, J. F., Ringle, C. M., Thiele, K. O., & Gudergan, S. P. (2016). Estimation issues with PLS and CBSEM: Where the bias lies! *Journal of Business Research*, *69*(10), 3998–4010. https://doi.org/10.1016/j.jbusres.2016.06.007

Schroeder, R. G., & Flynn, B. B. (2001). *High performance manufacturing : global perspectives* (p. 308).

Shah, N., & Soomro, B. A. (2021). Internal green integration and environmental performance: The predictive power of proactive environmental strategy, greening the supplier, and environmental collaboration with the supplier. *Business Strategy and the Environment*, *30*(2), 1333–1344. https://doi.org/10.1002/bse.2687

Shmueli, G., Sarstedt, M., Hair, J. F., Cheah, J. H., Ting, H., Vaithilingam, S., & Ringle, C. M. (2019). Predictive model assessment in PLS-SEM: guidelines for using PLSpredict. *European Journal of Marketing*, *53*(11), 2322–2347. https://doi.org/10.1108/EJM-02-2019-0189

Tachizawa, E. M., Gimenez, C., & Sierra, V. (2015). Green supply chain management approaches: drivers and performance implications. *International Journal of Operations and Production Management*, *35*(11), 1546–1566. https://doi.org/10.1108/IJOPM-01-2015-0023

Tang, H. li, Liu, J. min, & Wu, J. guang. (2020). The impact of command-and-control environmental regulation on enterprise total factor productivity: A quasi-natural experiment based on China's "Two Control Zone" policy. *Journal of Cleaner Production*, *254*, 120011. https://doi.org/10.1016/j.jclepro.2020.120011

Um, K. H., & Kim, S. M. (2019). The effects of supply chain collaboration on performance and transaction cost advantage: The moderation and nonlinear effects of governance mechanisms. *International Journal of Production Economics*, *217*(March 2018), 97–111. https://doi.org/10.1016/j.ijpe.2018.03.025

United States Department of Commerce website, 2009. Available at:: http://web.archive.org/web/20170127160912/http://trade.gov/competitiveness/sustainablemanufacturing/how_doc_defines_SM.asp. Accessed on October 5th, 2012.

Vachon, S., & Klassen, R. D. (2006). Extending green practices across the supply chain: The impact of upstream and downstream integration. *International Journal of Operations and Production Management*, *26*(7), 795–821. https://doi.org/10.1108/01443570610672248

Wagner, M. (2015). The link of environmental and economic performance: Drivers and limitations of sustainability integration. *Journal of Business Research*, *68*(6), 1306–1317. https://doi.org/10.1016/j.jbusres.2014.11.051

Wang, J., & Dai, J. (2018). Sustainable supply chain management practices and performance.

Industrial Management and Data Systems, *118*(1), 2–21. https://doi.org/10.1108/IMDS-12-2016-0540

Yang, D., Jiang, W., & Zhao, W. (2019). Proactive environmental strategy, innovation capability, and stakeholder integration capability: A mediation analysis. *Business Strategy and the Environment*, *28*(8), 1534–1547. https://doi.org/10.1002/bse.2329

Yildiz Çankaya, S., & Sezen, B. (2019). Effects of green supply chain management practices on sustainability performance. *Journal of Manufacturing Technology Management*, *30*(1), 98–121. https://doi.org/10.1108/JMTM-03-2018-0099

Zameer, H., Wang, Y., & Yasmeen, H. (2020). Reinforcing green competitive advantage through green production, creativity and green brand image: Implications for cleaner production in China. *Journal of Cleaner Production*, *247*, 119119. https://doi.org/10.1016/j.jclepro.2019.119119

Zhang, S., Wang, Z., & Zhao, X. (2019). Effects of proactive environmental strategy on environmental performance: Mediation and moderation analyses. *Journal of Cleaner Production*, *235*, 1438–1449. https://doi.org/10.1016/j.jclepro.2019.06.220

Zimon, D., & Sroufe, R. (2019). *Drivers of Sustainable Supply Chain Management : Practices To Alignment With Un Sustainable*. *14*(1), 219–236.

Study 2: The adoption of environmental sustainability practices: Institutional drivers and national culture

Abstract

Taking insights from institutional theory, this study analyses how both internal and external sustainability drivers interact with national culture to explain the adoption of environmental sustainability practices. Using a sample of 284 manufacturing plants from the High-Performance Manufacturing project, the results identify different drivers for the adoption of different environmental sustainability practices. The evidence further suggests that national culture moderates the effect of drivers.

Keywords: Sustainability drivers; Environmental sustainability practices; Institutional pressures; National culture; Manufacturing

1. Introduction

The increased awareness around environmental sustainability has guided manufacturing firms to comprehend the consequences of adopting sustainability practices worldwide (Gong et al., 2019). Previous studies have found that, when successfully implemented, sustainable supply chain management (SSCM hereinafter) fosters firm's competitiveness (Ahmadi-Gh & Bello-Pintado, 2022; Chacón Vargas et al., 2018) by improving environmental and operational performance (Kitsis & Chen, 2021; Zhu et al., 2013). However, being able to successfully implement sustainability within a firm and across global supply chains is challenging (Koberg & Longoni, 2019). Hence, understanding what drives environmental sustainability adoption is essential (Agarwal et al., 2018).

Institutional theory suggests that environmental sustainability adoption decisions are not only driven by internal factors (e.g. cost-saving pressures) but also by external pressures (e.g. customer pressures) in the form of coercive, normative and mimetic pressures that collectively push organisations to align their organisational practices with their institutional environment (DiMaggio & Powell, 1983; Dubey et al., 2019). As a result, organisations within an industry become similar or isomorphic (DiMaggio & Powell, 1983). Within this framework, Saeed and Kersten (2019) categorise drivers of SSCM and point out that regulatory and market (normative) pressures are the most prevailing ones. Similarly, Danese et al. (2019) indicate that pressures exerted from regulations are an essential driver for sustainability, while internal pressures related to cost saving are not inspiring. However, other

studies show that the coercive and normative pressures are unable to encourage sustainability adoption and point out internal factors as determinants for the adoption of SSCM practices (Agarwal et al., 2018).

This evidence highlights the difficulties in establishing a consistent link between drivers and environmental sustainability adoption decisions, suggesting that the driving forces are affected by the contextual characteristics of a firm (Tate et al., 2011). Hence, the power of pressures inspiring the adoption of each set of SSCM practices is affected by the context where plants are operating (Marculetiu et al., 2023; Power et al., 2015). In particular, socio-cultural factors, including national culture (NC hereinafter), play an important role in understanding the diverse behaviours regarding the adoption of SSCM practices in manufacturing (Azadegan et al., 2018; Miras-Rodríguez et al., 2018). On this premise, scholars call for further empirical research on this issues (Dai et al., 2021; Marculetiu et al., 2023).

This study employs the institutional theory lens and draws on data from 284 plants across various countries and three industry sectors, obtained from the 4th round of the High-Performance Manufacturing (HPM) project. The objective of the study is to enhance our understanding of the factors driving the adoption of SSCM practices. Specifically, the study examines how both internal factors (such as managers, employees and owners/shareholders) and external factors (including government regulations and customer demands) interact with three dimensions of NC (uncertainty avoidance, power distance and institutional collectivism) to explain SSCM adoption.

This study contributes to the literature in several ways: first, analysing the effect of different drivers from an institutional perspective can help us to better understand how the demand for relatively homogeneous environmentally sustainable initiatives are implemented in such a diverse way (Dubey et al., 2019; Gong et al., 2019). For example, pressures from customers (global) or regulations (standard and global) are expected to push the adoption of SSCM practices homogenously. In this sense, by incorporating cultural factors into the analysis, this study tries to improve the understanding of the heterogeneity in the proactivity of companies regarding environmental issues. In addition, the literature review suggests that very few studies have explored the effect of the driving forces on environmental sustainability at a cross-national/cross-cultural level (Calza et al., 2016; Song et al., 2018). Miras-Rodríguez et al. (2018) show that the effect of drivers on environmentally sustainability practices varies in different cultural contexts. This study suggests that the effect

of NC depends on which cultural dimensions are dominant in each country localisation as well as the type of SSCM practices adopted.

The paper is organised as follows: section two presents the theoretical background, the section three explains the development of the hypotheses, and the data and methodology are described in section four. Sections five and six present the data analysis and discussion, while the last section discusses the conclusion, limitations and implications of the study.

2. Literature Review and Hypothesis Development

2.1.Drivers of sustainability: Institutional perspective

SSCM is commonly defined as the voluntary integration of environmental considerations into manufacturing firms' supply chain management strategies (Ahi & Searcy, 2013). In the literature, environmental SSCM practices are typically classified into two main categories: internal and external (Zhu et al., 2013). Internal practices aim to enhance the performance of internal processes and may include initiatives such as pollution prevention and the implementation of internal environmental management systems. On the other hand, external practices are focused on ensuring that suppliers meet sustainability requirements and can be achieved through monitoring, including evaluation, assessment, audit and site visits, as well as collaboration through information sharing, communication, training and joint efforts (Gimenez & Tachizawa, 2012).

Institutional theory explains how different kinds of external factors derive organisations to adopt and pursue specific organisational behaviour (Dubey et al., 2019; Saeed & Kersten, 2019). Institutional theory has been built on the idea of invisible institutional environment that influence organisations to be conformed to the collective norms, rules, values and beliefs of the environment (Horak et al., 2018). From this perspective, the level of both environmental engagement and the adoption of SSCM practices are influenced by institutional pressures (Dai et al., 2021; Schoenherr et al., 2014; Tachizawa et al., 2015). These pressures, which are coercive, normative and mimetic, collectively push organisations to align their actions with their institutional environment, thus causing organisations within an industry to become isomorphic (DiMaggio & Powell, 1983).

Coercive pressure fundamentally refers to utilising force or threats (Marculetiu et al., 2023). It can be in the form of formal mechanisms through environmental regulations, standards or laws (Esfahbodi et al., 2017) or informal mechanisms through pressure from

customers (Dai et al., 2021; Zailani et al., 2012), managers and owners (Marculetiu et al., 2023; Nath & Eweje, 2021) to implement environmental initiatives for conformity purposes. Normative pressures occur by both external and internal factors. External factors refer to pressures from customers, suppliers or social groups through values, common beliefs and standards of conduct causing firms to seek legitimacy and good reputations (Chu et al., 2019; Sancha et al., 2015). Internal normative factors refer to the actions of managers and employees that can exert a kind of normative pressure to implement specific organisational behaviour from professionalisation (DiMaggio & Powell, 1983; Marculetiu et al., 2023). Finally, mimetic pressures arise from uncertainty behind environmental sustainability practices, technology and ambiguities in goals, thus encouraging firms to imitate the actions of their successful competitors or collaborators (Agarwal et al., 2018).

Previous studies suggest that to explain the environmental proactivity of firms, not only external institutional drivers but also internal factors of firms should be considered (Walker et al., 2008). In particular, managers who foster a kind of coercive/normative pressures within their companies (DiMaggio & Powell, 1983) as well as perceive the institutional pressures and decide on the level of response to those pressures (Dubey et al., 2019; Shibin et al., 2020). Therefore, adopting SSCM practices requires a great deal of pressure from internal factors and external pressures (Agarwal et al., 2018; Zhu et al., 2013), which together lead organisations to homogenisation or isomorphism, by which firms become similar in strategies, practices and performance (Roy & Goll, 2014).

Following previous studies (Danese et al., 2019; Miras-Rodríguez et al., 2018), the drivers of sustainability are divided into internal drivers (managers, employees and owners/shareholders) and external drivers (government regulation pressures and customer pressures).

2.2.National culture and environmental sustainability

The study of cross-national cultures has emerged as a crucial area of inquiry within the field of management, particularly since the onset of economic globalisation in the 1980s (Tung & Verbeke, 2010). This research is essential in comprehending the diverse cultural nuances that impact organisational behaviour and has facilitated the development of effective cross-cultural management strategies. NC refers to shared societal practices and values that are manifested in the behaviours, beliefs and interactions of society members, including organisations, policymakers and individual persons (Calza et al., 2016). It makes a nation

different from other nations (Hofstede, 2001), which is very challenging for international business and global operations (Luthans & Doh, 2018).

Various models have been developed to study the effects of cultural differences within organisations (Shi & Wang, 2011). Of these models, the Hofstede model (Hofstede, 1980) and the GLOBE model (House et al., 2004) have received considerable attention and have been applied extensively in research (Miska et al., 2018). These models offer valuable insights into the cultural dimensions that shape organisational behaviour and have been instrumental in guiding cross-cultural management practices. Both models also provide scholars with extensive insights into the structure and effects of NC by identifying and quantifying various cultural dimensions (Wang et al., 2021). The Hofstede model delineates six cultural dimensions, namely power distance, uncertainty avoidance, individualism/collectivism, masculinity/femininity, long/short-term orientation and indulgence/restraint. On the other hand, the GLOBE model highlights nine cultural dimensions, including power distance, uncertainty avoidance, performance orientation, assertiveness, future orientation, humane orientation, institutional collectivism, in-group collectivism and gender egalitarianism. These models provide researchers with a valuable framework for analysing cultural differences and have been widely utilised in cross-cultural management studies.

Hofstede's influence in management studies is huge. For instance, his book "*Culture's consequences: International differences in work-related values*" has received more than 70,000 citations. However, some scholars criticise this model of culture because of its research methodology, accuracy and outdatedness (Horak et al., 2018), as well as because it does not make a distinction between cultural characteristics like values and practices (Miska et al., 2018). The project GLOBE is more recent and considers NC as the shared values and practices of a country (Calza et al., 2016). Its cultural dimensions are developed for both actual society practices "as is" and for values as they "should be" (House et al., 2004). This paper follows GLOBE model and uses the dimensions of cultural practices because cultural practices might be better indicators of the adoption of sustainability practice (Miska et al., 2018).

Scholars have attempted to build a conceptual framework for explaining how the antecedents of sustainability may be affected by NC (Chwialkowska et al., 2020; Horak et al., 2018; Tata & Prasad, 2015), but few studies empirically examine the moderating role of NC (Song et al., 2018). By using the Governance Environment Index in reference to culture at a

national level, Miras-Rodríguez et al. (2018) find that the effect of drivers on environmental sustainability practices varies in different cultural contexts. Employing cultural characteristics from the project GLOBE, Power et al. (2015) observe that different cultural dimensions have different moderation effects on the environmental investment behaviour of manufacturing firms. These results suggest that NC plays a crucial role in the adoption of sustainability practices (Wang et al., 2021).

Although there is not a general consensus on which cultural dimensions are the most relevant for the study of environmental sustainability in manufacturing, previous studies consider that dimensions of power distance (PDI), uncertainty avoidance (UVI) and institutional collectivism (ISC) might play a role in inspiring the adoption of these practices (e.g. Hur & Kim, 2017; Miska et al., 2018; Song et al., 2018). In addition, these dimensions overlap in Hofstede and GLOBE models, allowing for greater generalisability of their effects on the environmental sustainability.

According to House et al. (2004), PDI indicates "the extent to which the community accepts and endorses authority, power differences, and status privileges", UVI determines "the extent to which a society, organization, or group relies on social norms, rules, and procedures to alleviate unpredictability of future events", and ISC influences "the degree to which organizational and societal institutional practices encourage and reward collective distribution of resources and collective action" (https://globeproject.com/study_2004_2007).

3. Hypotheses Development

3.1.The effect of external drivers

Government regulatory pressures: This is a formal mechanism of coercive pressures. It takes place when powerful parties (governmental agencies or regional/international regulators) exert an influence on other parties through setting laws, standards, regulations and procedures (Hsu et al., 2013; Tachizawa et al., 2015). Non-compliance behaviour can generate legal penalties and fines, which have negative effects on performance and reputation (Sajjad et al., 2015; Schrettle et al., 2014). Previous studies relate regulatory pressures with green procurement and sustainable distribution (Esfahbodi et al., 2017), implementing ISO 14001 (Dai et al., 2021), monitoring practices to assure the compliance behaviour of their suppliers (Khurshid et al., 2021) as well as cooperative practices regarding environmental practices (Hoejmose et al., 2014).

Customer pressures: Customers rely on market power to exert coercive pressure on the supply chain (Wang et al., 2018) by demanding environmental standards or directly influencing product specifications (Dai et al., 2021; Zailani et al., 2012). Moreover, by stemming normative pressures through their values, awareness and expectations (Schrettle et al., 2014), customers motivate manufacturing firms to adopt environmental initiatives (Walker et al., 2008). They can inspire the whole supply chain to be involved in environmental sustainability (Gong et al., 2019). Evidence in this line supports the role of customer pressures on the adoption of environmental practices. For instance, Hoejmose et al. (2014) show that manufacturers push their suppliers to adopt environmental practices under the coercive influence of customer´s requirements and expectations. Chu et al. (2019) find that customers' environmental requirements push firms to undertake green innovations to improve and design environmentally friendly packaging (reusable or recyclable packaging). Yen (2018) observes that customer demands for sustainability raise pressure on manufacturing firms to collaborate with their suppliers in order to pass along customer pressures to them. We thus posit the following hypothesis:

H1: External drivers have a positive effect on the adoption of both internal and external environmental SSCM practices.

3.2.The effect of internal drivers

Managers: Top managers are responsible for the formulation and adoption of environmentally focused strategies and policies, the promotion of an environmentally friendly culture, the provision of resources, training and incentives to ensure that SSCM practices are implemented (Dai et al., 2021). Their commitment and participation are key for appropriate responses to institutional pressures (Dubey et al., 2019) and critical to comprehend the stakeholder pressures (Kitsis & Chen, 2021). Through their professionalisation, managers exert normative pressures within their organisations to implement environmental practices (Stoughton & Ludema, 2012) and to imitate the environmental actions of successful companies (Agarwal et al., 2018). In addition, their power in the organisation can exert pressure for the effective adoption of formulated policies, procedures and environmental codes with supply chain actors (Nath & Eweje, 2021). Previous studies have reported that the adoption and implementation of SSCM practices and their effectiveness are positively related to top management commitment, their beliefs and perceptions about sustainability (Chacón Vargas et al., 2018; Shibin et al., 2020). Evidence also shows that top management commitment diffuses sustainability concerns to suppliers by

establishing sustainability-focused supplier relationship management (Blome et al., 2014). Committed managers are more likely to provide the necessary help and support to their suppliers (Kumar & Rahman, 2016).

Employees: Employees play an important role in the successful adoption and implementation of environmental sustainability practices (Walker et al., 2008; Wolf, 2013). Through professionalisation, employees can pressure firms and suppliers to follow environmentally focused organisational norms and to solve environmental issues similarly to their industry networks and peers (DiMaggio & Powell, 1983). Hence, their motivation and encouragement is crucial for SSCM practices (Longoni et al., 2018), which in turn enable organisational changes to implement an environmentally friendly culture (Wolf, 2013). Evidence from the field reports that manufacturing firms´ operational and environmental improvements rely on the employees' involvement (Hanna et al., 2000) because they have knowledge about the source of environmental issues, such as pollution and waste in operation process (Zhang & Yang, 2016). Farooq et al. (2019) find that employee participation in decision-making fosters the organisational goals regarding environmental practices through motivating them to express their suggestions, make decisions and pursue their environmental sustainability targets. Other scholars also reveal support for linking employee involvement and motivation with external SSCM practices with suppliers through the diffusion of environmental values and requirements in cross-functional teams and with suppliers (Longoni et al., 2018; Yu et al., 2020).

Owners/shareholders: The pressure from owners and shareholders to adopt proactive environmental actions is generally due to their environmental awareness as well as the benefits associated with good environmental performance, such as increased efficiency and improved reputation (Testa et al., 2018). In addition, their moral and ethical attitude can also exert normative pressures to value sustainability across the supply chain (Sajjad et al., 2020). In this sense, cost-saving reasons (economic rational/efficiency) are expected to induce manufacturing firms to introduce environmental improvements in their processes and products (Glover et al., 2014; Horbach et al., 2012; Wang et al., 2018). Environmental practices are therefore an opportunity to increase efficiency and reduce cost in operations (Sajjad et al., 2015; Wong et al., 2020) and to address the owners' expectations for reducing costs and waste (Marculetiu et al., 2023) by the efficient use of energy, water and materials and by preserving the natural resources (Walker et al., 2008). Testa et al. (2018) find a link between owner/shareholder pressures and the implementation of environmental management

practices. Claro and Esteves (2020) show that owners also apply pressure for the adoption of external sustainability practices. Involving suppliers in green procurement facilitates the development of environmentally friendly products and services, thereby reducing the environmental impact of waste and emissions and improving costs and the firm's reputation (Esfahbodi et al., 2017). We thus posit the following hypotheses:

H2: Internal drivers have a positive effect on the adoption of both internal and external environmental SSCM practices.

3.3.Moderation effect of NC

According to institutional theory, the levels of pressures exerted by sustainability drivers can be conditioned by the institutional context (Gouda & Saranga, 2020). In this regard, scholars have stated that NC and institutions are two interrelated concepts that mutually influence each other (Horak et al., 2018). Culture at the national level itself is part of the institutional environment (Peng & Zhang, 2022) but simultaneously influences the political, social, economic and legal institutional environment embedded in a firm (Hofstede et al., 2010).

As an informal institutional factor (Scott, 2001), NC establishes divergent moral and ethical orientations, values and beliefs in the society, which in turn can influence the institutional environments (Hofstede et al., 2010; Peng & Zhang, 2022) and society´s expectation of organisations (Ringov & Zollo, 2007). It also affects the ethical orientation and values of the society (Hur & Kim, 2017), shaping their value and attitudes towards environmental issues, such as natural resources consumption (Husted, 2005). In turn, it influences firm stakeholders' perceptions and concerns about the importance of the natural environment (Ringov & Zollo, 2007) and the development of environmental government regulations (González-Benito & González-Benito, 2006). Thus, there is an expectation that the interaction between NC and sustainability drivers moderates the relationship between environmental concerns (pressures) and sustainability behaviours (adoption practices) (Chwialkowska et al., 2020). As a result, firms in different cultural contexts may respond to the institutional pressures differently and may have different levels of organisational commitment to adopting environmental sustainability practices depending on which cultural values are dominant (Horak et al., 2018)[2].

[2] It is noteworthy that the ANOVA analysis shows that the variation in variance of SSCM practices for our sample is considerably attributed to the firms (within countries). This finding on one hand does not allow us to apply hierarchical regression analysis but to statistically confirm that the heterogeneity in the adoption of sustainability comes from the firm´s (or industry´s) contextual elements.

Moderation effect of uncertainty avoidance (UVI): In high UVI cultures, characterized by an inherent discomfort with ambiguity and uncertainty, companies are profoundly influenced by government regulations, customer expectations and shareholder demand, as they offer a predictable framework for companies to operate within (House et al., 2004). These well-defined rules, norms and demands minimize outcome unpredictability (House et al., 2004) – crucial for risk-taking activities such as in-house sustainability adoption as well as sustainable-focused buyer-supplier practices (Kumar and Rahman, 2015). In UVI cultures, these pressures are perceived as more pronounced because they provide a roadmap to mitigate uncertainty and risks related to sustainability along with their supply chain (Wang et al., 2021). Consequently, companies are driven to establish formalized supply relationships that emphasize clear rules (Miska et al., 2018) and to promote buyer-supplier collaboration (Yen, 2018).

In contrast, companies operating in high UVI cultures perceive pressures from managers and employees as less urgent. They exhibit a greater reluctance to embrace sustainability practices. This reluctance stems from the anticipation of significant changes, the need for extensive training, and rigorous monitoring of existing processes (Tata and Prasad, 2015). Implementing these changes can increase costs (Song et al., 2018), jeopardizing the short-term return on sustainability investments (Horak et al., 2018). Consequently, high UVI cultures hinder managerial and employees´ intention to incorporate sustainability in their own organizations and in buyer-supplier relationship, often limiting their focus to ISO certifications and adopting monitoring-based approaches (Orcos et al., 2018).

H1: The moderation effect of UVI on the relationship between sustainability drivers and adoption of environmental SSCM practices is:

- *Positive for Government regulatory pressures, Customer pressures and Owners/Shareholders.*
- *Negative for Managers and Employees.*

Moderation effect of power distance (PDI): In high PDI cultures, where there is an unequal power distribution and a clear hierarchy, power assumes a distinctive role (House et al., 2004). It ensures "social order, fosters relational harmony, and maintains stability" for authoritative figures like the government, customers, or owners (Miska et al., 2018). The perceived coercive pressures from these actors are intensified, allowing them to exert greater

influence on organizations to adopt environmental practices (Horak et al., 2018). In such scenario, "formal rules and guidelines" have greater importance as controlling tools used by superiors to define expectations on ethical and behavioral codes. This includes relations with stakeholders, compliance procedures, and legal items (Vitolla et al., 2021). Within this cultural context, companies often sense amplified normative pressures from customers to conform to their requirements through environmental conduct (Song et al., 2018). Likewise, high PDI cultures tend to enhance pressures from owners/shareholders and managers, urging companies to adhere to the rules and regulations affecting supply chain activities. These heightened pressures strengthen companies' sense of obligation towards key stakeholders and society, driving them to pursue corporate sustainability practices (Miska et al., 2018). Furthermore, environmental sustainability may act as a tool to safeguard authority over suppliers (Song et al., 2018), motivating them to implement supplier-focused sustainability practices (Husted, 2005).

However, from an employees' standpoint, the loyalty and respect for authority, coupled with a limited latitude to challenge assumptions (Horak et al., 2018) – characteristic of high PDI cultures (House et al., 2004) – can hamper workers' ability to pressure companies on the adoption of environmental practices. In such scenario, employee voices tend to be subdued (Lin et al., 2019). As a result, employees might find themselves powerless in altering company decisions or flagging potential issues to superiors without drawing scrutiny (Gupta and Gupta, 2019). This can lead to missed opportunities to fully realize the potential of SSCM.

H2: The moderation effect of PDI on the relationship between sustainability drivers and adoption of SSCM environmental practices is:

- *Positive for Government regulatory pressures, Customer pressures, Managers, and Owners/Shareholders.*
- *Negative for Employees.*

Moderation effect of institutional collectivism (ISC): In high ISC cultures, where the emphasis is on what benefits the society as a whole (House et al., 2004), pressures to adopt SSCM practices are likely heightened. In such environments, companies might perceive increased coercive pressures from governmental regulations that aim to align governmental policies with societal norms (Song et al., 2018; Horak et al., 2018). To achieve legitimacy,

companies often prioritize environmental directives set by governments (Roy and Goll, 2014; Tata and Prasad, 2015).

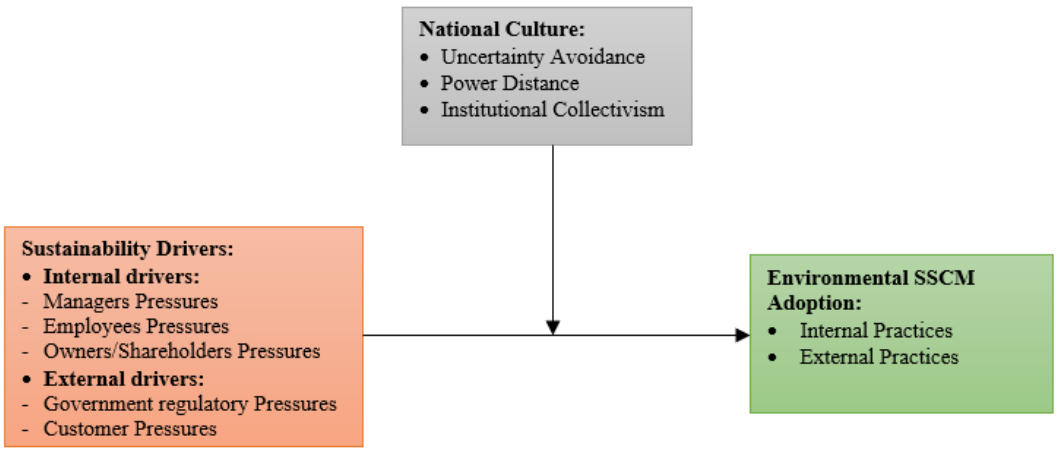
Conversely, pressures from customers for environmental sustainability are often seen as less pressing. This perception arises because commercial-based socialization and professionalism, regarded as sources of normative pressure, tend to resonate more with individualist cultures than collectivist ones (Azadegan et al., 2018; Horak et al., 2018). Pressures from managers for adopting SSCM practices necessitate a degree of individual freedom and voluntarily actions to be effective (Husted, 2005). Such effectiveness is limited in high ISC contexts, leading companies to primarily focus on adhering to internal environmental management standards (Orcos and Palomas, 2019) rather than adopting a more proactive approach including collaboration with suppliers (Wang et al., 2023). In high ISC societies, where collective goals prevail over individual employee objectives (House et al., 2004), the drive from employees to implement SSCM practices is lessened. This is because SSCM practices may not always align with the prevailing institutional priorities (Calza et al., 2016). Similarly, shareholders might be less effective in incentivizing SSCM if its implementation is perceived to disrupt company harmony by provoking conflicting viewpoints.

H3: The moderation effect of ISC on the relationship between sustainability drivers and adoption of SSCM environmental practices is:

- *Positive for Government regulatory pressures.*
- *Negative for Customer pressures, Managers, Employees and Owners/Shareholders.*

The structural model of this study is presented graphically in Figure 1.

Figure 1: Structural Model



4. Methodology

4.1.Sampling

The sample used in this study is a part of the research efforts for the fourth HPM project, which was conducted by 25 international research teams across the world from May 2012 to February 2016. The HPM is a large-scale, multi-country and multi-industry project that was designed to analyse the operation of manufacturing plants and their impact on the plant performance (Wang et al., 2018). The plant sample was selected randomly from the master list of manufacturing plants in each country from the mechanics, electronics and transportation equipment industries. Data has been obtained through survey method by the local research team in each country. Each team was responsible for translating the questionnaires from English language into the local language, approaching the sample plants, distributing the questionnaire, instructing the respondents and collecting the completed questionnaires.

The HPM project developed a set of 12 types of questionnaires, each of which was related to a specific topic of plant functions (e.g. upstream/downstream supply chain management, supervision and plant management) (Danese et al., 2019). A panel of experts reviewed the questionnaires, and the survey was pre-tested in several plants to assure the reliability and validity of the measures and the understandability of the questions by different respondents (Ahmadi-Gh & Bello-Pintado, 2022). Each questionnaire (except the accounting section) was submitted to and answered by two different informants in the plant for the purpose of reducing the risk of item non-response bias and common-method bias (Miras-Rodríguez et al., 2018). Regarding sustainability practices and drivers, both the Environmental Affairs Manager and the Plant Manager answered the questions. The sample for this study was composed of 284 manufacturing plants from 14 countries. Table 1 reports the data distribution according to the sector and country.

4.2.Measures

The “environmental affairs” questionnaire section of HPM project was considered for this study. Respondents were asked to list different initiatives related to environmental issues in response to the following: “Please indicate the degree to which your plant is engaged in the following initiatives/practices”. These items later have been used to create two constructs for environmental SSCM practices (Wang et al., 2018). In line with previous studies, these constructs were termed ISP (internal SSCM practices) and ESP (external SSCM practices)

(e.g. Ahmadi-Gh & Bello-Pintado, 2022). These two bundles of environmental sustainability practices are considered dependent variables.

The questionnaire also contained items regarding sustainability drivers. In this case, the respondents were requested to complete the following statement: "My plant's involvement in environmental initiatives has been motivated by...". Following Danese et al. (2019), five constructs developed as independent variables termed D_Mngr (managers), D_Empl (employee), D_Shldr (owner/shareholder pressures), D_Cstm (customer pressures), D_Rgln (government regulatory pressures). All the constructs used in this study (e.g. three types of sustainability practices and five sustainability drivers) are multi-items based on 5-point Likert-type scales from 1 (strongly disagree) to 5 (strongly agree), which have already been validated in the academic literature (e.g. Danese et al., 2019; Miras-Rodríguez et al., 2018; Wang et al., 2018). The measurement properties of the constructs are presented in Appendix A.

Each company is known also through the country code that allows us to identify NC characteristics and other country traits. For this purpose, we utilised the Globe cultural practices country scores (House et al., 2004). Data on the three national cultural dimensions of UVI, PDI and ISC have been retrieved and assigned to the HPM companies.

Regarding control variables, at the company level, we captured the effect of the plant size and industry sector. Plant size is measured by the number of employees and is expected to positively influence the adoption of environmental sustainability practices (Miska et al., 2018). The manufacturing sector to which a plant belongs was taken into account as a control variable for specific features related to the industry-sector influence on the adoption of SSCM (Ahmadi-Gh & Bello-Pintado, 2022). Regarding control variables at the national level, previous studies reported that the difference in national wealth and national levels of pollution can be associated with the implementation of environmental practices (Azadegan et al., 2018; Song et al., 2018; Walker et al., 2008). Hence, we considered gross domestic product (GDP) per capita as a proxy for economic development and gross greenhouse gas emission (GHG) per capita as an indicator for the national level of environmental performance using the statistics of the World Bank (see Table 1).

Table 1: Country Profile

Country	Electronics	Mechanical	Transportation Equipment	No. of Sample plants	GDP Per Capita (USD) of 2013	Metric tons of CO2 per capita of 2013	National Culture (Value)		
							UVI	PDI	ISC
Austria	1	6	1	8	42600	9.15	3.66	2.44	4.73
Brazil	3	7	11	21	11700	5.03	4.99	2.35	5.62
China	10	14	4	28	9100	8.49	5.28	3.1	4.56
Spain	7	6	10	23	30100	6.57	4.76	2.26	5.2
Finland	6	6	5	17	35800	11.69	3.85	2.19	4.11
Germany	6	12	8	26	38700	11	3.63	2.615	4.75
Israel	16	2	0	18	33900	11.46	4.38	2.72	4.27
Italy	7	17	5	29	29800	7.05	4.47	2.47	5.13
Japan	6	7	9	22	35900	10.55	4.33	2.86	3.99
Kora	8	5	13	26	31900	13.43	4.67	2.55	3.9
Sweden	4	4	1	9	40300	5.29	3.6	2.7	3.94
Switzerland	2	0	1	3	44900	6.34	3.16	2.44	4.69
Taiwan	19	10	1	30	38400	9.74	5.31	3.09	5.15
UK	4	5	4	13	36600	8.45	4.11	2.8	4.31
USA	3	5	3	11	51700	19.9	4	2.85	4.17
Total	102	106	76	284					

5. Data Analysis

5.1.Exploratory factor analysis (EFA)

First, all the items used in the analysis were tested for normality and standardised to avoid issues of multicollinearity (Cohen et al., 2003). Since the missing values were less than 10%, missing values of the independent variables were treated by replacing the average for each item. EFA was then used to determine the latent variables and their respective items. By entering all the items into principal component analysis (unrotated solution), Harman's single factor test indicated that the total variance explained by a single factor was 0.4719, confirming that common method variance is not a serious issue in this study (Podsakoff et al., 2003). Further, the adequacy of the sample was tested through the Keiser–Meyer–Olkin (KMO), with a result of 0.9328 and Bartlett's tests of sphericity with a result of chi-square 8833.924, $p < 0.001$, indicating that the dataset is suitable for a data-reduction technique. EFA finally reports eight factors with eigenvalues above 1 (see Appendix A).

Table 2 presents the correlation between the main variables of the study (see Table 2).

Table 2: Correlation Matrix (All variables are standardized)

Variables	ISP	ESP	D_Mngr	D_Empl	D_Shldr	D_Rgln	D_Cstm	UVI	PDI	ISC
ISP	1.0000									
ESP	0.6619*	1.0000								
D_Mngr	0.6292*	0.5315*	1.0000							
D_Empl	0.5319*	0.5232*	0.6353*	1.0000						
D_Shldr	0.3151*	0.3307*	0.3929*	0.4159*	1.0000					
D_Rgln	0.4758*	0.3643*	0.5125*	0.3853*	0.3243*	1.0000				
D_Cstm	0.5169*	0.5729*	0.5047*	0.4917*	0.2733*	0.4975*	1.0000			
UVI	0.1261*	0.2223*	0.1122	0.0377	-0.0005	0.0299	0.2176*	1.0000		
PDI	0.1499*	0.2936*	0.2054*	0.1618*	0.1151	-0.0238	0.2592*	0.4144*	1.0000	
ISC	0.0862	-0.0488	0.0283	-0.0218	-0.0497	0.0821	-0.0118	0.4099*	-0.1740*	1.0000

5.2.Hypotheses tests

A multiple regression analysis was then conducted for each individual bundle of practices to test the research hypotheses. The analysis was preliminarily performed by using a metric known as the variance inflation factor (VIF) as well as by plotting the residual versus predicted values to ensure no violation of multicollinearity and homoscedasticity. All the VIF values were below the cut-off of 5 (Cohen et al., 2003), with 1.79 as the greatest value, thereby showing that multicollinearity was not a problem in this study. Further, the examination of scatterplots of residuals indicated that our regression output was also free from homoscedasticity.

Estimation results can be observed in Tables 3 and 4. Model 1 in both tables capture the isolated effect of control variables on the adoption of internal (Table 3) and external (Table 4) environmental practices. Subsequent models (model 2 and model 3a to 3c) capture the individual effect of drivers as well as the effect of interaction with NC dimensions on both types of environmental practices.

The results presented in Model 2 (Tables 3 and 4) demonstrate a positive relationship between external drivers and the adoption of internal environmental practices. Government regulations and customer pressures show a positive and significant relationship with ISP (β_1 = 0.129; β_2 = 0.174, respectively). Additionally, customer pressures also explain the adoption of external environmental practices (β_2 = 0.337). These results provide support to H1, but not full acceptance, since government regulatory pressures do not exhibit a statistically significant effect on the adoption of external practices (Table 4). Regarding internal drivers,

estimation results of Model 2 in Tables 3 and 4 show that manager and employee pressures have an effect on the adoption of both internal environmental practices ($\beta_3 = 0.367$; $\beta_4 = 0.132$, respectively) as well as with the adoption of external practices ($\beta_3 = 0.210$, $\beta_4 = 0.173$, respectively). No statistically significant relationship was reported for the effect of owner/shareholder pressures. This result partially supports H2 but does not lend full support. No all drivers have a similar effect on different environmental sustainability practices.

Model 3a to 3c in Tables 3 and 4 present the estimation results when the three cultural dimensions interact with drivers. The results reveal that UVI, PDI, and ISC moderates the effect of some drivers. In this regard, the result shows that UVI negatively moderates the relationship between employee pressures and internal environmental practices; that is, the interaction between both is negative and statistically significant ($\beta = -0.153$, $p < 0.05$). On the other hand, UVI positively moderates the relationship between owners/shareholders and the adoption of external environmental practices since the interaction between both variables is positive and statistically significant ($\beta = 0.118$, $p < 0.05$). This result partially supports H3a. Regarding the moderation effect of PDI, it has been observed that PDI positively moderates the relationship between owner/shareholder pressures and the adoption of internal sustainability practices ($\beta=0.165$, $p<0.01$). No moderation effect is observed for the link between drivers and external environmental practices. It brings us to partially support H3b.

Finally, regarding the moderation effect of ISC, the findings exhibit that ISC negatively moderates the relationship between managers and the adoption of internal environmental practices ($\beta = -0.139$, $p < 0.10$). On the other hand, ISC also interacts with external drivers of customer and government regulatory pressures. A negative moderation effect is observed for customer pressures to explain the adoption of external environmental practices ($\beta = -0.134$, $p < 0.05$), while it positively moderates the relationship between government regulatory pressures and the adoption of internal practices. ($\beta = 0.124$, $p < 0.05$). These results partially support H3c.

The results presented in Model 1 (Table 3 and Table 4) show a positive relationship between firm size with two sets of environmental practices (ISP: $\beta = 0.229$, $p < 0.01$; ESP = 0.223, $p < 0.01$), while the country wealth (GDP per capita) has a negative significant relationship with external practices (ISP: $\beta = -0.049$, $p > 0.10$; ESP: $\beta = -0.169$, $p < 0.05$). In addition, the country´s GHG emission index has only a negative significant association with the adoption of internal environmental practices (ISP: $\beta = -0.130$, $p < 0.10$; ESP = -0.017, $p >$

0.10). None of the industry dummy variables have any significant controlling effect on the SSCM practices.

Table 3- Multiple Regression Analysis result - Internal SSCM Practices (ISP)

Variables:	model 1	model 2	model 3a	model 3b	model 3c
Control variables:					
Size	0.229***	0.122***	0.120***	0.105***	0.108***
Ind1	0.046	0.026	0.016	0.055	0.066
Ind2	0.082	0.057	0.055	0.047	0.082
GDP per Capita	-0.049	-0.008	-0.022	0.002	0.005
GHG per Capita	-0.130*	-0.098**	-0.090*	-0.100**	-0.085
Sustainability Drivers					
D_Rgln		**0.129****	**0.142****	**0.103***	**0.146****
D_Cstm		**0.174*****	**0.177*****	**0.157****	**0.172*****
D_Mngr		**0.367*****	**0.319*****	**0.357*****	**0.314*****
D_Empl		**0.132***	**0.155****	**0.142****	**0.154****
D_Shldr		0.010	0.021	0.079	0.038
Cultural Dimensions:					
UVI			-0.011		
PDI				0.007	
ISC					0.007
Moderation Effect:					
UVI*D_Rgln			0.107		
UVI*D_Cstm			0.001		
UVI*D_Mngr			-0.051		
UVI*D_Empl			**-0.153****		
UVI*D_Shldr			0.117		
PDI*D_Rgln				-0.043	
PDI*D_Cstm				-0.041	
PDI*D_Mngr				-0.047	
PDI*D_Empl				0.032	
PDI*D_Shldr				**0.165*****	
ISC*D_Rgln					**0.124****
ISC*D_Cstm					-0.012
ISC*D_Mngr					**-0.139***
ISC*D_Empl					-0.041
ISC*D_Shldr					0.007
No. Observation	284	284	284	284	284
F	3.38	26.80	20.37	17.77	20.15
Prob	0.0056	0.0000	0.0000	0.0000	0.0000
R-Squared	0.0758	0.4986	0.5158	0.5193	0.5212

*$p < 0.10$; **$p < 0.05$; ***p < 0.01

Table 4- Multiple Regression Analysis result - External SSCM Practices (ESP)

Variables:	model 1	model 2	model 3a	model 3b	model 3c
Control variables:					
Size	0.223***	0.099***	0.102***	0.062*	0.108***
Ind1	0.023	-0.002	-0.014	-0.086	0.066
Ind2	-0.093	-0.119	-0.124	-0.191*	0.082
GDP per Capita	-0.169**	-0.116**	-0.072	-0.078	0.005
GHG per Capita	-0.017	-0.006	-0.009	-0.042	-0.085
Sustainability Drivers					
D_Rgln		-0.017	0.004	-0.024	-0.002
D_Cstm		**0.337*** **	**0.314*** **	**0.318*** **	**0.355*** **
D_Mngr		**0.210*** **	**0.198*** **	**0.166*** **	**0.178*** **
D_Empl		**0.173****	**0.175****	**0.212*** **	**0.169****
D_Shldr		0.084	0.085	0.080	0.084
Cultural Dimensions:					
UVI			0.071		
PDI				**0.140*** **	
ISC					**-0.123****
Moderation Effect:					
UVI*D_Rgln			-0.022		
UVI*D_Cstm			-0.107		
UVI*D_Mngr			-0.034		
UVI*D_Empl			0.012		
UVI*D_Shldr			**0.118****		
PDI*D_Rgln				-0.107	
PDI*D_Cstm				0.056	
PDI*D_Mngr				-0.033	
PDI*D_Empl				0.110	
PDI*D_Shldr				0.005	
ISC*D_Rgln					0.042
ISC*D_Cstm					**-0.134****
ISC*D_Mngr					-0.038
ISC*D_Empl					-0.046
ISC*D_Shldr					0.070
No. Observation	284	284	284	284	284
F	4.37	22.28	18.13	17.42	15.01
Prob	0.0008	0.0000	0.0000	0.0000	0.0000
R-Squared	0.0818	0.4616	0.4771	0.4894	0.4974

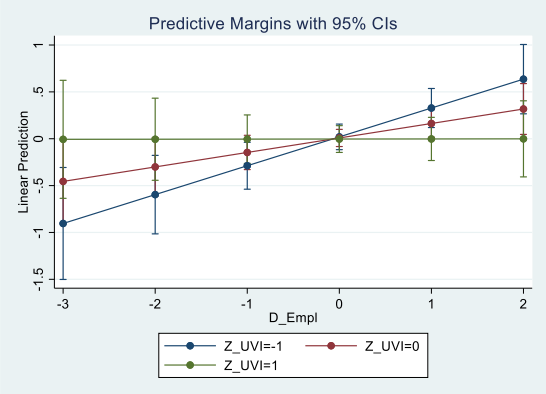
*p < 0.10; **p < 0.05; ***p < 0.01

5.3.Post-hoc analysis

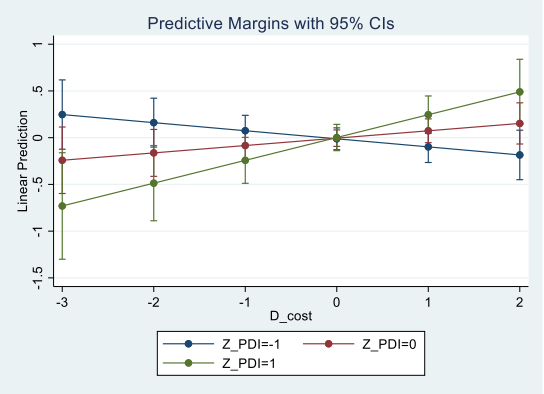
The post analysis results indicate NC's influence with respect to the link between sustainability drivers and environmental sustainability practices. For this purpose, the plotting

analysis has been conducted to demonstrate a simple slope of five sustainability drivers at 'low', 'medium' and 'high' levels of NC dimensions for each set of SSCM practices.

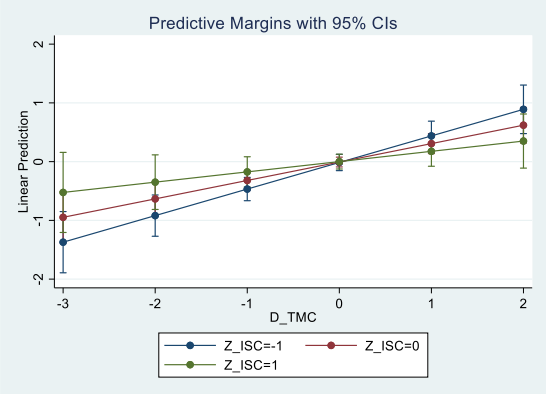
Figure 2: Interaction Plots



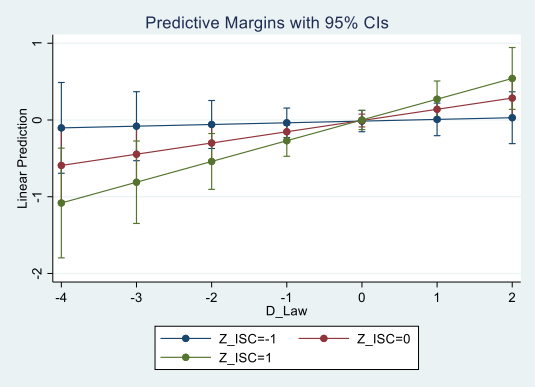
The moderation effect of UVI on the link between D_Empl and ISP.



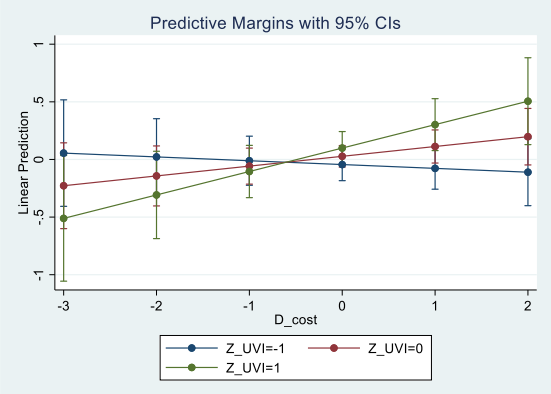
The moderation effect of PDI on the link between D_Shldr and ISP.



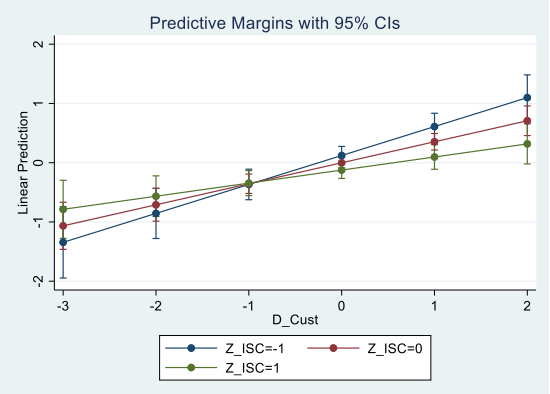
The moderation effect of ISC on the link between D_Mngr and ISP



The moderation effect of ISC on the link between D_Rgln and ISP



The moderation effect of UVI on the link between D_Shldr and ESP



The moderation effect of ISC on the link between D_Cstm and ESP

Figure 2 presents the moderation effect plots for only statistically significant findings, proposing that each driver can have either a positive or negative impact on environmental SSCM adoption and NC attributes affect not only the strength but also their direction. The first plot from the left shows that employees are effective for the adoption of internal SSCM practices at medium level (β=0.154, $p<0.05$) and low level (β=0.308, $p<0.01$) of UVI culture. It becomes insignificant when UVI is high (β=0.001, $p>0.1$). The second plot presents the enhancing effect of PDI, indicating that owner/shareholder pressures encourage the adoption of internal SSCM practices only at high level of PDI (β=0.244, $p<0.01$). The third and fourth plots exhibit that the adoption of internal SSCM practices is influenced by managers at the medium and low levels of ISC (β=0.313, $P<0.01$; β=0.452, $P<0.01$, respectively), while it is driven by regulatory pressures at the medium and high levels of ISC (β=0.146, $p<0.05$; β=0.270, $p<0.01$, respectively). The fifth plot shows that owner/shareholder pressures are effective for the adoption of external SSCM practices only when UVI is high (β=0.203, $p<0.05$). As shown in plot six, in all circumstances, customer pressures drive the adoption of external SSCM practices but the higher level of collectivism, the lower effect of customer pressures (high: β=0.220, $p<0.01$; medium: β=0.354, $p<0.01$; low: β=0.488, $p<0.01$).

6. Discussion

6.1.Direct effect of drivers

Consistent with prior research (Chacón Vargas et al., 2018; Kumar & Rahman, 2016; Shibin et al., 2020), our regression analysis confirms the critical importance of managers in promoting sustainability within organisations. Given their influential positions and expertise, managers possess the knowledge and ability to not only comprehend external regulatory and customer pressures (Dubey et al., 2019) but also to integrate sustainability guidelines and environmental policies into firm-level strategies and supply chain activities. By institutionalising these sustainability practices, managers can drive positive environmental outcomes throughout the organisation and its broader network.

The findings of this study also confirm the importance of employees in environmental SSCM adoption (Yu et al., 2020). Their professionalisation makes them aware of environmental concerns and solutions, new industry/social norms and new ways of thinking (Glover et al., 2014). As a consequence, they are able to diffuse sustainability values and

principles and may have better solutions for sustainability issues with suppliers (Longoni et al., 2018).

This study could not find support for owner/shareholder pressures. It seems that this factor is not sufficiently powerful to trigger manufacturing firms to adopt environmental practices internally and extend them to suppliers. This finding is in contrast with the general assumption concerning the important role of cost-saving goals determined by owners in motivating managers to undertake environmental initiatives (Horbach et al., 2012; Wang et al., 2018). Within the institutional theoretical perspective, the desire to be legitimated by customers and regulators is stronger than efficiency purposes or environmental legislation demanded by shareholders/owners (Danese et al., 2019).

In line with the statement of institutional theory, the results confirm the logic that manufacturing firms adopt environmental sustainability practices because of perceived pressures to conform to the regulations and environmental standards as well as to meet customers' requirements. This finding supports previous studies on the adoption of internal SSCM practices (Dai et al., 2021; Esfahbodi et al., 2017).

However, government regulatory pressures could not be linked to the adoption of external SSCM practices, in contrast to the findings of Khurshid et al. (2021) and Tachizawa et al. (2015). A possible explanation is that these types of activities are voluntarily in nature (Ahi & Searcy, 2013) and beyond compliance behaviour hidden in the nature of this type of pressure (Sancha et al., 2015). Being exposed to the coercive pressures arising from governmental regulations likely pushes top managers of manufacturing firms to internalise these pressures for addressing their own sustainability issues to avoid the sanctions and penalties rather than investing in the supplier side (Khurshid et al., 2021). To stimulate suppliers' sustainability practices, it seems that more effort, coordination, organisational changes and stronger incentives are needed (Hoejmose et al., 2014; Zhu et al., 2013).

Our findings highlight the crucial role of customers in driving proactive behaviours across the supply chain, consistent with previous research (Gong et al., 2019; Tachizawa et al., 2015). This contradicts the findings of Dubey et al. (2019), who did not find a link between customer pressure and sustainability practices among suppliers perhaps because suppliers are not directly exposed to the coercive or normative pressures of customers (Hofman et al., 2020). However, our results suggest that normative and coercive pressures from customers collectively inspire suppliers to seek environmental certifications and

implement various initiatives to maintain their relationships with manufacturing firms. Furthermore, our findings support the notion that the most powerful players in the supply chain – customers and managers of manufacturing firms – exert pressures through coercive structures such as purchasing contracts that are highly relevant to suppliers' sustainability practices (Glover et al., 2014).

6.2.The moderation effect of NC

Uncertainty avoidance (UVI): The result of this study exhibits that UVI culture has a negative interaction effect on the driving role of employees, which supports our expectations. One explanation is that, under characteristics of this culture, several formal/informal rules and written procedures for work processes are developed to predict behaviours and control the rights and duties of employees which can ignore the skills, self-autonomy and competencies of employees and inhibit their motivations (Agarwal et al., 2018). Hence, it may discourage employees from being involved in making decisions and suggesting ideas on sustainability issues.

On the other hand, UVI plays an enabling role by facilitating the effect of owner/shareholder pressures on the adoption of external SSCM practices. Further, although the interaction effect for internal practices is statistically insignificant, its magnitude is positive and relatively high compared to the direct effect. In line with our hypothesis, in this cultural setting, owners/shareholders driven pressures play a vital role in promoting environmental practices as they provide a roadmap to mitigate uncertainty and potential risk (Wang et al., 2021). More precisely, this strategic approach is driven by the need to address environmental risk avoidance pressures originating from owners and shareholder.

In line with our expectation, UVI negatively moderates the effect of managers on the adoption of environmental SSCM practices. This finding suggests that coercive pressures arising from governmental regulations, customer requirements and owners/shareholders force companies with respect to what to do, but it ignores managerial autonomy (Agarwal et al., 2018). It causes them to perceive sustainability as inconvenient (Tata & Prasad, 2015), with an uncertain return on investment (Horak et al., 2018). Therefore, they are not interested in developing new organisational practices, including environmental sustainability practices with uncertainty outcomes (Calza et al., 2016). As a response to those coercive pressures, top managers are more likely to undertake environmental initiatives that require minimum managerial actions, such as ISO certifications and monitoring-focused approaches (Agarwal

et al., 2018; Zhu et al., 2013) to avoid the negative consequence associated with non-compliance behaviours (Horak et al., 2018).

Power Distance (PDI): The findings of this study show that PDI facilitates the driving effect of owner/shareholder pressures for the adoption of internal SSCM practices. This result suggests that the power position of owners and shareholders are reinforced in this cultural setting. Thus, they exert stronger pressures on managers to internalise proactive environmental activities (Testa et al., 2018).

Unexpectedly, the result could not support any moderation effects for other drivers as well as for the adoption of external SSCM practices. Contrary to our primary assumption, these findings demonstrate that PDI is unable to boost the effect of the external institutional pressures on the adoption of different SSCM practices, suggesting that sustainability drivers function independently from this cultural attribute.

Institutional collectivism (ISC): The result demonstrates that ISC positively moderates the effect of government regulatory pressure on the adoption of internal SSCM practices, which is consistent with our primary assumption and could not support the proposition suggested by Horak et al. (2018). It suggests that firms in such a culture receive more coercive pressure from governmental regulations to protect the natural environment (Song et al., 2018).

In line with our hypothesis, the result exhibits that ISC negatively moderates the driving effects of customer pressures for the adoption of external SSCM practices consistent with (Song et al., 2018) as well as managers for the adoption of internal SSCM practices consistent with (Calza et al., 2016). These findings, however, are somehow in contrast with the notion that collectivism strengthens the belief and perception of sustainability (Tata & Prasad, 2015), leading managers to put more effort into sustainability adoption (Chwialkowska et al., 2020). It may be because collectivism weakens institutional capacity (Husted, 2005) to understand and respond to external pressures. Furthermore, ISC values loyalty to the institutions, which makes managers consider the interest of their organisations above the interest of society (Parboteeah et al., 2012). In general, managers strive towards short-term objectives such as short-term profitability and survival (Flammer et al., 2019). Hence, they may push for economic goals over sustainability goals within their companies and across their supply chain. This result suggests that in collectivistic cultures stakeholder pressures, in particular customer pressures, can be effective for sustainability adoption if

managers understand, prioritise and address them in their business strategies, organisational policies and supply chain management practices (Agarwal et al., 2018; Kitsis & Chen, 2021).

7. Conclusion, Implications and Limitations

This manuscript aims to contribute to the extant literature on environmental SSCM by providing empirical evidence of the distinct influences of key sustainability drivers on their adoption. Moreover, this study elucidates how cultural attributes of the operational environment of plants can account for heterogeneity in sustainability behaviours. Our results demonstrate that managers and customers wield significant power to exert both coercive and normative pressures, thus playing pivotal roles in shaping organisational behaviours towards sustainability.

By shedding light on the complex dynamics of environmental SSCM, this research underscores the crucial importance of stakeholder engagement and cultural factors in driving sustainable practices. Our findings contribute to the broader discourse on SSCM and offer practical implications for managers seeking to implement environmentally responsible practices.

In addition, this study has also shown that the impact of sustainability drivers on the adoption of sustainable practices is influenced by the cultural context of the country where plants operate. While pressures from owners and shareholders may not be sufficient to inspire sustainability adoption, cultures with high levels of UVI and PDI can facilitate these drivers and increase their impact. Additionally, institutional collectivistic cultures can increase the coercive power of regulatory pressures but diminish the driving effect of customer pressures. Overall, these findings suggest that the sustainability drivers work differently within each cultural context, indicating that NC matters in the adoption of environmental SSCM practices. However, its role is multifaceted, varying based on the specific combination of cultural dimensions and drivers analysed. As a result, heterogeneity in the adoption of sustainability across countries is expected.

7.1.Implications

This study has several implications for managers, practitioners as well as for academia. For managers, this study highlights that it is imperative to know which drivers are more influential for the adoption of environmental SSCM practices where plants are or will be operating. Even more challenging is for managers to understand how drivers interact with

contextual factors, in particular the NC. In this sense, we observed that cultural factors facilitate or discourage sustainability-focused relationships with suppliers. For instance, in high PDI cultures sustainability practices could not act as a tool to safeguard manufacturing firms' power against their suppliers. However, if managers of those manufacturing firms want to influence their suppliers to undertake environmental practices, they should invest in training, empowering and involving their employees. Involved employees can then push suppliers towards environmental behaviours by exerting normative pressures from that professionalisation. In addition, this study has a lesson for owners/shareholders. If they intend to inspire top managers to be engaged in sustainability actions either for efficiency reasons or to avoid environmental risks, they should promote green incentives by integrating environmental criteria with executive compensations, as suggested by Flammer et al. (2019).

For policymakers, this study demonstrates that specific knowledge about the cultural context is a determinant to push firms to adopt and implement environmental initiatives. Valuing sustainability does not necessarily translate to practising it (Caprar & Neville, 2012). Therefore, understanding which sustainability drivers are more effective in which cultural context is essential to move both companies and the society towards sustainable development goals. For policymakers, this study helps them to better develop policies and regulations according to their dominant culture. Policymakers in conservative cultures, such as China and Taiwan, need to be aware that relying solely on regulatory pressures may not be effective in promoting environmental practices in companies with high UVI. However, these firms may still be motivated to adopt environmentally sustainable practices if they lead to cost savings. Thus, regulators can encourage compliance by offering monetary incentives rather than resorting to coercion. On the other hand, in collectivistic cultures, such as Brazil, Spain, and Italy, environmental objectives may not be prioritised as highly as other organisational goals. As a result, governmental regulators may need to apply more pressure to ensure that firms adopt sustainable practices.

This study provides several contributions to academia. Firstly, we propose an institutional theory lens for understanding the driving pressures behind responsible environmental behaviour in manufacturing companies. These pressures can be coercive, mimetic or normative, and their equilibrium is influenced by NC as a contextual factor. Our empirical evidence sheds light on the heterogeneity of sustainability practices across the world. Despite the general concept of sustainability and the existence of sustainability drivers

that should encourage homogeneous behaviours, the adoption of sustainability initiatives is shaped by the contextual attributes of individual firms.

7.2.Limitations and future research

Finally, this study also suffers from some limitations which provide an opportunity for future research. For example, the sustainability practices in this study have focused on the environmental aspect of sustainability. It may be interesting if future research includes the social dimension as well. Probably, the impact of cultural dimensions on the link between sustainability drivers and social sustainability practices is different with the result of this study for environmental practices. Furthermore, by considering the contradictory results reported in the literature for the effect of NC on sustainability adoption, it may be interesting to investigate individual cultural dimensions. Therefore, future study can intensify the knowledge on how a specific culture attribute, such as PDI, influences the behaviour of sustainability drivers. The other limitation is related to the lack of information at the national level, specifically concerning the regional culture or subculture in each country. Finally, future research can consider the role of organisational contextual factors, such as organisational culture or leadership style on the association between sustainability drivers and sustainability adoption because the adoption behaviour is also influenced by the organisational culture of the firms, which may be different from NC.

8. References

Agarwal, A., Giraud-Carrier, F. C., & Li, Y. (2018). A mediation model of green supply chain management adoption: The role of internal impetus. *International Journal of Production Economics*, *205*(September 2017), 342–358. https://doi.org/10.1016/j.ijpe.2018.09.011

Ahi, P., & Searcy, C. (2013). A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of Cleaner Production*, *52*, 329–341. https://doi.org/10.1016/j.jclepro.2013.02.018

Ahmadi-Gh, Z., & Bello-Pintado, A. (2022). Why is manufacturing not more sustainable? The effects of different sustainability practices on sustainability outcomes and competitive advantage. *Journal of Cleaner Production*, *337*, 130392. https://doi.org/10.1016/j.jclepro.2022.130392

Azadegan, A., Golara, S., Kach, A., & Mousavi, N. (2018). Corporate environmental investments: A cross-national study on managerial decision making. *International Journal of Production Economics*, *199*(September 2016), 47–64. https://doi.org/10.1016/j.ijpe.2017.09.010

Blome, C., Hollos, D., & Paulraj, A. (2014). Green procurement and green supplier

development: Antecedents and effects on supplier performance. *International Journal of Production Research*, *52*(1), 32–49. https://doi.org/10.1080/00207543.2013.825748

Calza, F., Cannavale, C., & Tutore, I. (2016). The important effects of national culture on the environmental proactivity of firms. *Journal of Management Development*, *35*(8), 1011–1030. https://doi.org/10.1108/JMD-10-2015-0145

Caprar, D. V., & Neville, B. A. (2012). "Norming" and "Conforming": Integrating Cultural and Institutional Explanations for Sustainability Adoption in Business. *Journal of Business Ethics*, *110*(2), 231–245. https://doi.org/10.1007/s10551-012-1424-1

Chacón Vargas, J. R., Moreno Mantilla, C. E., & de Sousa Jabbour, A. B. L. (2018). Enablers of sustainable supply chain management and its effect on competitive advantage in the Colombian context. *Resources, Conservation and Recycling*, *139*(September), 237–250. https://doi.org/10.1016/j.resconrec.2018.08.018

Chu, Z., Wang, L., & Lai, F. (2019). Customer pressure and green innovations at third party logistics providers in China: The moderation effect of organizational culture. *International Journal of Logistics Management*, *30*(1), 57–75. https://doi.org/10.1108/IJLM-11-2017-0294

Chwialkowska, A., Bhatti, W. A., & Glowik, M. (2020). The influence of cultural values on pro-environmental behavior. *Journal of Cleaner Production*, *268*. https://doi.org/10.1016/j.jclepro.2020.122305

Claro, P. B. de O., & Esteves, N. R. (2020). Sustainability-oriented strategy and Sustainable Development Goals. *Marketing Intelligence and Planning*, *39*(4), 613–630. https://doi.org/10.1108/MIP-08-2020-0365

Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). Applied multiple regression/correlation analysis for the behavioral sciences.

Dai, J., Xie, L., & Chu, Z. (2021). Developing sustainable supply chain management: The interplay of institutional pressures and sustainability capabilities. *Sustainable Production and Consumption*, *28*, 254–268. https://doi.org/10.1016/j.spc.2021.04.017

Danese, P., Lion, A., & Vinelli, A. (2019). Drivers and enablers of supplier sustainability practices: a survey-based analysis. *International Journal of Production Research*, *57*(7), 2034–2056. https://doi.org/10.1080/00207543.2018.1519265

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., & Helo, P. (2019). Supplier relationship management for circular economy: Influence of external pressures and top management commitment. *Management Decision*, *57*(4), 767–790. https://doi.org/10.1108/MD-04-2018-0396

Esfahbodi, A., Zhang, Y., Watson, G., & Zhang, T. (2017). Governance pressures and performance outcomes of sustainable supply chain management – An empirical analysis of UK manufacturing industry. *Journal of Cleaner Production*, *155*, 66–78. https://doi.org/10.1016/j.jclepro.2016.07.098

Farooq, O., Farooq, M., & Reynaud, E. (2019). Does employees' participation in decision making increase the level of corporate social and environmental sustainability? An investigation in South Asia. *Sustainability (Switzerland)*, *11*(2). https://doi.org/10.3390/su11020511

Flammer, C., Hong, B., & Minor, D. (2019). Corporate governance and the rise of integrating corporate social responsibility criteria in executive compensation: Effectiveness and

implications for firm outcomes. *Strategic Management Journal*, *40*(7), 1097–1122. https://doi.org/10.1002/smj.3018

Gimenez, C., & Tachizawa, E. M. (2012). Extending sustainability to suppliers: A systematic literature review. *Supply Chain Management*, *17*(5), 531–543. https://doi.org/10.1108/13598541211258591

Glover, J. L., Champion, D., Daniels, K. J., & Dainty, A. J. D. (2014). An Institutional Theory perspective on sustainable practices across the dairy supply chain. *International Journal of Production Economics*, *152*, 102–111. https://doi.org/10.1016/j.ijpe.2013.12.027

Gong, M., Gao, Y., Koh, L., Sutcliffe, C., & Cullen, J. (2019). The role of customer awareness in promoting firm sustainability and sustainable supply chain management. *International Journal of Production Economics*, *217*(July 2017), 88–96. https://doi.org/10.1016/j.ijpe.2019.01.033

González-Benito, J., & González-Benito, Ó. (2006). A review of determinant factors of environmental proactivity. *Business Strategy and the Environment*, *15*(2), 87–102. https://doi.org/10.1002/bse.450

Gouda, S. K., & Saranga, H. (2020). Pressure or premium: what works best where? Antecedents and outcomes of sustainable manufacturing practices. *International Journal of Production Research*, *58*(23), 7201–7217. https://doi.org/10.1080/00207543.2020.1717010

Gupta, M., & Gupta, S. (2019). Influence of National Cultures on Operations Management and Supply Chain Management Practices—A Research Agenda. *Production and Operations Management*, *28*(11), 2681–2698. https://doi.org/10.1111/poms.13100

Hanna, M. D., Rocky Newman, W., & Johnson, P. (2000). Linking operational and environmental improvement through employee involvement. *International Journal of Operations and Production Management*, *20*(2), 148–165. https://doi.org/10.1108/01443570010304233

Hoejmose, S. U., Grosvold, J., & Millington, A. (2014). The effect of institutional pressure on cooperative and coercive "green" supply chain practices. *Journal of Purchasing and Supply Management*, *20*(4), 215–224. https://doi.org/10.1016/j.pursup.2014.07.002

Hofman, P. S., Blome, C., Schleper, M. C., & Subramanian, N. (2020). Supply chain collaboration and eco-innovations: An institutional perspective from China. *Business Strategy and the Environment*, *29*(6), 2734–2754. https://doi.org/10.1002/bse.2532

Hofstede, G. (1980). Culture's consequences: International differences in work-related values. Beverly Hills, CA: Sage

Hofstede, G., Hofstede, G., Minkov, M., 2010. Cultures and organizations, software of the mind. Intercult. Cooper. Imp. Surv.

Horak, S., Arya, B., & Ismail, K. M. (2018). Organizational Sustainability Determinants in Different Cultural Settings: A Conceptual Framework. *Business Strategy and the Environment*, *27*(4), 528–546. https://doi.org/10.1002/bse.2018

Horbach, J., Rammer, C., & Rennings, K. (2012). Determinants of eco-innovations by type of environmental impact - The role of regulatory push/pull, technology push and market pull. *Ecological Economics*, *78*, 112–122. https://doi.org/10.1016/j.ecolecon.2012.04.005

House, R. J., Hanges, P. J., Javidan, M., Dorfman, P. W., & Gupta, V. (2004). Culture, leadership, and organizations: The GLOBE study of 62 societies. Thousand Oaks, CA: Sage.

Hsu, C. C., Tan, K. C., Zailani, S. H. M., & Jayaraman, V. (2013). Supply chain drivers that foster the development of green initiatives in an emerging economy. *International Journal of Operations and Production Management*, *33*(6), 656–688. https://doi.org/10.1108/IJOPM-10-2011-0401

Hur, W. M., & Kim, Y. (2017). How Does Culture Improve Consumer Engagement in CSR Initiatives? the Mediating Role of Motivational Attributions. *Corporate Social Responsibility and Environmental Management*, *24*(6), 620–633. https://doi.org/10.1002/csr.1432

Husted, B. W. (2005). Culture and ecology: A cross-national study of the determinants of environmental sustainability. *Management International Review*, *45*(3), 349–371.

Ioannou, I., & Serafeim, G. (2012). What drives corporate social performance the role of nation-level institutions. *Journal of International Business Studies*, *43*(9), 834–864. https://doi.org/10.1057/jibs.2012.26

Khurshid, A., Muzaffar, A., & Bhutta, M. K. S. (2021). Institutional pressures and supplier involvement: a perspective on sustainability. *Operations Management Research*, *14*(1–2), 123–137. https://doi.org/10.1007/s12063-021-00181-4

Kitsis, A. M., & Chen, I. J. (2021). Do stakeholder pressures influence green supply chain Practices?Exploring the mediating role of top management commitment. *Journal of Cleaner Production*, *316*(July), 128258. https://doi.org/10.1016/j.jclepro.2021.128258

Koberg, E., & Longoni, A. (2019). A systematic review of sustainable supply chain management in global supply chains. *Journal of Cleaner Production*, *207*, 1084–1098. https://doi.org/10.1016/j.jclepro.2018.10.033

Kumar, D., & Rahman, Z. (2015). Sustainability adoption through buyer supplier relationship across supply chain: A literature review and conceptual framework. In *International Strategic Management Review* (Vol. 3, Issues 1–2). Holy Spirit University of Kaslik. https://doi.org/10.1016/j.ism.2015.04.002

Kumar, D., & Rahman, Z. (2016). Buyer supplier relationship and supply chain sustainability: Empirical study of Indian automobile industry. *Journal of Cleaner Production*, *131*, 836–848. https://doi.org/10.1016/j.jclepro.2016.04.007

Lin, X., Chen, Z. X., Tse, H. H. M., Wei, W., & Ma, C. (2019). Why and When Employees Like to Speak up More Under Humble Leaders? The Roles of Personal Sense of Power and Power Distance. *Journal of Business Ethics*, *158*(4), 937–950. https://doi.org/10.1007/s10551-017-3704-2

Longoni, A., Luzzini, D., & Guerci, M. (2018). Deploying Environmental Management Across Functions: The Relationship Between Green Human Resource Management and Green Supply Chain Management. *Journal of Business Ethics*, *151*(4), 1081–1095. https://doi.org/10.1007/s10551-016-3228-1

Marculetiu, A., Ataseven, C., & Mackelprang, A. W. (2023). A review of how pressures and their sources drive sustainable supply chain management practices. *Journal of Business Logistics*, *December 2022*, 1–32. https://doi.org/10.1111/jbl.12332

Miras-Rodríguez, M. del M., Machuca, J. A. D., & Escobar-Pérez, B. (2018). Drivers that

encourage environmental practices in manufacturing plants: A comparison of cultural environments. *Journal of Cleaner Production*, *179*, 690–703. https://doi.org/10.1016/j.jclepro.2017.11.029

Miska, C., Szőcs, I., & Schiffinger, M. (2018). Culture's effects on corporate sustainability practices: A multi-domain and multi-level view. *Journal of World Business*, *53*(2), 263–279. https://doi.org/10.1016/j.jwb.2017.12.001

Nath, S. D., & Eweje, G. (2021). Inside the multi-tier supply firm: exploring responses to institutional pressures and challenges for sustainable supply management. *International Journal of Operations and Production Management*, *41*(6), 908–941. https://doi.org/10.1108/IJOPM-09-2020-0651

Orcos, R., & Palomas, S. (2019). The impact of national culture on the adoption of environmental management standards: The worldwide diffusion of ISO 14001. *Cross Cultural and Strategic Management*, *26*(4), 546–566. https://doi.org/10.1108/CCSM-10-2018-0168

Orcos, R., Pérez-Aradros, B., & Blind, K. (2018). Why does the diffusion of environmental management standards differ across countries? The role of formal and informal institutions in the adoption of ISO 14001. *Journal of World Business*, *53*(6), 850–861. https://doi.org/10.1016/j.jwb.2018.07.002

Parboteeah, K. P., Addae, H. M., & Cullen, J. B. (2012). Propensity to Support Sustainability Initiatives: A Cross-National Model. *Journal of Business Ethics*, *105*(3), 403–413. https://doi.org/10.1007/s10551-011-0979-6

Paul J. DiMaggio and Walter W. Powell. (1983). The Iron Cage Revisited : Institutional Isomorphism and Collective Rationality in Organizational Fields Author (s): Paul J . DiMaggio and Walter W . Powell Published by : American Sociological Association Stable URL : https://www.jstor.org/stable/209510. *American Sociological Review*, *48*(2), 147–160.

Peng, X., & Zhang, R. (2022). Corporate governance, environmental sustainability performance, and normative isomorphic force of national culture. In *Environmental Science and Pollution Research* (Vol. 29, Issue 22). Springer Berlin Heidelberg. https://doi.org/10.1007/s11356-022-18603-6

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Power, D., Klassen, R., Kull, T. J., & Simpson, D. (2015). Competitive goals and plant investment in environment and safety practices: Moderating effect of national culture. *Decision Sciences*, *46*(1), 63–100. https://doi.org/10.1111/deci.12121

Ringov, D., & Zollo, M. (2007). Corporate responsibility from a socio-institutional perspective: The impact of national culture on corporate social performance. *Corporate Governance*, *7*(4), 476–485. https://doi.org/10.1108/14720700710820551

Roy, A., & Goll, I. (2014). Predictors of various facets of sustainability of nations: The role of cultural and economic factors. *International Business Review*, *23*(5), 849–861. https://doi.org/10.1016/j.ibusrev.2014.01.003

Saeed, M. A., & Kersten, W. (2019). Drivers of sustainable supply chain management: Identification and classification. *Sustainability (Switzerland)*, *11*(4).

https://doi.org/10.3390/su11041137

Sajjad, A., Eweje, G., & Tappin, D. (2015). Sustainable Supply Chain Management: Motivators and Barriers. *Business Strategy and the Environment*, *24*(7), 643–655. https://doi.org/10.1002/bse.1898

Sajjad, A., Eweje, G., & Tappin, D. (2020). Managerial perspectives on drivers for and barriers to sustainable supply chain management implementation: Evidence from New Zealand. *Business Strategy and the Environment*, *29*(2), 592–604. https://doi.org/10.1002/bse.2389

Sancha, C., Longoni, A., & Giménez, C. (2015). Sustainable supplier development practices: Drivers and enablers in a global context. *Journal of Purchasing and Supply Management*, *21*(2), 95–102. https://doi.org/10.1016/j.pursup.2014.12.004

Schoenherr, T., Modi, S. B., Talluri, S., & Hult, G. T. M. (2014). Antecedents and performance outcomes of strategic environmental sourcing: An investigation of resource-based process and contingency effects. *Journal of Business Logistics*, *35*(3), 172–190. https://doi.org/10.1111/jbl.12052

Schrettle, S., Hinz, A., Scherrer-Rathje, M., & Friedli, T. (2014). Turning sustainability into action: Explaining firms' sustainability efforts and their impact on firm performance. *International Journal of Production Economics*, *147*(PART A), 73–84. https://doi.org/10.1016/j.ijpe.2013.02.030

Shi, X., & Wang, J. (2011). Interpreting Hofstede Model and GLOBE Model: Which Way to Go for Cross-Cultural Research? *International Journal of Business and Management*, *6*(5), 93–99. https://doi.org/10.5539/ijbm.v6n5p93

Shibin, K. T., Dubey, R., Gunasekaran, A., Hazen, B., Roubaud, D., Gupta, S., & Foropon, C. (2020). Examining sustainable supply chain management of SMEs using resource based view and institutional theory. *Annals of Operations Research*, *290*(1–2), 301–326. https://doi.org/10.1007/s10479-017-2706-x

Song, F. (Sophie), Montabon, F., & Xu, Y. (2018). The impact of national culture on corporate adoption of environmental management practices and their effectiveness. *International Journal of Production Economics*, *205*(September), 313–328. https://doi.org/10.1016/j.ijpe.2018.09.020

Stoughton, A. M., & Ludema, J. (2012). The driving forces of sustainability. *Journal of Organizational Change Management*, *25*(4), 501–517. https://doi.org/10.1108/09534811211239191

Tachizawa, E. M., Gimenez, C., & Sierra, V. (2015). Green supply chain management approaches: drivers and performance implications. *International Journal of Operations and Production Management*, *35*(11), 1546–1566. https://doi.org/10.1108/IJOPM-01-2015-0023

Tata, J., & Prasad, S. (2015). National cultural values, sustainability beliefs, and organizational initiatives. *Cross Cultural Management*, *22*(2), 278–296. https://doi.org/10.1108/CCM-03-2014-0028

Tate, W. L., Dooley, K. J., & Ellram, L. M. (2011). Transaction Cost and Institutional Drivers of Supplier Adoption of Environmental Practices - Tate - 2011 - Journal of Business Logistics - Wiley Online Library. *Journal of Business Logistics*, *32*(1), 6–16.

Testa, F., Boiral, O., & Iraldo, F. (2018). Internalization of environmental practices and

institutional complexity: Can stakeholders pressures encourage greenwashing? *Journal of Business Ethics*, *147*(2), 287–307. https://doi.org/10.1007/s10551-015-2960-2

Tung, R. L., & Verbeke, A. (2010). Beyond hofstede and GLOBE: Improving the quality of cross-cultural research. *Journal of International Business Studies*, *41*(8), 1259–1274. https://doi.org/10.1057/jibs.2010.41

Vitolla, F., Raimo, N., Rubino, M., & Garegnani, G. M. (2021). Do cultural differences impact ethical issues? Exploring the relationship between national culture and quality of code of ethics. *Journal of International Management*, *27*(1), 100823. https://doi.org/10.1016/j.intman.2021.100823

Walker, H., Di Sisto, L., & McBain, D. (2008). Drivers and barriers to environmental supply chain management practices: Lessons from the public and private sectors. *Journal of Purchasing and Supply Management*, *14*(1), 69–85. https://doi.org/10.1016/j.pursup.2008.01.007

Wang, H., Guo, T., & Tang, Q. (2021). The effect of national culture on corporate green proactivity. *Journal of Business Research*, *131*(February 2020), 140–150. https://doi.org/10.1016/j.jbusres.2021.03.023

Wang, Z., Wang, Q., Zhang, S., & Zhao, X. (2018). Effects of customer and cost drivers on green supply chain management practices and environmental performance. *Journal of Cleaner Production*, *189*, 673–682. https://doi.org/10.1016/j.jclepro.2018.04.071

Wolf, J. (2013). Improving the Sustainable Development of Firms: The Role of Employees. *Business Strategy and the Environment*, *22*(2), 92–108. https://doi.org/10.1002/bse.1731

Wong, C. Y., Wong, C. W. Y., & Boon-itt, S. (2020). Effects of green supply chain integration and green innovation on environmental and cost performance. *International Journal of Production Research*, *58*(15), 4589–4609. https://doi.org/10.1080/00207543.2020.1756510

Yen, Y. X. (2018). Buyer–supplier collaboration in green practices: The driving effects from stakeholders. *Business Strategy and the Environment*, *27*(8), 1666–1678. https://doi.org/10.1002/bse.2231

Yu, W., Chavez, R., Feng, M., Wong, C. Y., & Fynes, B. (2020). Green human resource management and environmental cooperation: An ability-motivation-opportunity and contingency perspective. *International Journal of Production Economics*, *219*(June 2019), 224–235. https://doi.org/10.1016/j.ijpe.2019.06.013

Zailani, S. H. M., Eltayeb, T. K., Hsu, C. C., & Tan, K. C. (2012). The impact of external institutional drivers and internal strategy on environmental performance. *International Journal of Operations and Production Management*, *32*(6), 721–745. https://doi.org/10.1108/01443571211230943

Zhang, H., & Yang, F. (2016). On the drivers and performance outcomes of green practices adoption An empirical study in China. *Industrial Management and Data Systems*, *116*(9), 2011–2034. https://doi.org/10.1108/IMDS-06-2015-0263

Zhu, Q., Sarkis, J., & Lai, K. hung. (2013). Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *Journal of Purchasing and Supply Management*, *19*(2), 106–117. https://doi.org/10.1016/j.pursup.2012.12.001

Appendix A: Constructs and Items description

Variables	Item No.	Description	Loading factor	Cronbach´s Alpha	Proportion of variance
ISP				0.8884	0.5308
	ENVRTX02	Water efficiency	0.6322		
	ENVRTX03	Reducing waste in internal processes (e.g., improving yield or efficiency)	0.7104		
	ENVRTX04	Improving the workforce environment (e.g., indoor air quality)	0.7158		
	ENVRTX05	Pollution prevention (eliminating emissions or waste)	0.8279		
	ENVRTX06	Pollution Control	0.6876		
	ENVRTX08	Decreasing the likelihood or impact of an environmental accident	0.7858		
	ENVRTX14	Complying with an industry-sided code of conduct	0.7202		
	ENVRTX23	Environmental improvements in the disposition of your organization's scrap or excess material (re-use, recycling, etc.)	0.7075		
	ENVRTX24	Environmental improvements in the disposition of your organization's equipment	0.7519		
ESP				0.8737	0.6149
	ENVRTX29	Encouraging suppliers to improve the environmental performance of their processes	0.8528		
	ENVRTX31	Requesting that your suppliers sign a code of environmental conduct	0.7090		
	ENVRTX38	Incorporating environmental consideration in evaluating and selecting suppliers	0.7763		
	ENVRTX39	Providing design specification to suppliers in line with environmental requirements (e.g., green purchasing, blacklist of raw materials)	0.7360		
	ENVRTX40	Co-development with suppliers to reduce the environmental impact of the product (e.g., eco-design, green packaging, recyclability)	0.8133		
	ENVRTX41	Involvement of suppliers in re-design of internal processes (e.g., remanufacturing, reduction of by-products)	0.8086		
D_Mngr				0.8977	0.7654
	DRIVRX01	The examples top management provides	0.8981		
	DRIVRX02	Requirements made by senior management	0.8736		
	DRIVRX03	Top-down initiatives	0.8671		
	DRIVRX04	Top management's commitment to environmental responsibility	0.8602		
D_Empl				0.9353	0.7251
	DRIVRX09	Employee initiatives	0.8152		
	DRIVRX10	Championing efforts by individual employees or small groups of employees	0.8386		
	DRIVRX11	Employee problem-solving teams	0.8215		
	DRIVRX12	The morals of individual employees	0.8611		
	DRIVRX13	The personal desires of employees to do what is right	0.8774		
	DRIVRX14	A personal sense of obligation among employees	0.8852		
	DRIVRX15	The underlying values of employees	0.8590		

D_Shldr				0.8758	0.7378
	DRIVRX21	The belief that we could reduce costs and help the environment at the same time	0.6472		
	DRIVRX22	The desire to be more cost competitive	0.9053		
	DRIVRX23	The need to reduce costs	0.9362		
	DRIVRX24	The desire for cost savings	0.9145		
D_Rgln				0.8584	0.7161
	DRIVRX16	Current government legislation	0.8648		
	DRIVRX17	The threat of future government legislation	0.7420		
	DRIVRX19	Industry or government regulation	0.8935		
	DRIVRX20	Regulations dealing with the environment	0.8762		
D_Cstm				0.9319	0.8330
	DRIVRX05	Programs that our customers have in place	0.8440		
	DRIVRX06	Customers who seek environmentally responsible suppliers	0.9252		
	DRIVRX07	Increased awareness of environmental issues among our customers	0.9428		
	DRIVRX08	Customers who believe that environmental protection is important	0.9353		

Study 3: Sustainability isomorphism in buyer–supplier relationships: The impact of supply chain leadership

Abstract

Within the framework of institutional theory, this study explores how the adoption of sustainability practices by buying firms influences the sustainability performance of their suppliers. Additionally, it examines how the leadership capability of buying firms, particularly in terms of supply chain leadership, can play a crucial role in this link. Using primary data sourced from the fourth round of the High-Performance Management (HPM) project, our study reveals compelling evidence indicating that buying firms, by adopting internal initiatives, external monitoring efforts, and collaborative approaches with suppliers, possess the capacity to engender unique institutional pressures. These pressures serve as a conduit for the diffusion of a shared set of sustainability goals, values, and norms among suppliers, ultimately contributing to the development of sustainability competences and improving their overall sustainability performance. Furthermore, our findings suggest that when buying firms undertake a leading position, they can effectively translate isomorphism pressures into sustainability improvements on the supplier side. Overall, this study sheds light on important and understudied aspects of sustainability practices in buyer-supplier relationships and underscores the critical role that supply chain leadership can play in promoting sustainable practices across the entire supply chain.

Keywords: Supplier sustainability performance; supplier monitoring; supplier collaboration; supply chain leadership; isomorphism pressures.

1. Introduction

The mitigation of environmental burdens from industrial production and supply chain activity has become a growing concern on the global scale (Singh et al., 2022). This concern is particularly pronounced due to the substantial energy consumption of industrial activities and their considerable contribution to environmental impacts (Huo et al., 2021). To address this issue, manufacturing firms are progressively more focused on adopting sustainable operations in their production and logistics processes (Dai et al., 2021). However, implementing sustainable operations in global supply chains is challenging and highly complex (Koberg & Longoni, 2019), particularly under conditions of growing uncertainty (Flynn et al., 2016), risks and disruptions (Birkie & Trucco, 2020). Moreover, maintaining collaborative relationships with suppliers while ensuring accountability to stakeholders

(Gualandris et al., 2015) and implementing sustainability-focused monitoring poses significant challenges for buying firms (Shafiq et al., 2017; Wolf, 2014).

In this context, companies face increasing pressure from various stakeholders to demonstrate greater environmental awareness and promote sustainability initiatives throughout their supply chains (Bello-Pintado et al., 2023). According to institutional theory (DiMaggio and Powell, 1983), these pressures take the form of coercive, normative, and mimetic pressures, which drive companies to adopt best practices (Ketchen & Hult, 2007; Hoejmose, Grosvold, et al., 2014) and emulate supplier relationship management strategies used by their competitors (Dubey et al., 2019). As a result, companies in the same industry, including both buying firms and their suppliers, are becoming similar or isomorphic in organizational practices (DiMaggio & Powell, 1983).

The sustainable supply chain management (SSCM) model, introduced by Seuring & Müller (2008), integrates sustainability goals (i.e., economic, environmental and social goals) into supply chain management enabling buying firms to pass those isomorphic pressures to their suppliers. Beyond this, SSCM serves as an approach for buying firms to manage sustainability concerns with suppliers in the form of supplier evaluation for risk and performance (Chowdhury & Quaddus, 2021). To assess sustainability performance of suppliers, the most common tools suggested to buying firms are certifications, sustainability report and codes of conduct (Naffin et al., 2023). However, implementing SSCM requires more than just supplier evaluation. Within this perspective, different managerial/organizational practices including supplier monitoring (i.e., the post-selection assessment of suppliers in terms of their compliance to sustainability mandates) and supplier collaboration are proposed to the buying firms to develop suppliers sustainability capability (Dubey et al., 2019) and to ensure that their suppliers are accountable to the environment and society (Gualandris & Kalchschmidt, 2016).

Despite the increasing attention that the literature in the field has paid to examining the adoption of SSCM practices in the last decade, some issues still remain unclear regarding the interplay between sustainability proactiveness of buying firms in terms of sustainability adoption and the sustainability performance of suppliers (Hoejmose, Roehrich, et al., 2014; Koberg & Longoni, 2019; Allenbacher & Berg, 2023). In this sense, while the adoption of diverse SSCM sustainability practices by buying firms is expected to enhance the sustainability performance of both suppliers and buying firms, their consequences are not yet

clear, with mixed results observed on the suppliers' sides (Bai & Satir, 2022). For instance, Ahmed & Shafiq (2022) underscored the importance of buying firms´ legitimacy as an indicator of their commitment to sustainability in shaping suppliers' sustainability performance. However, the authors did not elucidate how buying firms translate their legitimacy into actionable strategies to influence their suppliers' sustainability performance. Likewise, Sancha et al. (2019) investigated the impact of supplier assessment and collaboration practices on supplier performance; however, they did not explore how these activities could enhance sustainability performance. The current body of research highlights a gap in understanding the driving forces that prompt suppliers to enhance their sustainability performance, as indicated in previous studies (Liu et al., 2018; Y. Chen & Chen, 2019; Belotti Pedroso et al., 2021). This underscores the need for further empirical research in this domain (M. Jia et al., 2021; Allenbacher & Berg, 2023). The lack of comprehensive empirical studies in this area presents significant challenges for decision-makers seeking to achieve their sustainability goals in the context of supplier relationships (Giannakis et al., 2020).

This paper aims to contribute to the field by conducting an analysis of the impact of buying firms on the sustainability-related behaviours of their suppliers. The primary research question addressed in this study is how the proactive efforts of buying firms can enhance the sustainability performance of their suppliers. Specifically, the focus is on how the adoption and implementation of diverse SSCM practices by buying firms, (i.e., internal, external supplier monitoring and external supplier collaboration), can improve the sustainability performance of their suppliers in terms of supplier´s engagement and reputation to sustainability as well as their environmental certifications. By considering the existence of institutional pressures that promote institutional isomorphism in buyer-supplier relationships (DiMaggio & Powell, 1983), this proposal builds on and extends previous studies (Liu et al., 2019; Sancha et al., 2019; Ahmed & Shafiq, 2022; Allenbacher & Berg, 2023).

Additionally, based upon the notion that leadership in supply chain is essential for facilitating the supply chain orientation (Rintala, 2023), this paper addresses the role of supply chain leadership (SCL), provided by sustainability-oriented firms, in shaping and aligning the sustainability initiatives of supply chain members. To achieve sustainability goals, all organizations involved in a supply chain must work together in a cohesive manner (Seuring & Müller, 2008), requiring commitment, coordination, and information sharing

(Awasthi & Grzybowska, 2014). Thus, SCL is crucial for achieving desired sustainability objectives. Despite this, few studies have examined the relationship between sustainability in supplier relationship management, leadership in the supply chain, and supplier performance (Mokhtar et al., 2019a; Fontoura & Coelho, 2020). A literature review conducted by Mokhtar et al. (2019b) identified the role of SCL in improving supplier performance as a significant research gap in the field. In our opinion, SCL can enhance isomorphism in buyer-supplier relationships.

This paper proposes four hypotheses to be tested empirically, drawing on the perspectives of SSCM and SCL and using the theoretical lens of institutional theory. Three constructs were developed for sustainability practices adopted and initiated by buying firms: internal as well as two external SSCM practices with suppliers termed supplier monitoring and supplier collaboration. These two mechanisms are contradictory in nature and produce different outcomes and responses from suppliers (Klassen & Vachon, 2003). While the majority of sustainability practices in this study focus on environmental concerns, social practices are also included. This study, therefore, adopts a holistic perspective of sustainability, focusing on environmental greenness while also acknowledging both environmental and social responsibility practices. This approach is well-established in both theory and in practice (Carter & Rogers, 2008). The generalization of this concept allows us to further simplify our approach and quickly enter the overall discussion (Danese et al., 2019; Ahmadi-Gh & Bello-Pintado, 2022; Bello-Pintado et al., 2023). Sustainable supplier evaluation of performance refers to the buying firm's perception of the supplier's sustainability improvement through post-selection evaluation of the major suppliers by means of certification, reputation, and the application of sustainability initiatives. The paper, further, developed one construct for sustainable supplier evaluation of performance and one construct for SCL. Using data collected from the fourth round of the HPM project, a sample of 325 manufacturing firms was analysed using PLS-SEM to test the proposed hypotheses.

This study provides contributions to the literature in several ways. Firstly, by extending the previous research, this study addresses often-overlooked connection between a buying firm's sustainability practices and the sustainability performance of its suppliers, thus shifting attention from the buyer to the supplier (M. Jia et al., 2021; Allenbacher & Berg, 2023). Moreover, by employing theoretical framework of institutional theory, this study explains how the proactive approaches of buying focal firms can lead to isomorphism within

buyer-supplier relationship which, in turn, serves to enhance the sustainability performance of their key suppliers. Secondly, it sheds light on the efficacy of monitoring approaches and collaborative approaches in improving supplier sustainability performance, and thus enriches the understanding of the role of sustainable supplier management practices in supplier development. In this context, both mechanisms (monitoring and collaboration) act as potent tools for effectively disseminating institutional pressures to suppliers by addressing institutional requirements for sustainability. Despite of being often perceived as less effective in comparison to collaborative mechanisms, this study underscores the significance of the monitoring mechanisms as vital components of focal firms´ proactive approaches. Thirdly, it contributes to the understanding of the role of supply chain leadership in enhancing suppliers' sustainability performance, bridging the gap between SSCM and SCL literatures. Finally, by drawing on a multi-country, multi-industry HPM project, this study provides valuable insights into how leading sustainability-oriented firms can improve the sustainability performance of their key suppliers.

After this introduction, section 2 provides a review of the research literature; section 3 states how the hypotheses are grounded; section 4 explains how the samples were collected and describes the measures that were used; section 5 presents the methodology and analysis; section 6 discusses the findings against the reviewed literature; and, finally, section 7 summarises the theoretical and practical contributions, acknowledges the limitations of the research and indicates potential research directions.

2. Literature background

2.1.Institutional isomorphism and sustainability in supply chains

Institutional theory provides insight into how firms interact with their suppliers on sustainability issues to maintain legitimacy, organizational visibility, and reputation (Blome et al., 2014; Koberg & Longoni, 2019). Firms often look to accepted practices and industry norms for guidance on supply chain activities, resulting in homogeneity within institutional fields over time (Ketchen & Hult, 2007). This process of institutional isomorphism, as defined by DiMaggio and Powell (1983), is driven by three types of pressures: coercive, normative, and mimetic. Previous research has shown that these institutional drivers impact

firm behaviour, but their effects vary depending on the type of pressure exerted (Hoejmose, Grosvold, et al., 2014; Tachizawa et al., 2015).

Coercive pressure is derived from the power of governmental regulators or other organisations with which companies have a partnership to force them to conform to sustainability requirements (Hoejmose, Roehrich, et al., 2014; Varsei et al., 2014). Some examples are reducing certain toxic materials in their products or encouraging manufacturers to apply sustainability initiatives, such as green packaging or reverse logistics, to achieve competitive advantages (Zhu et al., 2013). Suppliers are coerced not only by regulatory pressures in their local environment but also by the powerful proactive buying firms (Ahmed & Shafiq, 2022), which force them to exercise the demanded sustainability practices (Wilhelm et al., 2016; Y. Chen & Chen, 2019). For example, buying firms usually exert coercive pressures on suppliers by defining sustainability metrics or applying third-party certification in the selection or assessment of suppliers (Nath et al., 2019). In addition, buying firms usually undertake the role of regulators and impose pressures on suppliers to adopt more sustainable behaviour in the form of a code of conduct for buyers (Subramaniam et al., 2020).

Normative pressure occurs from the professionalization of educated employees or the cognitive legitimation developed by universities and other professional or social groups that cause firms to seek legitimacy and positive reputations (DiMaggio & Powell, 1983; Kauppi, 2013). Suppliers may undertake effort to improve their sustainability performance for instance by acquiring ISO certificates under normative pressures exerted from buying firms´ legitimacy and sustainability commitments (Ahmed & Shafiq, 2022). Furthermore, they usually adopt sustainability practices if they identify that rivals within the industry are engaged in sustainability initiatives (Tate et al., 2011; Sancha, Longoni, et al., 2015).

Mimetic pressure motivates companies to imitate the successful strategies implemented by competitors to overtake them (Sancha, Longoni et al., 2015). Mimetic pressure induces buying firms to imitate the supplier relationship management approaches undertaken by competitors and customers to overcome uncertainty (Sancha, Longoni, et al., 2015; Khurshid et al., 2021). Moreover, suppliers usually undertake fast learning approaches by imitating the good or advanced practices of supply chain members (buying firm and peer suppliers) as they are considered as the main source of sustainability knowledge for suppliers (Liu et al., 2019).

Under SSCM, a buying firm responds to collective institutional pressures by intending to enhance its own processes through the adoption of different socially focused practices and environmentally focused practices which are referred to internal SSCM (Wang & Dai, 2018; Dai et al., 2021). SSCM act also as a tool for buying firms to manage the institutional isomorphic pressures by facilitating the diffusion of sustainability concerns throughout their supply chain (Zeng et al., 2017). At the heart of SSCM practices lies the practice of imposing pressure on suppliers through the integration of sustainability objectives into supplier relationship management (Zimon et al., 2020).

The extension of sustainability requirements to suppliers which are referred to external SSCM (Gualandris & Kalchschmidt, 2016), are conducted by buying firms to manage their suppliers' behaviours towards society and the environment by pushing them to engage with sustainability requirements and improve their sustainability performance (Yang & Zhang, 2017). The literature has distinguished between different sustainability initiatives with suppliers (Subramaniam et al., 2020). Amongst them, monitoring strategies aim to ensure the basic compliance of suppliers through activities such as supplier evaluation and assessment, collaborative approaches target the development of suppliers' technical and financial capabilities to implement proactive initiatives through joint efforts (Y. Chen & Chen, 2019; Koberg & Longoni, 2019; Sancha et al., 2019).

Managing buyer-supplier relationship regarding sustainability requires measuring and evaluating the sustainability performance of their suppliers to be able to develop appropriate sustainability norms and codes of conduct (Varsei et al., 2014). Hence, the identification of sustainability metrics is crucial to improve decision making regarding the supplier selection and performance evaluation process (Gualandris et al., 2015; Zimmer et al., 2016; Giannakis et al., 2020) as well as to achieve the goal of a long-term (collaborative or monitoring) relationship with suppliers (Govindan et al., 2021). The evaluation of suppliers' sustainability performance embraces different criteria by integrating three objectives of sustainability (i.e., economic, social and environmental) and sustainability policies (Khan et al., 2018; Coşkun et al., 2022) into traditional indicators of performance (i.e., price, quality, etc.). The extant literature has outlined the evaluation process as a continuous assessment of suppliers in terms of their compliance with standards and minimum requirements as well as an evaluation of the improvement in their sustainability performance through different measures, including certification and audits (Zimmer et al., 2016; León Bravo et al., 2022).

2.2.Leadership in supply chains

SCL focuses on the inter-organisational level of leadership (Mokhtar et al., 2019a). SCL is defined as the capability to motivate, influence and guide the behaviour, actions and commitment of supply chain members to improve supply chain performance (Defee et al., 2009; L. Chen et al., 2021). Lockstrom et al. (2010: p. 275) defined SCL as 'the ability to influence one's own organisation and the suppliers' organisations in order to establish and accomplish common goals and objectives.' From Defee et al.'s point of view, a leader in a supply chain is a party who identifies the necessary changes and determines a vision for a better future for the whole chain (Defee et al., 2009). Other scholars consider the leading firm as the buying firm that has the leadership ability to improve the relationship with suppliers, orchestrate their actions and enhance their commitment (Lockstrom et al., 2010; Mokhtar et al., 2019b).

The literature in the field had paid attention to two main forms of SCL: transactional leadership and transformational leadership (Defee et al., 2009; L. Chen et al., 2021). The former refers to management-by-expectation and contingent rewards behind leader–follower interactions, while the latter includes the behaviours of inspiration, intellectual stimulation and individual consideration (Gosling et al., 2016). Through 'transformational' SCL, which emphasises the inspiring role of leaders, followers´ self-interests can be transformed to align with the collective interests, hence enhancing the compliance performance of followers (F. Jia et al., 2019). Evidence in the field has observed that this style of leadership, as opposed to transactional leadership, exerts a more substantial influence on the effective management of sustainability strategies within buyer-supplier relationship (Birasnav et al., 2015; Huo et al., 2021). This impact is manifested through its facilitation of learning regarding sustainability initiatives (Gosling et al., 2016) and its active promotion of ongoing training and guidance for suppliers (Mokhtar et al., 2019b).

Furthermore, researchers have also recognized the complementary characteristics of these two leadership styles, highlighting that a one-size-fits-all approach to leadership is not universally applicable (Mokhtar et al., 2019b). Consequently, the adoption of an hybrid approach that combines elements of both styles is recommended to achieve superior performance in supply chain sustainability (Chen et al., 2021). In the context of this study, SCL encompasses both transformational and transactional leadership aspects; however, the emphasis remains on aligning with the transformational aspect of SCL.

In the efforts to conceptualise SCL, previous studies have underlined the role of power in driving suppliers to adopt sustainability measures (Sharif & Irani, 2012; Fontoura & Coelho, 2020), considering that the power of leaders is determinant of the suppliers' commitment (Defee et al., 2009; Gosling et al., 2016). By highlighting the voluntary characteristic of SSCM (Ahi & Searcy, 2013), other scholars have emphasised the collaborative behaviour of SCL, pointing out that suppliers may adopt sustainability when motivated by a supply chain leader's vision of it (Gosling et al., 2016). Thus, leaders should constantly improve sustainability in their supplier relationship management to maintain a leading position through the evaluation of their own and their suppliers' sustainability performance before its impact can be understood by the public (Leppelt et al., 2013).

3. Hypothesis development

3.1.The effect of internal sustainability practices

According to institutional theory, the adoption of internal sustainability practices can be derived for two main reasons: the coercion of law and regulation and the incentives to exercise the best as possible environmental and social practices (Saeed et al., 2018). To be environmentally and socially responsible, firms must adopt sustainable practices in their in-house operations. This includes initiatives such as implementing an environmental management system, conducting a life cycle analysis, incorporating eco-design, establishing a health system, and improving the workforce's environment (Wang & Dai, 2018). Once sustainability becomes a core consideration in the procurement function, buying firms seek out suppliers who share this vision and are committed to sustainability for collaborative purposes (Blome et al., 2014). It leads buying firms to develop technical competencies and knowledge that facilitate the implementation of sustainable supplier management mechanisms, such as monitoring and collaboration (Gualandris & Kalchschmidt, 2016; Ahmadi-Gh & Bello-Pintado, 2021).

Zhu et al. (2013) asserted that successful adoption and implementation of sustainability initiatives within firms necessitates coordination among all organizational functions inside firms, as well as with external organizations within the supply chain to influence supply chain managers to adopt sustainable practices. This proactive stance adopted by buying firms can act as a coercive force on suppliers pushing them to be involved in sustainability related activities and boost their sustainability performance (Nath et al., 2019).

Without internal implementation of sustainability initiatives, a buying firm is unable to evaluate and support the sustainability performance of their suppliers (Gualandris & Kalchschmidt, 2016).

Sustainable buying firms use both coercive and normative pressures to influence their suppliers' sustainability practices (Ahmed & Shafiq, 2022). For example, Dai et al. (2021) found that normative pressures from customers are a significant driving force behind the adoption of sustainable supply chain management practices by Chinese manufacturers certified with ISO-14001 certificates. Similarly, Blome et al. (2014) identified a positive relationship between green procurement practices and supplier performance by setting appropriate environmental standards and promoting green initiatives. Additionally, firm´s own proactiveness can create mimetic pressures through sustainability-oriented managers and employees that demand competitive benchmarking of supplier collaboration practices adopted by successful companies in the industry (Andalib Ardakani et al., 2022). Collaborative approaches, then, lead uncertainty-avoided suppliers to imitate sustainability practices of proactive buying firm through inter-organizational exchanges (Liu et al., 2019) Accordingly, we propose the following hypothesis:

H1: The adoption of internal sustainability practices is positively associated with the sustainability performance of suppliers.

3.2.The effect of external sustainability practices: Suppliers monitoring and Suppliers collaboration

Buyers use monitoring and collaboration mechanisms to manage sustainability in their relationships with suppliers, according to Gimenez & Tachizawa (2012). Monitoring practices include evaluation, assessment, and control of suppliers' performance with respect to social and environmental criteria (Gualandris et al., 2014). Nath et al. (2019) indicated that buyers use coercive pressures in terms of codes of conduct or third-party auditing as well as mimetic pressures from the best sustainability practices of competitors to push suppliers toward sustainability. The authors observed that the buying firms directly applied assessment practices through their internal codes of conduct to evaluate the suppliers' performance.

Nevertheless, while incorporating sustainability monitoring practices is an effective way to manage sustainability risk in the supply chain (Shafiq et al., 2017), coercive pressures through monitoring did not show significant effects on sustainability outcomes (Sancha et al., 2016). For instance, Tachizawa et al. (2015) studied 71 purchasing managers from Spain to

explore the relationship between supplier monitoring practices and environmental outcomes. They found that simply monitoring suppliers' environmental footprint in response to government regulations did not improve their sustainability performance. Similarly, Subramaniam et al. (2020) conducted a study on 141 multinational companies in Malaysia and observed that regular assessment and control of suppliers' compliance with buyers' codes of conduct did not enhance their social sustainability performance. Likewise, it seems that the attempts by buying firms to exert regulatory pressures or impose international trade barriers on suppliers through monitoring and certification activities do not necessarily improve suppliers' social and environmental performance. For instance, compliance with a buyer's code of conduct, acquiring certificates, or self-assessments may not produce reliable data and may only indicate compliance requirements rather than actual performance levels. Studies by Wu (2017) and Yang & Zhang (2017) support these findings. Moreover, Akamp & Müller (2013) found no significant relationship between supplier performance and social and environmental reviews through ISO14000 and SA8000 certifications.

In this line, Sancha et al. (2019) demonstrated that evaluation and assessment practices were insufficient in improving supplier sustainability performance (compliance with standards). Bearing the cost and efforts of monitoring activities by suppliers may cause coercive institutional pressures that negatively impact on their performance (Sancha et al., 2019). Such monitoring activities merely serve to satisfy buying firms' requirements and improve their public image without necessarily leading to better performance in supplier side (Akamp & Müller, 2013; Subramaniam et al., 2020).

Despite several contradictory findings in the literature, we believe that extending institutional isomorphism, which involves pressuring suppliers to meet sustainability standards and codes of conduct, may be effective in enhancing their sustainability performance. Within the context of institutional theory, monitoring activities exert coercive pressures to suppliers directly from the expectations of buying firms and third-party certifications and indirectly from customers´ sustainability requirements and/or buying firms' perceived regulatory pressures (Nath et al., 2019). In addition, these types of activities create mimetic pressures due to the uncertainty behind sustainability requirements and competitive conditions between peer suppliers. Collectively, those pressures push suppliers to follow the buying firms´ codes of conduct and obtain required standards and certifications. However, monitoring practices also provide an opportunity for suppliers to receive feedback from their buying firms on their inefficiencies, protentional social and environmental risks and

alignment/non-alignment with expectations (Gualandris et al., 2015; Yang & Zhang, 2017), through which buying firms are able to diffuse sustainability values, norms and knowledge to their suppliers (Gualandris & Kalchschmidt, 2016; Lee et al., 2014). Hence, monitoring acts as a start-point of supplier´s performance improvement (Akamp & Müller, 2013). Therefore, we posit the following hypothesis:

H2a: The adoption of sustainability monitoring practices is positively associated with the sustainability performance of suppliers.

Supplier collaboration practices typically require a significant level of involvement from buying firms to develop a cooperative approach with their suppliers. However, implementing sustainability requirements can be challenging due to a lack of capabilities, knowledge, and technological advancements on the supplier side (Kumar & Rahman, 2015). According to institutional theory, manufacturing firms facing strong competitive pressure often imitate the collaborative approaches of other firms in the industry with their suppliers (Khurshid et al., 2021). Alternatively, under normative pressure from customers, NGOs, or civil society, buying firms may invest heavily in developing relationships with their suppliers (Ahmed & Najmi, 2018; Saeed et al., 2018). Nath et al. (2019) found that normative pressure, such as that various institutions form an alliance, is an effective approach for encouraging buying firms to adopt collaborative development practices with key suppliers and improve their sustainability awareness through training.

Moreover, undertaking a collaborative strategy in sustainable supplier management can have a positive impact on the sustainability capabilities of suppliers. Collaborative approaches involve sharing information, promoting a common understanding of sustainability risks, and working together to solve problems and address sustainability issues (Gualandris et al., 2014; I. L. Wu et al., 2014; Sancha et al., 2019). By fostering a trusting and committed relationship, collaborative efforts can generate and transfer knowledge between two parties and thereby enrich sustainability learning (Gosling et al., 2016).

Collaboration is also essential for suppliers to shorten their learning curve and implement sustainability practices effectively (Sancha et al., 2019). Adopting collaboration strategies can provide suppliers with access to training, technology, standards, and knowledge related to environmental issues, thus enabling them to produce more environmentally friendly products and improve operational efficiency (Tachizawa et al., 2015; Yang & Zhang, 2017). Sancha et al. (2016) indicated that a buying firm's involvement in solving the social issues of

suppliers through a collaborative attitude could enhance the social outcomes of suppliers' sustainability performance in Spanish manufacturers. Other scholars also sound a positive link between collaboration and supplier sustainability performance (Kumar & Rahman, 2016; Vanalle et al., 2017). It suggests that isomorphic pressure may enhance the sustainability performance of suppliers by driving buying firms to adopt a collaborative approach to managing sustainability practices with suppliers. Thus, we propose the following hypothesis:

H2b: The adoption of supplier collaboration practices is positively associated with the sustainability performance of suppliers.

3.3.The moderating role of Supply Chain Leadership

Blome et al. (2014) emphasized that organizational sustainability behaviour cannot be solely explained by legitimacy from an institutional perspective. Rather, buying firms in supply chains hold significant power to drive environmental and social responsibility practices in their buyer-supplier relationships, as evidenced by (Defee et al., 2009). By highlighting the voluntary nature of sustainability initiatives in SSCM, prior studies have outlined that the power of leading firms is not the sole influential factor, but their sustainability vision is also influencing followers in supply chains to adopt sustainability initiatives (Ahi & Searcy, 2013; Gosling et al., 2016).

In the context of supply chain sustainability, a sustainable leader who develops policies, goals, and a code of conduct can leverage their power to apply institutional pressures on suppliers or motivate them to undertake sustainability initiatives and engage in corporate social responsibility practices. To improve suppliers' compliance and sustainability behaviour, it is crucial for leading firms to develop the capability of their suppliers through supportive mechanisms as proposed by Birasnav et al. (2015) and Mokhtar et al. (2019b).

Leadership in supply chains requires buying firms to individually consider their suppliers and provide them with consultancy, coaching, and incentives to be proactive. Joint efforts should be made to promote trust and commitment in their interactions, as noted by Lockström & Lei (2013). In this regard, SCL may act as a facilitator of collaborative relationship between supply chain members as proposed by Rintala (2023). In their qualitative case study, F. Jia et al. (2019) affirmed the importance of buying firms' vision of sustainability in stimulating suppliers to find sustainable solutions. Through the application of appropriate mechanisms (e.g., monitoring vs. collaboration) in different ties, buying firms can assist and support their suppliers by giving them individualized consideration, such as

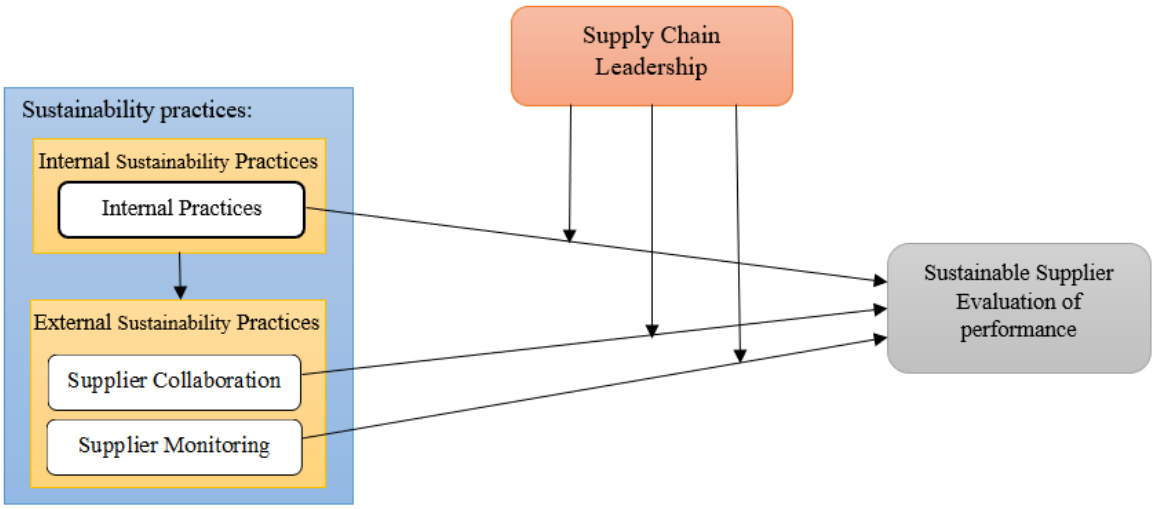
financing, training, and the provision of information and lessons based on experience (F. Jia et al., 2019).

Research in this area has provided evidence that buying firms' SCL has a positive impact on the sustainability performance of suppliers by facilitating information exchange between buyers and suppliers through the implementation of sustainability initiatives in supply chains (Birasnav et al., 2015; L. Chen et al., 2021). SCL provides buying firms with a tool to motivate their suppliers either by creating an incentive/sanction system based on performance assessment or by collaborating with suppliers to develop a shared sustainability mission that focuses on learning and improving sustainability practices (Gosling et al., 2016). Aligned with institutional theory perspective, Ahmed & Najmi (2018) demonstrated that the achievement of a leadership position by Pakistani buying firms that have obtained ISO 14000 certificates promotes green collaboration with suppliers by developing sustainability policies and helping them to implement sustainability initiatives in their plant. Additionally, Mokhtar et al. (2019a) observed that the adoption of SCL by buying firms contributed to better reverse supply chain performance of suppliers because of the monitoring of their compliance performance as well as the encouragement and training of suppliers to adopt sustainability initiatives and achieve sustainable goals cooperatively. We thus posit the following hypothesis:

H3: SCL moderates the link between buying firms' internal and external sustainability practices and suppliers' sustainability performance.

The structural model of this study is presented graphically in Figure 1.

Figure 1: Structural Model



4. Research Methodology

4.1.Sampling

This study used data from the fourth HPM project, which were collected by 25 international research teams across the world from May 2012 to February 2016. This dataset has been used in the authors' previous studies to examine other relationships in the context of SSCM in manufacturing (Ahmadi-Gh & Bello-Pintado, 2021, 2022). The HPM is a large-scale, multi-country and multi-industry project that was conducted to investigate the operation of manufacturing plants and their associated performance. This project was initially launched by Schroeder and Flynn in 1991 and regularly updated and developed through different rounds (Schroeder & Flynn, 2001; Bello-Pintado et al., 2023).

Using a survey response method, the data were collected from manufacturing plants in three industries (i.e., mechanics, electronics, and transportation equipment) in each country. These industries were selected because they are in continuous transition and facing intense global competition (Schroeder & Flynn, 2001). The sample plants was chosen randomly from the master list of manufacturing plants with at least 100 employees in each country (Flynn et al., 2016). The local research team in each country was responsible for contacting the sample plant, performing the research, and supporting the respondents during the survey. The questionnaires were first developed in English, then translated into the local language by the national research team of each country and back-translated into English by different team members to ensure the cohesion and reliability of the translation (Flynn et al., 2016). The questionnaires consisted of a set of twelve sections, each of which was related to a specific function of the plant, such as upstream/downstream supply chain management, supervision, quality management, or sustainability management. Two individuals responsible for each of these functions acted as respondents for their respective questionnaires (Danese et al., 2019). Collecting responses from more than one knowledgeable informant for each section of the questionnaire in each plant helped reduce the risk of item non-response bias (Li et al., 2021). For example, for the section related to environmental practices, both the Environmental Affairs Director and the Environmental Affairs Manager answered the questions.

Different methods such as having two respondents for the same item, using a mix of item types in each questionnaire section or pilot testing the items to assure their reliability, validity and clarity have been applied to reduce the risk of common method bias (Danese et

al., 2019). Finally, after cleaning up the data by a global coordinator the surveys were collected from the sample of 330 plants with a response rate that was approximately 65% in each country; thus, there was no need to check for non-response bias (Danese et al., 2019). The dataset included 325 sample firms from sixteen countries. Table 1 reports the data distribution according to the sector and country.

Table 1: Data distribution according to the sector and country

Country	Electronics	Mechanical	Transportation Equipment	Total	GDPP	GHGP
Austria	1	6	1	8	42600	9.15
Brazil	5	7	11	23	11700	5.03
China	10	17	3	30	9100	8.49
Spain	7	7	10	24	30100	6.57
Finland	6	6	5	17	35800	11.69
Germany	6	13	9	28	38700	11.00
Israel	18	5	0	23	33900	11.46
Italy	7	17	5	29	29800	7.05
Japan	6	7	9	22	35900	10.55
Kora	8	5	13	26	31900	13.43
Sweden	4	4	1	9	40300	5.29
Switzerland	2	0	1	3	44900	6.34
Taiwan	19	10	1	30	38400	9.16
UK	4	5	4	13	36600	8.45
USA	5	7	3	15	51700	19.9
Vietnam	10	7	8	25	3800	2.81
Total	118	123	84	325		

4.2.Measures

All the constructs in this study are multi-items based on 5-point Likert-type scales from 1 (strongly disagree) to 5 (strongly agree). Given the focus of this study, only the environmental affairs and upstream supply chain management questionnaire sections were considered. In the line with the previous studies, three constructs for sustainability practices were created to distinguish between different sustainability practices as independent variables based on SSCM literature (Danese et al., 2019; Jing Wang & Dai, 2018). The respondents were requested to list several activities related to environmental issues in response to the item "Please indicate the degree to which your plant is engaged in the following initiatives/practices". These constructs were named ISP (internal); ESPc (external collaborative); and ESPm (external monitoring; Danese et al., 2019). The literature affirmed

the positive association between the adoption of internal sustainability practices and external sustainability practices (Ahmadi-Gh & Bello-Pintado, 2021).

The questionnaire also contained items to form SCL (Min et al., 2007) as a moderator variable. In this case, the upstream supply chain managers were requested to indicate "the extent to which the plant is perceived to be the leader with its supply chains". In addition, the HPM project suggested items to develop the evaluation of the strategic key suppliers' sustainability performance as a dependent variable labelled SSEP by asking the respondents to indicate whether "We are satisfied with the performance of our key suppliers on the following criteria". In this study, the SSEP scale was developed through the implementation of sustainability initiatives, sustainability reputation and the adoption of environmental management system practices through ISO 14001 certification. Previous literature has revealed that those metrics are positively related to supplier sustainability performance (Naffin et al., 2023; F. Yang & Zhang, 2017; Zimmer et al., 2016).

All constructs were treated as reflective measures. The measurement properties of the constructs are presented in Table 2.

Control variables capture the effect of the sector and firm size as two commonly used control variables at firm level. In this study, the firm size was presented by the logarithm of the number of people employed by the sample plants. The manufacturing sector to which a firm belongs was incorporated through the creation of dummy variables (ind1 for the electronics, ind2 for the mechanical and ind3 for the transportation equipment sector). Moreover, other variables such as region can act as influencer of the link between sustainability practices, SCL and suppliers' performance (Dubey et al., 2015; L. Chen et al., 2021). Thus, gross domestic product per capita (GDPP) as a proxy for national wealth and metric tons of CO2 per capita (GHGP) as an indicator for the national level of gross greenhouse gas emission were considered as control variables at country level. The information for both variables has been extracted from the World Bank webpage related to year 2013 which coincides with the implementation date of the 4the round of HPM project (Please see Table 1).

Table 2: Constructs and Items description

Variables	Items	Description	Means	Std. Dev.	Loading factor	T-Stat.	Cronbach´s Alpha	Composite Reliability	AVE
Please indicate the degree to which your plant is engaged in the following initiatives/practices:									
ISP							0.894	0.914	0.543
	S_Isp01	Water efficiency	3.646	0.896	0.669	18.479			
	S_Isp02	Reducing waste in internal processes (e.g., improving yield or efficiency)	3.991	0.745	0.727	23.202			
	S_Isp03	Improving the workforce environment (e.g., indoor air quality)	4.062	0.745	0.725	24.030			
	S_Isp04	Pollution prevention (eliminating emissions or waste)	4.069	0.777	0.803	34.620			
	S_Isp05	Pollution control (scrubbing, waste treatment)	4.126	0.912	0.687	19.345			
	S_Isp06	Decreasing the likelihood or impact of an environmental accident	3.936	0.797	0.791	34.861			
	S_Isp07	Complying with an industry-wide code of conduct	3.908	0.910	0.743	24.199			
	S_Isp08	Environmental improvements in the disposition of your organization's scrap or excess material (re-use, recycling, etc.)	4.044	0.764	0.721	18.750			
	S_Isp09	Environmental improvements in the disposition of your organization's equipment	3.678	0.860	0.754	26.933			
ESPc							0.868	0.910	0.716
	S_Espc01	Encouraging suppliers to improve the environmental performance of their processes	3.194	1.057	0.877	60.927			
	S_Espc02	Providing design specification to suppliers in line with environmental requirements (e.g., green purchasing, blacklist of raw materials)	3.281	1.119	0.797	32.869			
	S_Espc03	Co-development with suppliers to reduce the environmental impact of the product (e.g., eco-design, green packaging, recyclability)	3.064	1.018	0.846	32.490			
	S_Espc04	Involvement of suppliers in the re-design of internal processes (e.g., remanufacturing, reduction of by-products)	2.911	1.023	0.863	46.226			
ESPm							0.795	0.857	0.549
	S_Espm01	Requesting that your suppliers sign a code of environmental conduct	2.928	1.273	0.774	30.514			
	S_Espm02	Visiting suppliers' plants or ensuring that they are not using sweatshop labour	3.012	1.176	0.793	30.915			
	S_Espm03	Ensuring that suppliers comply with child labour laws	3.238	1.388	0.782	27.301			
	S_Espm04	Using a third party to monitor working conditions at supplier facilities	2.322	1.172	0.548	9.371			
	S_Espm05	Incorporating environmental consideration in evaluating and selecting suppliers	3.304	1.029	0.780	33.234			
Please indicate the extent to which the plant is perceived to be the leader with its supply chains:									
SCL							0.804	0.86	0.507
	S_Scl01	In our supply chains, our plant provides supply and/or demand forecasting, which is critical to other members' supply chains.	3.898	0.946	0.682	15.061			
	S_Scl02	Our plant sets the standards that all of our supply chain members are expected to follow	3.938	0.903	0.744	22.109			
	S_Scl03	Our plant acts as a consultant for our supply chain partners' practices.	3.366	1.030	0.701	14.498			
	S_Scl04	In our supply chains, our plant establishes rules for sharing information about product orders, shipments, and inventory.	3.818	0.899	0.739	25.885			
	S_Scl05	Our plant maintains an integrated database and access methods to facilitate information sharing with other supply chain members.	3.269	1.164	0.629	12.394			
	S_Scl06	Our plant transfers knowledge to our supply chain members.	3.640	0.900	0.813	25.934			
We are satisfied with the performance of our key suppliers on the following criteria:									
SSEP							0.717	0.837	0.631
	S_Ssep01	Environmental certification, such as ISO 14001	3.775	0.906	0.826	21.524			
	S_Ssep02	Reputation for corporate social responsibility	3.537	0.860	0.782	16.271			
	S_Ssep03	Use of sustainability practices	3.577	0.821	0.774	13.162			

5. Data analysis

PLS-SEM analysis technique is an appropriate tool for studies with exploratory characteristics and given conditional process models (mediation and moderation models) (D. X. Peng & Lai, 2012; Sarstedt et al., 2020). Furthermore, variance inflation factors (VIF) collinearity in PLS-SEM modelling is more sufficient to realise the problem of common method variance (Kock, 2015). Therefore, PLS-SEM, by using SmartPLS 4.0 software, was conducted to examine the effect of sustainability practices (Hypotheses H1, H2a and H2b) as well as the moderation effect of SCL (Hypothesis 3).

Although there is no established measures for goodness-of-fit in PLS-SEM, some scholars considered the ability to predict the endogenous constructs as a measure of its goodness-of-fit (Hair et al., 2014). For the predictive power of the models, Shmueli et al., (2019) proposed to consider the coefficient of determination (R2) demonstrating the proportion of the variance for each dependent construct explained by its indicators as well as the Stone-Geisser's Q2 value reporting cross-validated redundancy values for all endogenous constructs (i.e., ESPm, ESPc and SSEP). The R2 values of this study showed a good predictive power of the predictors on the predicted variables (40.20%, 43.10% and 35.40% respectively). The Stone-Geisser's Q2 values in both models were above zero (0.210, 0.298 and 0.194 respectively), indicating all these constructs had predictive relevance. A common rule of minimum sample size for robust PLS-SEM is ten times the largest number of indicators used to measure one construct (Hair et al., 2014); suggesting that the minimum sample size of 90 was sufficient for this study. Therefore, a sample size of 325 in this study was appropriate to test the hypotheses using PLS-SEM.

Following Hair Jr et al., (2016), PLS-SEM model of this study also embraced two stages: the assessment of the measurement model and the evaluation of the path (structural) model.

5.1.Measurement Model results

The reflective constructs are preliminarily assessed by using a metric known as internal consistency, convergent validity, indicator reliability, and discriminant validity (please see Table 3). Internal consistency reliability of the constructs is evaluated through composite reliability (CR) and Cronbach's alpha (Sarstedt et al., 2016). Both values for all reflective constructs were above the criteria of 0.7, indicating strong reliability exists for the constructs.

As for convergent validity, the item loadings (except S-Isp01 = 0.669, S-Isp05 =

0.687, S_Espm04=0.548, S-Scl01 = 0.682, and S- Scl05 = 0.629) were higher than 0.7, significant at 0.000 and have a T-value higher than 1.96. The five indicators with factor loading less than 0.7 were kept in the model because the elimination of them could not contribute significant improvement to the composite reliability and average variance extracted (AVE) values (Hair Jr et al., 2016). Moreover, AVE results of all reflective constructs were above the minimum value of 0.5 confirming that convergent validity existed at the indicator level (D. X. Peng & Lai, 2012).

Finally, discriminant validity was examined through the Fornell–Larcker criterion by comparing the square root of AVE value of each construct with the correlation between all possible pairs of constructs in the model (Hair Jr et al., 2016). Accordingly, the square root of the AVE values of all constructs was greater than their correlation with other constructs in the model. Hence, the results support discriminant validity among the constructs (please see Table 3).

Table 3: Fornell-Larcker Criterion

Main Variables	SSEP	ISP	ESPc	ESPm	SCL
SSEP	**0.799**				
ISP	0.172	**0.737**			
ESPc	0.287	0.656	**0.846**		
ESPm	0.280	0.635	0.774	**0.741**	
SCL	0.536	0.180	0.305	0.280	**0.712**

The square roots of the AVE are presented on the diagonal bold. The numbers bellow the AVE values are the correlation between the relevant construct with another construct in the model.

5.2.Structural Model results

The evaluation of structural model relies on the bootstrapping procedure aimed to test the hypothesised relationship between constructs in terms of sign, magnitude, and significance. To assure the multicollinearity issues, scholars suggested considering VIF values for all sets of predictor constructs. Accordingly, the observed values including outer and inner models were below the threshold of 3.3 indicating that multicollinearity is not critical in the model (Shmueli et al., 2019). The results of the PLS-SEM analyses by bootstrapping of 5000 samples are summarised in Table 4.

The test was performed with two models. In the first model, the three independent variables (ISP, ESPm and ESPc) were inserted into the analysis in the presence of all the

control variables. The results indicated that the adoption of external sustainability practices in buyer-supplier relationship is strongly related to buying firm´s sustainability vision and proactiveness (ISP->ESPc: β=0.656, p<0.001; ISP->ESPm: β=0.635, p<0.001;) which can result in better sustainability performance in supplier side (ISP->SSEP total indirect effect: β=0.205, p<0.001). Therefore, the H1 was supported. In addition, the adoption of different sustainability practices along with suppliers directly affects their sustainability performance, thereby providing evidence to support H2a and H2b (ESPc β=0.194, p<0.05; ESPm β=0.157, p<0.10).

The second model examined the moderating effect of SCL by including SCL and the relevant interaction effect of each practice separately. The result indicated that the presence of SCL reinforces the linkage between sustainability practices and suppliers' sustainability performance only for collaborative approaches with suppliers (ESPc β=0.170, p<0.10), while it is unable to foster the link for internal practices (the interaction effect for ISP β=-0.099, p>0.1; ESPm β=0.039, p>0.1). Thus, H3 was partially supported. Figure 2 represents the structural model of the study by showing the path co-efficient (β) and its significance.

Table 4: PLS Result

Variables	Model 1	T- Statistic	Model 2	T- Statistic
Control variables:				
Size -> SSEP	0.014	0.252	-0.015	0.314
Ind1 -> SSEP	0.175	1.256	0.124	1.015
Ind2 -> SSEP	-0.072	0.512	0.026	0.220
GDPP -> SSEP	-0.141*	1.752	-0.156**	2.363
GHGP-> SSEP	0.162**	2.132	0.216***	3.477
Independent Variables:				
ISP -> SSEP	-0.021	0.268	-0.014	0.197
ISP -> ESPm	0.635***	19.812	0.634***	19.770
ISP -> ESPc	0.656***	21.073	0.657***	21.116
ESPm -> SSEP	0.157*	1.783	0.096	1.268
ESPc -> SSEP	0.194**	2.018	0.057	0.736
Moderation Effect:				
SCL -> SSEP			0.595***	9.531
SCL* ISP -> SSEP			-0.099	1.433
SCL* ESPm -> SSEP			0.039	0.544
SCL * ESPc -> SSEP			0.170*	1.891

*p < 0.10; **p < 0.05; ***p < 0.01

Finally, regarding the effect of the control variables, none of the firm level control variables influence on the models. But, both country level control variables of GDPP and GHGP have statistically significant effects in both models. While the influence of GDPP is negative, the effect of GHGP is positive indicating that manufacturing firms are more involved in the evaluation of their supplier sustainability performance in the nations with higher level of GHG emission due to greater pressures for managing risk of their supply chain. A summary of the results is presented in Table 5.

Figure 2- Structural Model (Source: Authors estimations using PLS4).

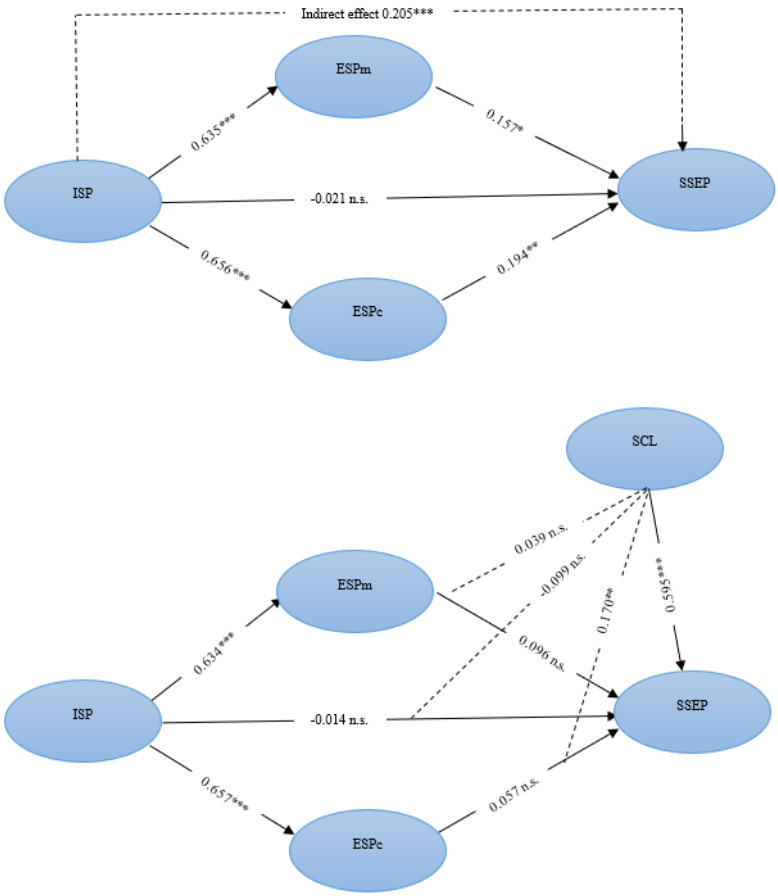


Table 5: Summary of the result.

Hypothesis	Result
H1: Effect of ISP on SSEP	Supported (indirect effect)
H2a: Effect of ESPm on SSEP	Supported
H2b: Effect of ESPc on SSEP	Supported
H3: Moderation effect of SCL	Partially supported

6. Discussion of the findings

The results of our empirical study support the prediction that a buying firm's sustainability practices play a critical role in promoting responsible behaviour within buyer-supplier relationships. Specifically, our findings demonstrate that proactive buying firms are more likely to achieve higher sustainability performance from suppliers, as they utilize monitoring approaches to strictly evaluate compliance with regulatory standards. Furthermore, our study suggests that training and collaboration mechanisms, driven by both normative and mimetic pressures, are effective in improving suppliers' sustainability competencies.

Our study reveals that while the adoption of sustainability practices within the operational processes of buying firms may not have a direct impact on supplier sustainability performance, it does establish a foundation for influencing suppliers to adopt responsible practices (Gualandris & Kalchschmidt, 2016). We observed a negative path coefficient for the direct effect of ISP on SSEP, which can be attributed to the costs and time associated with evaluating supplier performance. Nonetheless, our findings suggest that buying firms can enhance supplier sustainability performance by defining more appropriate codes of conduct, standards, and sustainability goals (Blome et al., 2014), coordinating inter- and intra-organizational practices (Zhu et al., 2013) and involving suppliers in joint green manufacturing practices (Trujillo-Gallego et al., 2021). By doing so, buying firms can encourage suppliers to undertake sustainability practices for instance through obtaining ISO14001 certificates or by enhancing their sustainability knowledge through interorganizational exchanges. It may inspire suppliers to align their strategies with the buying firms' sustainability goals and ultimately improve their overall performance.

Regarding monitoring practices, our findings provide important evidence to encourage buying firms to adopt assessment and evaluation approaches, despite the significant effort, time, and cost involved in monitoring practices. Contrary to previous research (e.g., Tachizawa et al., 2015; Sancha et al., 2016; Yang & Zhang, 2017; Sancha et al., 2019), our empirical analysis demonstrates that the risk of environmental and social damages resulting from supplier non-compliance can be eliminated if buying firms enforce codes of conduct, demand certifications, and regularly audit, assess, and evaluate the actual performance of their suppliers. Such measures allow for early identification of supplier misconduct and help to maintain strong buyer-supplier relationships (D. Kumar & Rahman, 2015). Moreover, this type of inter-organizational interaction involves the communication of monitoring results and feedback (Sancha et al., 2019) that facilitates the diffusion of

sustainability values, norms and knowledge from buying firms to suppliers (S. Y. Lee et al., 2014). It helps suppliers to access the knowledge of sustainability or improve their existing knowledge that eventually leads them to enhance their sustainability performance (Gualandris & Kalchschmidt, 2016; Liu et al., 2019).

Our study also confirms the presence of a relationship between supplier sustainability performance and collaboration practices within sustainability-oriented buyer-supplier relationships. Faced with normative isomorphism from customers, industry associations, and NGOs that seek to improve industry awareness and influence the actions of manufacturing firms, buying firms encourage their suppliers to adopt collaborative approaches in their relationship. By establishing trusting and committed collaborative practices, suppliers are motivated to emulate the sustainability manufacturing processes and corporate social responsibilities of their buying firms or their closest competitors. Consistent with prior research (Gualandris et al., 2014; Yang & Zhang, 2017; Sancha et al., 2019), integrating suppliers into joint practices, such as new product development, can improve their access to information, training, technology, and sustainability standards, which in turn promotes the development of sustainability competence among suppliers through the generation and exchange of knowledge and learning related to sustainability.

The results of this study suggest that the leadership capabilities of proactive firms in supply chains can strengthen the link between sustainability practices and suppliers' sustainability performance. These findings underscore the significance of supply chain leadership (SCL) in translating isomorphism pressures into tangible sustainability outcomes within buyer-supplier relationships. By assuming a leading role, buying firms with a strong commitment to sustainability can leverage their influence to exert coercive pressure on suppliers to adopt sustainable initiatives, such as the establishment of sustainability policies, standards, and codes of conduct. In addition, they can encourage suppliers to imitate their best sustainability practices through education and supportive mechanisms (Dubey et al., 2019). The possibility of integration into the sustainability vision of buying firms, better communication and learning about sustainability, which are all facilitated by SCL, can lead to improved sustainability performance in suppliers (Gosling et al., 2016; Pham & Kim, 2019; Huo et al., 2021). Furthermore, by distinguishing between the two classic styles of leadership, our findings corroborate the previous research emphasizing the predominant role played by transformational SCL in the management of supplier relationship. This is evidenced by this ability to inspire, stimulate intellectual growth, and more individualized attention to suppliers

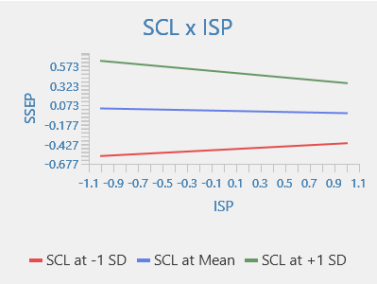
on the part of focal companies (Birasnav et al., 2015; Mokhtar et al., 2019b; L. Chen et al., 2021). Nevertheless, it is worth noting that the impact of SCL on the alignment between internal practices and sustainability supplier performance, which tend to be more internally focused, may not be as pronounced. This divergence can be attributed to the inherent characteristics of SCL, which primarily revolve around setting standards, offering consultancy and information, and sharing methods with suppliers.

In summary, these findings underscore the pivotal role of SCL in fostering sustainability-driven interactions between buyers and suppliers. It also highlights the potential advantages associated with the adoption of SCL strategies for enhancing supplier sustainability performance.

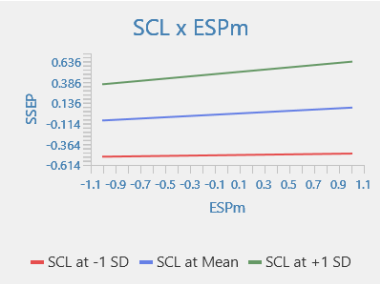
The post-analysis results indicate SCL's effectiveness with respect to the link between buying firms' sustainability practices and suppliers' sustainability performance. For this purpose, the robustness check analysis has been conducted by dividing the sample in two groups (i.e., high proactive and low proactive) through applying cluster analysis. By running the regression analysis for both groups, we observed that the high proactive group behaves better in terms of sustainability adoption than low proactive group and SCL is only effective when the manufacturing firms are more proactive. Additionally, the plotting analysis demonstrates a simple slope of three sustainability practices at 'low', 'medium' and 'high' levels of SCL (please see Figure 3). At the presence of SCL, the plots suggest that both external approaches (ESPc and ESPs) are effective for SSEP if we use more SCL. At the highest levels of SCL, we achieve higher SSEP for a given time input, highlighting the importance of SCL.

However, the values obtained for the direct effect of these approaches show that a change by buying firms from the mere evaluation of suppliers to greater involvement has a significantly better impact on the sustainability performance of suppliers (the coefficient of direct effect: ESPm=0.157 vs ESPc=0.194). In the moderating effect as well, the slope for collaboration is greater than that for monitoring initiatives (the coefficient of moderation effect: ESPm=0.039 vs ESPc=0.170), confirming that a collaboration mechanism in buyer–supplier relationships is more efficient in terms of supplier sustainability performance.

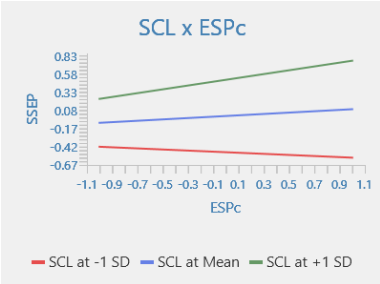
Figure 3- Moderation effect plots (Source Authors estimations using PLS4)



The results suggest that the negative effect of ISP on SSEP will be enhanced by higher level of SCL.



The results suggest that ESPm has its own effect on SSEP independently from SCL at lower level of SCL. However, the slope increases gradually and almost constantly by increasing the level of SCL.



The results suggest that at the presence of SCL, the effect of ESPc on SSEP is positively enhanced by applying more level of SCL. At the highest levels of SCL, the higher SSEP for a given time input is achieved.

7. Conclusion, implications, and future research

7.1.Conclusion

In the context of mounting expectations placed upon manufacturing firms to demonstrate responsibility, mitigate the risk of supplier misconduct, and uphold their legitimacy and reputation, it becomes imperative for these firms to effectively transmit the institutional pressures they face to their supplier network. One viable strategy entails the extension of the buying firms' sustainability vision to encompass their suppliers, accomplished through the integration of sustainability requirements into their supplier relationship management framework. This strategic alignment not only ensures suppliers' adherence to sustainability standards but also fosters the development of sustainability capabilities among key suppliers through vigilant monitoring and collaborative initiatives. The findings of this study underscore the potency of isomorphic forces within buyer-supplier relationships, particularly when coupled with sustainable supplier management practices. Buying firms that take a proactive approach to sustainability can improve the sustainability performance of their suppliers by exerting coercive pressures through the establishment of sustainability policies, standards, and codes of conduct and/or normative pressures arisen from collaborative approaches. Additionally, by adopting a leadership position in the supply chain, firms can create a position for themselves to use their power to stimulate suppliers to imitate their best sustainability practices through education and supportive mechanisms.

However, sustainability-focused monitoring and collaboration mechanisms can have an even greater impact on supplier performance when combined with supplier leadership capability (SCL). SCL refers to the capability of buying firms, derived from their power and sustainability vision, to induce their suppliers to behave responsibly. By influencing suppliers' behaviour and commitment to sustainability as well as by shaping and guiding their sustainability activities, SCL can be effective in improving supplier performance. Therefore, firms that take a leadership position in their supply chain and adopt SCL strategies may be better positioned to develop sustainable supplier management practices and improve the sustainability performance of their suppliers.

Overall, this study highlights the importance of sustainable supplier management practices and SCL in improving supplier sustainability performance. As institutional pressures continue to mount, it is crucial for buying firms to adopt proactive approaches to sustainability and extend their sustainability vision to their suppliers in order to maintain legitimacy, manage risks, and improve overall sustainability performance.

7.2. Implications

This study has implications for managers and SSCM practitioners as well as for academia. Manufacturing firms are increasingly pressured to take action, but their performance is greatly related to the social and environmental performance of their suppliers; this finding highlights the importance of isomorphism forces to suppliers through sustainable supplier management practices. This allows manufacturers to adopt responsible attitudes in their own operations and transmit those pressures to their suppliers through different sets of activities, including monitoring and collaboration. However, managers should balance their resources and their efforts related to SSCM practices. This study may help all supply chain actors to make better decisions on the most appropriate kinds of initiatives for their social and environmental responses and to implement them better in their organisations both economically and operationally. The findings suggest two alternatives: on the one hand, to adopt passive strategies (evaluation and monitoring practices) to push their suppliers to follow sustainability requirements strictly due to regulatory pressures; and, on the other hand, to conduct supplier development practices through collaborative approaches under normative isomorphism from industry bodies and associations as well as the expectations of customers. However, each of these strategies or a configuration of them might be employed depending on which type of relationship with their suppliers they are intended to have or which stage of relationship (short run or long run) they are in.

The findings demonstrate that both approaches are beneficial for buying firms and suppliers. Manufacturers can establish a proper code of conduct, a sustainability vision and supportive programmes by benchmarking the guidelines of NGOs, for example the United Nations' Sustainable Development Goals, or by imitating the best sustainability practices implemented in the industry. Suppliers can improve their sustainability capabilities and knowledge by learning sustainability practices from their buyers or by being involved in joint efforts with the possibility of being educated through training programmes provided by their buying firms.

Moreover, the findings highlight the role of leadership capability in the leading firms in a supply chain. For those manufacturers that have the tendency and ability to take up a leading position in their supply chains, the results of this study may encourage them to act in a consultancy role with their suppliers; to set standards; to conduct regular audits and training; to facilitate suppliers' access to methods, technology, and knowledge; and to share information with suppliers. If a leading firm is itself proactive, suppliers can be driven either by the firm's power or by the inspiration to imitate the firm's sustainability practices, both of which result in more environmentally friendly products and more attention paid to the needs of employees and society.

The literature has primarily focused on the effect of SSCM practices, specifically sustainable supplier management practices, on the performance of buying firms, with less attention given to the supplier side (Koberg & Longoni, 2019; Sancha et al., 2019). In particular, there is a lack of understanding regarding how buying firms can encourage suppliers to adopt sustainability initiatives and how leadership capability (SCL) plays a role in this relationship (F. Jia et al., 2019; Mokhtar et al., 2019a). This study aims to fill these gaps by examining the relationship between SSCM practices, suppliers' performance, and SCL. Firstly, by identifying the main gaps in the literature, this study made efforts to enhance the understanding of how suppliers' sustainability performance is related to buying firms' proactiveness. This relationship is facilitated via SSCM practices adopted by proactive buying companies which effectively transmit the institutional pressures for sustainability. Thus, the need for further investigation and the provision of empirical evidence on the supplier side, which has been considered an underexamined topic in the literature (Liu et al., 2018; Belotti Pedroso et al., 2021), was fulfilled. Secondly, the study explored how SCL plays a role in enhancing suppliers' sustainability performance when buying firms adopt various mechanisms to monitor and collaborate with suppliers. Thirdly, the study advanced

previous attempts at analysing the role of monitoring and assessment in suppliers' sustainability performance (Gualandris et al., 2015; Sancha et al., 2016; Subramaniam et al., 2020). Lastly, using data from the multi-country, multi-industry HPM project, this paper presented an insightful view of how companies in different industries worldwide can improve the sustainability performance of their key suppliers, and how the leadership capability of sustainability-oriented leading firms can be effective in this link.

7.3. Limitations and Future research

This study had some limitations that can be addressed in future research. First, this study was based on survey data, which limits the assessment of our model over time. A longitudinal study could provide a deeper understanding of the relationship between buying firms' sustainability practices and suppliers' sustainability performance, as well as the moderating effect of SCL. Another limitation of this study is related to the selection of metrics from the HPM project, which is used for evaluating sustainable performance of suppliers. Future research could use a broader set of metrics for this purpose. Additionally, case studies could provide insights into how different sustainability initiatives implemented by leading buying firms could influence their suppliers' behaviours. The third limitation of this study is that the focus is only on buyer-supplier relationship from the viewpoint of buying firms. Future studies could also take into account the perception of suppliers.

In addition, we encourage future research to delve deeper into the model examined in this study. For instance, future research could examine the effect of different leadership styles on the linkage between sustainability practices and SCL. In this regard, future studies should explore the causality relationship between SCL, and the sustainability practices adopted and implemented by leading firms. Furthermore, future research is advocated to consider a broader view of sustainability known as the triple-bottom-line (TBL) perspective, including the economic pillar of sustainability. Finally, future research should examine how cultural alignment between buying firms and suppliers can be effective in the adoption of sustainability practices by suppliers.

8. References

Ahi, P., & Searcy, C. (2013). A comparative literature analysis of definitions for green and sustainable supply chain management. *Journal of Cleaner Production*, *52*, 329–341. https://doi.org/10.1016/j.jclepro.2013.02.018

Ahmadi-Gh, Z., & Bello-Pintado, A. (2021). The effect of sustainability on new product

development in manufacturing—internal and external practices. *Administrative Sciences*, *11*(4). https://doi.org/10.3390/admsci11040115

Ahmadi-Gh, Z., & Bello-Pintado, A. (2022). Why is manufacturing not more sustainable? The effects of different sustainability practices on sustainability outcomes and competitive advantage. *Journal of Cleaner Production*, *337*, 130392. https://doi.org/10.1016/j.jclepro.2022.130392

Ahmed, M. U., & Shafiq, A. (2022). Toward sustainable supply chains: impact of buyer's legitimacy, power and aligned focus on supplier sustainability performance. *International Journal of Operations and Production Management*, *42*(3), 280–303. https://doi.org/10.1108/IJOPM-08-2021-0540

Ahmed, W., & Najmi, A. (2018). Developing and analyzing framework for understanding the effects of GSCM on green and economic performance: Perspective of a developing country. *Management of Environmental Quality: An International Journal*, *29*(4), 740–758. https://doi.org/10.1108/MEQ-11-2017-0140

Akamp, M., & Müller, M. (2013). Supplier management in developing countries. *Journal of Cleaner Production*, *56*, 54–62. https://doi.org/10.1016/j.jclepro.2011.11.069

Allenbacher, J., & Berg, N. (2023). How assessment and cooperation practices influence suppliers' adoption of sustainable supply chain practices: An inter-organizational learning perspective. *Journal of Cleaner Production*, *403*(October 2022), 136852. https://doi.org/10.1016/j.jclepro.2023.136852

Andalib Ardakani, D., Soltanmohammadi, A., & Seuring, S. (2022). The impact of customer and supplier collaboration on green supply chain performance. *Benchmarking*. https://doi.org/10.1108/BIJ-12-2020-0655

Awasthi, A., & Grzybowska, K. (2014). Logistics Operations, Supply Chain Management and Sustainability. *Logistics Operations, Supply Chain Management and Sustainability*, *August*, 15–30. https://doi.org/10.1007/978-3-319-07287-6

Bai, C., & Satir, A. (2022). A critical content-analysis of sustainable supplier development literature and future research directions. *Journal of Cleaner Production*, *365*(May), 132443. https://doi.org/10.1016/j.jclepro.2022.132443

Bello-Pintado, A., Machuca, J. A. D., & Danese, P. (2023). Stakeholder pressures and sustainability practices in manufacturing: Consideration of the economic development context. *Business Strategy and the Environment*, *March 2022*, 1–19. https://doi.org/10.1002/bse.3355

Belotti Pedroso, C., Tate, W. L., Lago da Silva, A., & Ribeiro Carpinetti, L. C. (2021). Supplier development adoption: A conceptual model for triple bottom line (TBL) outcomes. *Journal of Cleaner Production*, *314*(April 2020), 127886. https://doi.org/10.1016/j.jclepro.2021.127886

Birasnav, M., Mittal, R., & Loughlin, S. (2015). Linking leadership behaviors and information exchange to improve supply chain performance: A conceptual model. *Global Journal of Flexible Systems Management*, *16*(2), 205–217. https://doi.org/10.1007/s40171-015-0092-2

Birkie, S. E., & Trucco, P. (2020). Do not expect others do what you should! Supply chain complexity and mitigation of the ripple effect of disruptions. *International Journal of Logistics Management*, *31*(1), 123–144. https://doi.org/10.1108/IJLM-10-2018-0273

Blome, C., Hollos, D., & Paulraj, A. (2014). Green procurement and green supplier development: Antecedents and effects on supplier performance. *International Journal of Production Research*, *52*(1), 32–49. https://doi.org/10.1080/00207543.2013.825748

Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. *International Journal of Physical Distribution and Logistics Management*, *38*(5), 360–387. https://doi.org/10.1108/09600030810882816

Chen, L., Jia, F., Li, T., & Zhang, T. (2021). Supply chain leadership and firm performance: A meta-analysis. *International Journal of Production Economics*, *235*(February), 108082. https://doi.org/10.1016/j.ijpe.2021.108082

Chen, Y., & Chen, I. J. (2019). Mediated power and sustainable supplier management (SSM): Linking power use, justice, and supplier performance. *International Journal of Physical Distribution and Logistics Management*, *49*(8), 861–878. https://doi.org/10.1108/IJPDLM-12-2018-0393

Coşkun, S. S., Kumru, M., & Kan, N. M. (2022). An integrated framework for sustainable supplier development through supplier evaluation based on sustainability indicators. *Journal of Cleaner Production*, *335*(January). https://doi.org/10.1016/j.jclepro.2021.130287

Dai, J., Xie, L., & Chu, Z. (2021). Developing sustainable supply chain management: The interplay of institutional pressures and sustainability capabilities. *Sustainable Production and Consumption*, *28*, 254–268. https://doi.org/10.1016/j.spc.2021.04.017

Danese, P., Lion, A., & Vinelli, A. (2019). Drivers and enablers of supplier sustainability practices: a survey-based analysis. *International Journal of Production Research*, *57*(7), 2034–2056. https://doi.org/10.1080/00207543.2018.1519265

Defee, C. C., Esper, T., & Mollenkopf, D. (2009). Leveraging closed-loop orientation and leadership for environmental sustainability. *Supply Chain Management*, *14*(2), 87–98. https://doi.org/10.1108/13598540910941957

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., & Helo, P. (2019). Supplier relationship management for circular economy: Influence of external pressures and top management commitment. *Management Decision*, *57*(4), 767–790. https://doi.org/10.1108/MD-04-2018-0396

Dubey, R., Gunasekaran, A., & Samar Ali, S. (2015). Exploring the relationship between leadership, operational practices, institutional pressures and environmental performance: A framework for green supply chain. *International Journal of Production Economics*, *160*, 120–132. https://doi.org/10.1016/j.ijpe.2014.10.001

Flynn, B. B., Koufteros, X., & Lu, G. (2016). On Theory in Supply Chain Uncertainty and its Implications for Supply Chain Integration. *Journal of Supply Chain Management*, *52*(3), 3–27. https://doi.org/10.1111/jscm.12106

Fontoura, P., & Coelho, A. (2020). The influence of supply chain leadership and followership

on organizational performance: An empirical study on a Portuguese energy supplier. *Baltic Journal of Management*, *15*(3), 333–353. https://doi.org/10.1108/BJM-01-2019-0012

Giannakis, M., Dubey, R., Vlachos, I., & Ju, Y. (2020). Supplier sustainability performance evaluation using the analytic network process. *Journal of Cleaner Production*, *247*, 119439. https://doi.org/10.1016/j.jclepro.2019.119439

Gimenez, C., & Tachizawa, E. M. (2012). Extending sustainability to suppliers: A systematic literature review. *Supply Chain Management*, *17*(5), 531–543. https://doi.org/10.1108/13598541211258591

Gosling, J., Jia, F., Gong, Y., & Brown, S. (2016). The role of supply chain leadership in the learning of sustainable practice: toward an integrated framework. *Journal of Cleaner Production*, *137*, 1458–1469. https://doi.org/10.1016/j.jclepro.2014.10.029

Govindan, K., Aditi, Dhingra Darbari, J., Kaul, A., & Jha, P. C. (2021). Structural model for analysis of key performance indicators for sustainable manufacturer–supplier collaboration: A grey-decision-making trial and evaluation laboratory-based approach. *Business Strategy and the Environment*, *30*(4), 1702–1722. https://doi.org/10.1002/bse.2703

Gualandris, J., Golini, R., & Kalchschmidt, M. (2014). Do supply management and global sourcing matter for firm sustainability performance?: An international study. *Supply Chain Management*, *19*(3), 258–274. https://doi.org/10.1108/SCM-11-2013-0430

Gualandris, J., & Kalchschmidt, M. (2016). Developing environmental and social performance: The role of suppliers sustainability and buyer-supplier trust. *International Journal of Production Research*, *54*(8), 2470–2486. https://doi.org/10.1080/00207543.2015.1106018

Gualandris, J., Klassen, R. D., Vachon, S., & Kalchschmidt, M. (2015). Sustainable evaluation and verification in supply chains: Aligning and leveraging accountability to stakeholders. *Journal of Operations Management*, *38*, 1–13. https://doi.org/10.1016/j.jom.2015.06.002

Hair, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European Business Review*, *26*(2), 106–121. https://doi.org/10.1108/EBR-10-2013-0128

Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Hoejmose, S. U., Grosvold, J., & Millington, A. (2014). The effect of institutional pressure on cooperative and coercive "green" supply chain practices. *Journal of Purchasing and Supply Management*, *20*(4), 215–224. https://doi.org/10.1016/j.pursup.2014.07.002

Hoejmose, S. U., Roehrich, J. K., & Grosvold, J. (2014). Is doing more doing better? The relationship between responsible supply chain management and corporate reputation. *Industrial Marketing Management*, *43*(1), 77–90. https://doi.org/10.1016/j.indmarman.2013.10.002

Hossan Chowdhury, M. M., & Quaddus, M. A. (2021). Supply chain sustainability practices

and governance for mitigating sustainability risk and improving market performance: A dynamic capability perspective. *Journal of Cleaner Production*, *278*, 123521. https://doi.org/10.1016/j.jclepro.2020.123521

Huo, B., Wang, K., & Zhang, Y. (2021). The impact of leadership on supply chain green strategy alignment and operational performance. *Operations Management Research*, *14*(1–2), 152–165. https://doi.org/10.1007/s12063-020-00175-8

Jia, F., Gong, Y., & Brown, S. (2019). Multi-tier sustainable supply chain management: The role of supply chain leadership. *International Journal of Production Economics*, *217*(July 2017), 44–63. https://doi.org/10.1016/j.ijpe.2018.07.022

Jia, M., Stevenson, M., & Hendry, L. (2021). A systematic literature review on sustainability-oriented supplier development. *Production Planning and Control*, *0*(0), 1–21. https://doi.org/10.1080/09537287.2021.1958388

Kauppi, K. (2013). Extending the use of institutional theory in operations and supply chain management research: Review and research suggestions. *International Journal of Operations and Production Management*, *33*(10), 1318–1345. https://doi.org/10.1108/IJOPM-10-2011-0364

Ketchen, D. J., & Hult, G. T. M. (2007). Bridging organization theory and supply chain management: The case of best value supply chains. *Journal of Operations Management*, *25*(2), 573–580. https://doi.org/10.1016/j.jom.2006.05.010

Khan, S. A., Kusi-Sarpong, S., Arhin, F. K., & Kusi-Sarpong, H. (2018). Supplier sustainability performance evaluation and selection: A framework and methodology. *Journal of Cleaner Production*, *205*, 964–979. https://doi.org/10.1016/j.jclepro.2018.09.144

Khurshid, A., Muzaffar, A., & Bhutta, M. K. S. (2021). Institutional pressures and supplier involvement: a perspective on sustainability. *Operations Management Research*, *14*(1–2), 123–137. https://doi.org/10.1007/s12063-021-00181-4

Klassen, R. D., & Vachon, S. (2003). Collaboration and evaluation in the supply chain: The impact on plant-level environmental investment. *Production and Operations Management*, *12*(3), 336–352.

Koberg, E., & Longoni, A. (2019). A systematic review of sustainable supply chain management in global supply chains. *Journal of Cleaner Production*, *207*, 1084–1098. https://doi.org/10.1016/j.jclepro.2018.10.033

Kock, N. (2015). Common Method Bias in PLS-SEM. *International Journal of E-Collaboration*, *11*(4), 1–10. https://doi.org/10.4018/ijec.2015100101

Kumar, D., & Rahman, Z. (2015). Sustainability adoption through buyer supplier relationship across supply chain: A literature review and conceptual framework. In *International Strategic Management Review* (Vol. 3, Issues 1–2). Holy Spirit University of Kaslik. https://doi.org/10.1016/j.ism.2015.04.002

Kumar, D., & Rahman, Z. (2016). Buyer supplier relationship and supply chain sustainability: Empirical study of Indian automobile industry. *Journal of Cleaner Production*, *131*, 836–848. https://doi.org/10.1016/j.jclepro.2016.04.007

Lee, S. Y., Klassen, R. D., Furlan, A., & Vinelli, A. (2014). The green bullwhip effect: Transferring environmental requirements along a supply chain. *International Journal of Production Economics*, *156*, 39–51. https://doi.org/10.1016/j.ijpe.2014.05.010

León Bravo, V., Jaramillo Villacrés, M., & Silva, M. E. (2022). Analysing competing logics towards sustainable supplier management. *Supply Chain Management*, *27*(7), 49–63. https://doi.org/10.1108/SCM-07-2020-0354

Leppelt, T., Foerstl, K., Reuter, C., & Hartmann, E. (2013). Sustainability management beyond organizational boundaries-sustainable supplier relationship management in the chemical industry. *Journal of Cleaner Production*, *56*, 94–102. https://doi.org/10.1016/j.jclepro.2011.10.011

Li, M., Falcone, E., Sanders, N., Choi, T. Y., & Chang, X. (2021). Buyer-supplier collaboration: A macro, micro, and congruence perspective. *Journal of Purchasing and Supply Management*, *September*, 100723. https://doi.org/10.1016/j.pursup.2021.100723

Liu, L., Zhang, M., Hendry, L. C., Bu, M., & Wang, S. (2018). Supplier Development Practices for Sustainability: A Multi-Stakeholder Perspective. *Business Strategy and the Environment*, *27*(1), 100–116. https://doi.org/10.1002/bse.1987

Liu, L., Zhang, M., & Ye, W. (2019). The adoption of sustainable practices: A supplier's perspective. *Journal of Environmental Management*, *232*(November 2018), 692–701. https://doi.org/10.1016/j.jenvman.2018.11.067

Lockström, M., & Lei, L. (2013). Antecedents to supplier integration in China: A partial least squares analysis. *International Journal of Production Economics*, *141*(1), 295–306. https://doi.org/10.1016/j.ijpe.2012.08.007

Min, S., Mentzer, J. T., & Ladd, R. T. (2007). A market orientation in supply chain management. *Journal of the Academy of Marketing Science*, *35*(4), 507–522. https://doi.org/10.1007/s11747-007-0020-x

Mokhtar, A. R. M., Genovese, A., Brint, A., & Kumar, N. (2019a). Improving reverse supply chain performance: The role of supply chain leadership and governance mechanisms. *Journal of Cleaner Production*, *216*, 42–55. https://doi.org/10.1016/j.jclepro.2019.01.045

Mokhtar, A. R. M., Genovese, A., Brint, A., & Kumar, N. (2019b). Supply chain leadership: A systematic literature review and a research agenda. *International Journal of Production Economics*, *216*(April), 255–273. https://doi.org/10.1016/j.ijpe.2019.04.001

Naffin, J., Klewitz, J., & Schaltegger, S. (2023). Sustainable development of supplier performance. An empirical analysis of relationship characteristics in the automotive sector. *Corporate Social Responsibility and Environmental Management*, *January*, 1–17. https://doi.org/10.1002/csr.2452

Nath, S. D., Eweje, G., & Bathurst, R. (2019). The Invisible Side of Managing Sustainability in Global Supply Chains: Evidence from Multitier Apparel Suppliers. *Journal of Business Logistics*, *42*(2), 207–232. https://doi.org/10.1111/jbl.12230

Paul J. DiMaggio and Walter W. Powell. (1983). The Iron Cage Revisited : Institutional Isomorphism and Collective Rationality in Organizational Fields Author (s): Paul J .

DiMaggio and Walter W . Powell Published by : American Sociological Association Stable URL : https://www.jstor.org/stable/209510. *American Sociological Review*, *48*(2), 147–160.

Peng, D. X., & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, *30*(6), 467–480. https://doi.org/10.1016/j.jom.2012.06.002

Pham, H., & Kim, S. Y. (2019). The effects of sustainable practices and managers' leadership competences on sustainability performance of construction firms. *Sustainable Production and Consumption*, *20*, 1–14. https://doi.org/10.1016/j.spc.2019.05.003

Rintala, O. (2023). How to not lose oneself: the case for relational identity in collaborative supply relationships. *International Journal of Physical Distribution & Logistics Management*, *53*(2), 231–247. https://doi.org/10.1108/ijpdlm-12-2021-0512

Saeed, A., Jun, Y., Nubuor, S. A., RasikaPriyankara, H. P., & Jayasuriya, M. P. F. (2018). Institutional pressures, green supply chain management practices on environmental and economic performance: A two theory view. *Sustainability (Switzerland)*, *10*(5), 1–24. https://doi.org/10.3390/su10051517

Sancha, C., Gimenez, C., & Sierra, V. (2016). Achieving a socially responsible supply chain through assessment and collaboration. *Journal of Cleaner Production*, *112*, 1934–1947. https://doi.org/10.1016/j.jclepro.2015.04.137

Sancha, C., Longoni, A., & Giménez, C. (2015). Sustainable supplier development practices: Drivers and enablers in a global context. *Journal of Purchasing and Supply Management*, *21*(2), 95–102. https://doi.org/10.1016/j.pursup.2014.12.004

Sancha, C., Wong, C. W. Y., & Gimenez, C. (2019). Do dependent suppliers benefit from buying firms' sustainability practices? *Journal of Purchasing and Supply Management*, *25*(4), 100542. https://doi.org/10.1016/j.pursup.2019.100542

Sarstedt, M., Hair, J. F., Nitzl, C., Ringle, C. M., & Howard, M. C. (2020). Beyond a tandem analysis of SEM and PROCESS: Use of PLS-SEM for mediation analyses! *International Journal of Market Research*, *62*(3), 288–299. https://doi.org/10.1177/1470785320915686

Sarstedt, M., Hair, J. F., Ringle, C. M., Thiele, K. O., & Gudergan, S. P. (2016). Estimation issues with PLS and CBSEM: Where the bias lies! *Journal of Business Research*, *69*(10), 3998–4010. https://doi.org/10.1016/j.jbusres.2016.06.007

Schroeder, R. G., & Flynn, B. B. (2001). *High performance manufacturing : global perspectives* (p. 308).

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, *16*(15), 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Shafiq, A., Johnson, P. F., Klassen, R. D., & Awaysheh, A. (2017). Exploring the implications of supply risk on sustainability performance. *International Journal of Operations and Production Management*, *37*(10), 1386–1407. https://doi.org/10.1108/IJOPM-01-2016-0029

Sharif, A. M., & Irani, Z. (2012). Supply chain leadership. *International Journal of Production Economics*, *140*(1), 57–68. https://doi.org/10.1016/j.ijpe.2012.01.041

Shmueli, G., Sarstedt, M., Hair, J. F., Cheah, J. H., Ting, H., Vaithilingam, S., & Ringle, C. M. (2019). Predictive model assessment in PLS-SEM: guidelines for using PLSpredict. *European Journal of Marketing*, *53*(11), 2322–2347. https://doi.org/10.1108/EJM-02-2019-0189

Singh, J., Pandey, K. K., Kumar, A., Naz, F., & Luthra, S. (2022). Drivers, barriers and practices of net zero economy: An exploratory knowledge based supply chain multi-stakeholder perspective framework. In *Operations Management Research*. Springer US. https://doi.org/10.1007/s12063-022-00255-x

Subramaniam, P. L., Iranmanesh, M., Kumar, K. M., & Foroughi, B. (2020). The impact of multinational corporations' socially responsible supplier development practices on their corporate reputation and financial performance. *International Journal of Physical Distribution and Logistics Management*, *50*(1), 3–25. https://doi.org/10.1108/IJPDLM-01-2019-0002

Tachizawa, E. M., Gimenez, C., & Sierra, V. (2015). Green supply chain management approaches: drivers and performance implications. *International Journal of Operations and Production Management*, *35*(11), 1546–1566. https://doi.org/10.1108/IJOPM-01-2015-0023

Tate, W. L., Dooley, K. J., & Ellram, L. M. (2011). Transaction Cost and Institutional Drivers of Supplier Adoption of Environmental Practices - Tate - 2011 - Journal of Business Logistics - Wiley Online Library. *Journal of Business Logistics*, *32*(1), 6–16.

Trujillo-Gallego, M., Sarache, W., & Sellitto, M. A. (2021). Identification of practices that facilitate manufacturing companies' environmental collaboration and their influence on sustainable production. *Sustainable Production and Consumption*, *27*, 1372–1391. https://doi.org/10.1016/j.spc.2021.03.009

Vanalle, R. M., Ganga, G. M. D., Godinho Filho, M., & Lucato, W. C. (2017). Green supply chain managementAn investigation of pressures, practices, and performance within the Brazilian automotive supply chain. *Journal of Cleaner Production*, *151*, 250–259. https://doi.org/10.1016/j.jclepro.2017.03.066

Varsei, M., Soosay, C., Fahimnia, B., & Sarkis, J. (2014). Framing sustainability performance of supply chains with multidimensional indicators. *Supply Chain Management*, *19*(3), 242–257. https://doi.org/10.1108/SCM-12-2013-0436

Wang, J., & Dai, J. (2018). Sustainable supply chain management practices and performance. *Industrial Management and Data Systems*, *118*(1), 2–21. https://doi.org/10.1108/IMDS-12-2016-0540

Wilhelm, M. M., Blome, C., Bhakoo, V., & Paulraj, A. (2016). Sustainability in multi-tier supply chains: Understanding the double agency role of the first-tier supplier. *Journal of Operations Management*, *41*, 42–60. https://doi.org/10.1016/j.jom.2015.11.001

Wolf, J. (2014). The Relationship Between Sustainable Supply Chain Management, Stakeholder Pressure and Corporate Sustainability Performance. *Journal of Business Ethics*, *119*(3), 317–328. https://doi.org/10.1007/s10551-012-1603-0

Wu, G. C. (2017). Effects of Socially Responsible Supplier Development and Sustainability-Oriented Innovation on Sustainable Development: Empirical Evidence from SMEs. *Corporate Social Responsibility and Environmental Management*, *24*(6), 661–675. https://doi.org/10.1002/csr.1435

Wu, I. L., Chuang, C. H., & Hsu, C. H. (2014). Information sharing and collaborative behaviors in enabling supply chain performance: A social exchange perspective. *International Journal of Production Economics*, *148*, 122–132. https://doi.org/10.1016/j.ijpe.2013.09.016

Yang, F., & Zhang, X. (2017). The impact of sustainable supplier management practices on buyer-supplier performance: An empirical study in China. *Review of International Business and Strategy*, *27*(1), 112–132. https://doi.org/10.1108/RIBS-08-2016-0043

Zeng, H., Chen, X., Xiao, X., & Zhou, Z. (2017). Institutional pressures, sustainable supply chain management, and circular economy capability: Empirical evidence from Chinese eco-industrial park firms. *Journal of Cleaner Production*, *155*(May 2014), 54–65. https://doi.org/10.1016/j.jclepro.2016.10.093

Zhu, Q., Sarkis, J., & Lai, K. hung. (2013). Institutional-based antecedents and performance outcomes of internal and external green supply chain management practices. *Journal of Purchasing and Supply Management*, *19*(2), 106–117. https://doi.org/10.1016/j.pursup.2012.12.001

Zimmer, K., Fröhling, M., & Schultmann, F. (2016). Sustainable supplier management - A review of models supporting sustainable supplier selection, monitoring and development. *International Journal of Production Research*, *54*(5), 1412–1442. https://doi.org/10.1080/00207543.2015.1079340

Zimon, D., Tyan, J., & Sroufe, R. (2020). Drivers of sustainable supply chain management: Practices to alignment with un sustainable development goals. *International Journal for Quality Research*, *14*(1), 219–236. https://doi.org/10.24874/IJQR14.01-14

Study 4: The effect of sustainability on new product development in manufacturing- Internal and external practices

Abstract

The purpose of this paper is to analyse the link between the adoption of sustainability practices and new product development (NPD) in manufacturing companies. From a triple bottom line (TBL) perspective and considering different theoretical approaches, this study hypothesizes on the effect of both internal and external sustainability practices, distinguishing between collaborative and controlling initiatives, on the success of new products. Using a unique database of 281 companies across three industries taken from the fourth round of the High-Performance Manufacturing project, the findings shows that both monitoring and collaborative actions with suppliers demonstrate positive impacts on NPD success. Internal sustainability practices do not have a direct effect on NPD success but are determinant in supporting external sustainability practices.

Keywords: Internal sustainability practices; External sustainability practices; New product development success; Monitoring; Collaboration

1. Introduction

Sustainability has being considered as a significant in creation of competitive advantage and as a driver of innovation for manufacturing firms (Claudy et al., 2016; Nidumolu et al., 2009). Companies are becoming more aware of the importance of sustainability and are increasingly incorporating the features of sustainable businesses into their corporate and operation strategies (Paulraj et al., 2017). Driven from popular notion of triple bottom line perspective (people, planet and profit) of Elkington (1998), sustainability is considered as taking simultaneously responsible approaches towards society, environment, and economy (Adams et al., 2016).

Literature in the field have identified that innovation practices among the supply chain helps companies to achieve sustainability (Lintukangas et al., 2019). Firms with a higher level of sustainability orientation are more likely to implement sustainability-oriented innovation (Adams et al., 2016; Claudy et al., 2016). In this context, new product development (NPD) is a determinant for the a company´s success and integrating their supplier-related sustainability practices into the early stages of NPD is key to improve both

sustainability and operational performance of new products (Gmelin & Seuring, 2014; Charbel Jose Chiappetta Jabbour et al., 2015).

Nevertheless, prior evidence bridging between innovation and NPD with sustainability in operations management, has analysed the association of sustainably-oriented innovations and innovation outcomes, considering the role of mediating factors such as organisational leadership, culture, market knowledge competences, and customer focus regarding this association (Claudy et al., 2016; Jin et al., 2019; Obal et al., 2020). In this context, many other studies sought to develop a systematic approach to sustainable new product (Ahmad et al., 2018; Tuli & Shankar, 2015) suggesting tools and mechanism to link sustainability with NPD, such as environmental or eco-design, eco-innovation, recyclability, and lean thinking (Nepal et al., 2011; Oliveira et al., 2018; Rossi et al., 2016). However, to our knowledge, very few empirical studies have attempted to explore any links between the adoption of sustainability practices form a broad perspective, considering both internal and external and the association between them, to explain NPD success. This confirms that sustainability orientation and NPD is still one of the least understood areas in sustainability management (Cheng, 2020; Claudy et al., 2016), with very limited empirical evidences (Adams et al., 2016; Neutzling et al., 2018). Sustainability and NPD are in the core of success for manufacturing companies nowadays and therefore, advancing in the knowledge on how both things interact is on great importance (Hallstedt et al., 2013; Lintukangas et al., 2019).

This study aims to shed new light on this issue by analysing how and to what extent a firm's sustainability practices effect the success of its NPD. For this purpose, sustainability practices are grouped into internal sustainability practices and external sustainability practices. Internal practices are those sustainability practices that are applied to the firm's internal operations, while external practices are those that are implemented beyond the boundaries of the firm, particularly with suppliers (Laari et al., 2016; Sancha et al., 2019). These practices typically require a certain level of cooperation with, and monitoring of, close supply chain actors (Danese et al., 2019). In addition, NPD success is classified to external and internal measures. Internal measure refers to the development process including time, quality, and other technical aspects of the product while the external success measure refers mostly to the non-technical dimensions including customer satisfaction and financial issues (García et al., 2008). As such, the expected effects of adopting those practices on NPD success are neither immediate nor intuitive.

The objective is to advance the understanding on the topic considering the existence of trade-offs between different strategies (e.g., monitoring vs. collaboration) and the difficulties that NPD managers face in balancing sustainability targets with the demands of supply chain actors and external pressures (Claudy et al., 2016). Hence, the theoretical part of the paper develops three sets of hypotheses that take advantage of statements of natural resource-based view (NRBV) theory, social capital theory and transaction cost theory which help to understand the link between sustainability and NPD. The SmartPLS approach is used to test the hypothesised relationships. The data used comes from the fourth round of the High-Performance Manufacturing project and includes a total of 281 interviews across three industries in 16 countries.

The study contributes to the literature in several ways. First, contributing to the debate on how manufacturing firms can improve the success of their new products. Our study advances these research streams by proposing how a buying firm could enhance NPD success through investing on sustainability issues in their operational process under NRBV theoretical perspective as well as extending the requirements to their supply chain through sustainability related practices with suppliers under social capital and transactional cost theoretical frameworks. We seek to facilitate the exchange between these three perspectives by highlighting how they complement and support each other.

Second, unlike the previous studies on suppliers integration in NPD considering only the importance of green suppliers collaboration for NPD success (Kähkönen et al., 2017; Neutzling et al., 2018; Wang et al., 2021), this study contributes to the field by differentiating various sustainability practices and distinguishing between different measures of NPD success.

Third, developing two separated constructs for external sustainability practices of focal firms (i.e., supplier monitoring and supplier collaboration practices) provides some additional insights on the trade-offs between these two ways to manage sustainability with suppliers and their effects on NPD success. Therefore, this study throws light on the unique impact of different sustainability practices on different measures of NPD success. The results highlight the benefits of adopting both controlling and collaborative frameworks of sustainability for the success of new products. Furthermore, the results of this study provide useful insights for both managers seeking to adopt sustainable practices and policymakers seeking to further promote a sustainable supply chain.

Forth, while many other studies are limited to the sample data from a specific industry or only one country, this study gathers the empirical evidence using a unique database that integrated 281 manufacturing firms from across three industries and 16 countries located in Asia, Europe, and America. Using such a multi-country, multi-industry sample contributes significantly to the empirical investigations related to the impact of sustainability on the success of NPD.

The rest of this paper is organised as follows: section 2 presents a literature review. In section 3, hypotheses development is explained. The empirical methodology, the statistic treatment, and empirical results are presented in section 4. Section 5 closes the paper with conclusions, implications, and future research opportunities.

2. Theoretical framework

Previous research on sustainability as well as in NPD has demonstrated that a focal firm's actions towards the environment and innovation are not only limited to its own performance but also to the actions of close supply chain members (Y. Chen & Chen, 2019b). Firms, therefore, have no option other than integrating sustainability features into their operation and extending it to their key partners, but also should simultaneously take up some activities for behavioural/relational issues related to interaction with them. It requires to explain this phenomenon through different theoretical lenses while considering their potential trade-offs. In this context, the natural resource based view (NRBV) theory provides a framework that emphasises the importance of environmental factors in terms of a firm's green competences (Hart, 1995). A sustainability strategy includes the adoption of intra–inter organisational environmental practices that may permit the building of causally ambiguous resources through continuous learning and repeated practices for example from pollution prevention strategies as well as the creation of complex resources through environmental collaboration in product stewardship or sustainable development projects (V. G. Shi et al., 2012).

By incorporating environmental requirements in NPD, a focal firm is able to improve environmental performance of new product in terms of energy efficiency and environmental footprint (Gerstlberger et al., 2014; Wang et al., 2021) resulting in enhanced performance of new products in terms of time to market, quality and cost of R&D (Wang et al., 2021). Collaborative teams integrated by sustainability-oriented firms are more likely to find environmentally friendly innovations in new products and processes, achieving more

efficiently use of resources and producing less waste and environmental burdens, which ultimately drive enhanced performance and NPD success (Claudy et al., 2016).

Close to this view, social relationships within supply chains can be formulated through different forms of inter-organisational activities (Putnam, 1995), which are particularly relevant for NPD and for sustainability (Woo et al., 2016). For instance, through supplier involvement in NPD, the level of information processing and information transfer from one party to another is improved (Wlazlak et al., 2018) facilitating the voluntary sharing innovative ideas, access to technology, knowledge, R&D services and resources required for NPD (Du et al., 2016; Mazzola et al., 2015). Further, the firm´s social capital obtained from buyer-supplier interaction enhances the innovation search span of the firm causing reduction in the search cost (Du et al., 2016). To convert such relational social capital to the rent for superior performance of NPD, a specific capability is needed (J. Zhang & Wu, 2013). NRBV provides such capability in the sustainability-oriented buyer-supplier relationship to integrate such joint efforts in form of NPD practices with sustainability environmental objectives. Therefore, the communication, information sharing, knowledge exchange and the trust under long term buyer-supplier collaborative relationship promotes the joint innovatively efforts and facilitate joint solution development to sustainability issues during NPD (Lee, 2015).

However, based on the transaction cost theory, different governing mechanisms, including supplier assessment and collaboration, have been proposed to focal firms in order to manage the relationship with their suppliers which can affect both sustainability and NPD (Gimenez & Sierra, 2013). Only sustainability-committed suppliers can design and develop new sustainable products and invest in new sustainability processes (Y. Chen & Chen, 2019b; Jansson et al., 2017). Further, the selection of supplier with high level of sustainability orientation either as a source of sustainability-related knowledge or as a source of technological and R&D services strengthen the NPD outcome (Cheng, 2020). Accordingly, monitoring-oriented strategies are usually conducted by focal firms to select, control, evaluate, and verify suppliers with respect to their compliance with sustainability requirements (Gualandris et al., 2015).

3. Hypothesis development

3.1. External Sustainability Practices (Collaboration) and NPD Success

Suppliers can positively influence both environmental and operational performance of supply chains (e.g., Croom et al., 2018; Geng et al., 2017). It has been stated that firms integrate sustainability concepts into their supply chains to achieve sustainability development through different strategies (Neutzling et al., 2018). Collaborative practices in sustainability that includes the involvement of suppliers in joint projects on product co-development is suggested to improve sustainability performance (Danese et al., 2019), innovation performance (Kähkönen et al., 2017) as well as the environmental performance of R&D projects (De Stefano & Montes-Sancho, 2018) of manufacturing companies.

Under collaborative relationships, the focal firm provides suppliers with the required communication, training, and technological knowledge to improve supplier capabilities and the performance of new products in accordance with sustainability requirements (Busse et al., 2016; Lawson et al., 2015). In addition to enhancement of knowledge, these interactions lead to increased satisfaction among the partners' employees and encourages them to participate proactively in NPD (Gmelin & Seuring, 2018a). Building relational collaboration also decreases conflict, information asymmetry, and likely opportunistic behaviour among supply chain actors, and permits firms to practice sustainability strategies across their organisations (Neutzling et al., 2018). Finally, through boosting information processing capacity, a collaborative framework on NPD can diminish ¨strategic uncertainties¨ in the buyer and supplier relationship (Wong et al., 2020).

Moreover, focal firms with higher sustainability orientation are better able to boost organisational learning by involving their supply chain members, particularly the NPD team of their suppliers to think innovatively about how to integrate those sustainability requirements into the NPD processes (Cheng, 2020; Claudy et al., 2016). This type of sustainability-oriented buyer–supplier relational collaboration fulfils joint learning processes, skills and resource sharing, and innovation capability developments necessary for the implementation of sustainability strategies that may benefit the development of new products (Chiarini, 2012; Neutzling et al., 2018). Consequently, while interfirm problem solving is facilitated, firms involved in such interorganisational relationships reap the benefits of interfirm knowledge exchanges through a learning process and idea generation for environmentally friendly design solutions that boost new product innovations (Lawson et al., 2015). This enhances a firm's environmental competences and knowledge and contributes to the building of reputation and brand image (Ageron et al., 2012) and cost reduction (Neutzling et al., 2018; Wong et al., 2020; Woo et al., 2016).

Additionally, prior research confirms the positive link between sustainability related buyer-suppliers collaboration in NPD with innovation (NPD) performance (Cheng, 2020; Kähkönen et al., 2017). Wang et al., (2021) based on dataset of 212 American manufacturers found that sustainability-oriented collaborative practices with suppliers enhance NPD performance not only through significant reduction in environmental burdens of the new product, also by fostering economic sustainability of NPD in terms of lower cost of R&D, higher flexibility of R&D, and reduced energy-resources consumption. Further, by providing additional resources and capabilities under such collaborative approaches contribute to environmental and social solutions during NPD without transferring the extra costs of high-priced external experts and extra investment of resources to buyers (Cousins & Lawson, 2007; Gmelin & Seuring, 2018b). In the background, enhanced knowledge of sustainability in NPD may facilitate joint decision making on NPD-related issues, improving outcomes of new products (Petersen et al., 2003), and enhancing a firm's corporate reputation and image with regard to society and the environment (Neutzling et al., 2018). In accordance with these arguments, the following hypothesis is proposed:

H1. The adoption of external collaborative practices in sustainability has a positive effect on both internal and external NPD success.

3.2. External Sustainability Practices (Monitoring) and NPD success

External sustainability practices can also be developed through monitoring. End customers increasingly demand sustainability-oriented products (Gmelin & Seuring, 2014) which lead manufacturing companies that are looking for environmental benefits to impose sustainability requirements on their suppliers, for example, by minimising the consumption rate of resources or by providing health, safety, and work welfare to society (Marshall et al., 2015; Pagell & Wu, 2009). A monitoring approach in sustainability oriented buyer.-supplier relationship seeks to ensure compliance performance of suppliers through different practices includes supplier selection practices, company visits for an audit, the assessment of suppliers through their conduct, a request to suppliers to sign a code of environmental conduct, an audit through certification of suppliers' environmental management systems, or a request to suppliers to pay a minimum 'living' wage (Danese et al., 2019).

Involving suppliers in NPD process while requesting them to follow sustainability principals have some risks for buyer companies particularly due to the risk of supplier incompetence in project execution (Goldberg & Schiele, 2018). Further, suppliers might

follow unethical behaviour in performing sustainability practices if the uncertainty relevant to the adoption of those sustainability initiatives is high or the adoption of those activities require considerable investment in their specific assets (Wang & Dai, 2018). In addition, there is a potentiality of opportunistic behaviour and sustainability related information asymmetric in the relationship (Carey et al., 2011; Lee, 2015). As a result to reduce the risk of incompliance to sustainability requirements or the risk of transactional related cost, companies undertake monitoring practices resulting in higher costs, more time and greater efforts (Gimenez & Tachizawa, 2012; Gualandris et al., 2015)

However, sustainability requirements in NPD dictated by buying firms implies suppliers to strictly follow eco-efficiency production so as to be more responsible towards their environment, society, and economics (Gimenez & Tachizawa, 2012). Prior research has identified a strong correlation between environmental compliance and green performance of NPD, since proactive sustainability- oriented buying firms prefer to selectively work for NPD with only key suppliers with higher level of sustainability orientation (Lee & Kim, 2011). Through conducting suppliers monitoring practices, the adverse environmental attributes of NPD can be eliminated (Pujari, 2006). Further, the implementation of environmental management system by suppliers has positive impact on the association of supplier involvement in sustainable design practices and performance through more possibility of offering environmental ideas and enhancement of environmental benefits (Wang et al., 2021). Among other things, monitoring practices look to ensure that teams working in NPD are sufficiently knowledgeable and aware of the sustainability requirements, have sufficient knowledge about environmentally-friendly techniques in manufacturing (Fish, 2015), and avoid potential opportunistic behaviour and information asymmetry (Y. Chen & Chen, 2019b; Gualandris et al., 2015). Thus, we can hypothesise that:

H2a. The adoption of external monitoring practices in sustainability has a positive effect on internal NPD success.

On the other hand, adopting monitoring practices for sustainability may have positive effects on sustainability performance of new products through enhanced corporate social responsibility and reputation (Gimenez & Sierra, 2013) since buying firms only interact with sustainability-committed suppliers (Wang & Dai, 2018). Monitoring enables companies to control for abusive working conditions and child labour, ensuring employee wellbeing and satisfaction (Gualandris et al., 2015). Moreover, there is evidence that relating sustainability issues to NPD can enhance the environmental performance of new products by applying

product life cycle technologies and improving market performance through better alignment with customer expectations (Charbel Jose Chiappetta Jabbour et al., 2015). Further, supplier´s adoption and implementation of environmental sustainability programs (e.g., acquiring ISO 14000 certificates) can improve the environmental and economic performance of NPD (Wang et al., 2021). In summary, ensuring that the supply network works in accordance with both social and sustainability responsibilities may improve the image, reputation, and market performance of new products.

H2b: The adoption of external monitoring practices in sustainability has a positive effect on external NPD success.

3.3. Internal Sustainability Practices and NPD success

Firms increasingly encounter pressures for sustainability from various internal and external stakeholders (Paulraj et al., 2017). Research has affirmed that the values behind sustainability issues drive a firm's sustainability culture and orientation to move beyond mere economic concerns to align its corporate philosophy, strategies, and culture with TBL perspectives and extend it to their supply chain (Pagell & Wu, 2009). Firms with a higher sustainability orientation are more likely to adopt sustainability practices and compliance strategies, including environmental management systems such as ISO 14001 that impose pressure on their supply chains to also adopt an environmental management system (Cheng, 2020; Claudy et al., 2016; Marshall et al., 2015). Furthermore, firms with high levels of sustainability orientation are probably better workplaces for sustainability-minded employees (Du et al., 2016) whose moral motives and commitment to sustainability brings to bear internal pressure on firms to adopt sustainability principles and practices along the supply chain (Y. Chen & Chen, 2019b).

In line with NRBV, focal firms that tackle environmental problems by implementing various reactive and proactive environmental strategies within their operations create value by addressing stakeholder expectations and by conforming to environmental regulations (Buysse & Verbeke, 2003). Greater involvement in proactive environmental strategies (i.e., a greater sustainability culture) is more likely to lead to the probable adoption of green supply chain practices, especially supplier monitoring and assessment by focal firms (Marshall et al., 2015; G. C. Wu et al., 2012). Additionally, supply chain management is considered as a cross-organisational activity. In the context of social capital theory, the establishment of social relationships between focal firms and suppliers based on trust, values, and

communication can result in the development of the same goals and visions among the partners, particularly regarding sustainability (G. C. Wu et al., 2012). Accordingly, focal firms with high levels of sustainability orientation due to the practise of various environmentally and socially oriented strategies are more likely to work with only sustainability-oriented suppliers (Wang & Dai, 2018), therefore they may regularly apply monitoring practices to ensure their suppliers´ compliance to sustainability and standards (Laari et al., 2016). Furthermore, those sustainability oriented focal firms are more probably share their knowledge and collaborate with their suppliers on sustainability issues (Claudy et al., 2016; G. C. Wu et al., 2012). Thus, we propose the following hypothesis:

H3a: The adoption of internal sustainability practices is positively associated with the adoption of external sustainability practices.

Internal sustainability practices embrace various environmental and social focused activities adopted and implemented by a focal firm in its in-house processes such as applying internal environmental management system, developing environmental policies and adopting internal social responsible management practices (Laari et al., 2016; Wang & Dai, 2018). In the context of manufacturing, a focal firm´s internal sustainability practices link the environmental and social related activities with manufacturing practices in order to enhance the benefits and returns for instance value, quality of product, efficiency in the use of resources, working conditions, health system and safety as well as to reduce the environmental burdens such as air and soil pollution, cost, waste, and resources consumption (Moldavska & Welo, 2017). Accordingly, a sustainability-oriented focal firm during NPD may incorporate TBL considerations in NPD looking for identifying and taking advantage of the opportunities for innovation (Du et al., 2016).

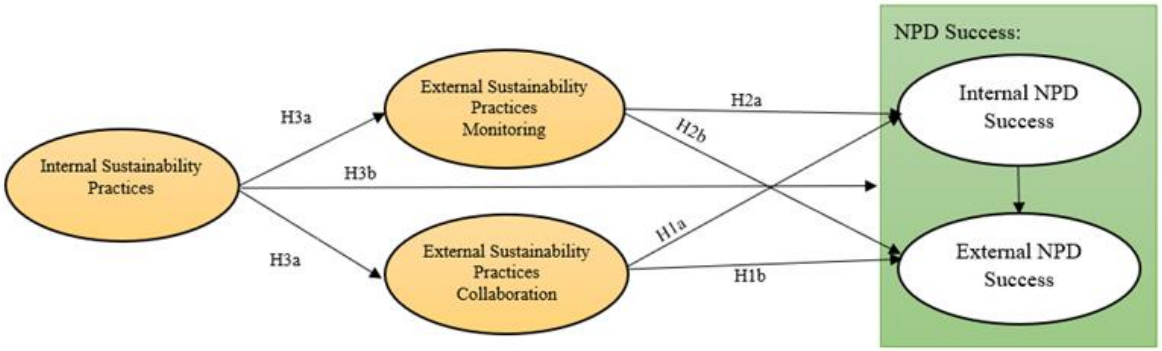
In the NRBV context, addressing sustainability issues during NPD processes, such as through pollution prevention, eco-design practices, or product life cycle analysis method, enables firms to tackle environmental issues and increase their eco-efficiency for example though design focused on reduction of waste generation or design for reusability and recyclability (González-Benito & González-Benito, 2006; V. G. Shi et al., 2012). Moreover, adopting internal sustainability practices by sustainability oriented firms helps to improve their operational efficiency in terms of quality and cost, and effectively use of their resources because of being NPD team more encouraged to find innovative solutions to environmental and social issues (Claudy et al., 2016). The conventional competence established by these sustainability-oriented innovation activities boosts the sustainable competitive advantage

through cost saving and better sustainability performance (Brulhart et al., 2017; Buysse & Verbeke, 2003). Jabbour et al., (2015) in their empirical study confirmed the direct influence of green product development not only on market performance as indicated by company reputation and image and the meeting of customer expectations but also on operational performance in terms of flexibility, process improvements, quality conformity, and short lead times. In sum, we posit the following hypothesis:

H3b: The adoption of internal sustainability practices is positively associated with NPD success.

According to the previous hypotheses, the conceptual model was developed as following in Fig. 1.

Figure 1: Structural Model Proposed: Hypothesis statements.



4. Methodology

4.1. Sample and Data Collection

The data used for empirical analysis was composed of 281 manufacturing plants from three major industries (mechanical, electronics, and transportation equipment) that participated in the fourth round of the High-Performance Manufacturing (HPM) project. More than 25 research groups from 16 countries across Europe, America, and Asia are involved in the project. The local research team in each country was responsible to contact the sample plant and conduct the research. The sample was selected randomly from the master list of plants in each country (Danese et al., 2019). Table 1 reports the data distribution according to the sector and country.

The survey method was used to collect data. The unit of analysis was the plant and not the company since different practices and performance are observed in different

locations. A set of 12 questionnaires specific to different operational management areas was administered through interviews with a number of plant managers. One of these sets of questionnaires was specific to sustainability issues and the other to NPD processes. Scales and items integrating all of the questionnaires had previously been used and validated by related literature. The questionnaires in each functional area were completed by two informants who were knowledgeable about that area (e.g., the section related to environmental affairs was filled by two environmental affairs managers). As a result, each plant submitted 23 questionnaires from different informants. The response rate was approximately 65% in each country.

Table 1: Industry to country distribution

Country	Industry			total
	Electronics	Mechanical	Transportation Equipment	
China	8	15	3	26
Germany	5	11	8	24
Sweden	1	4	0	5
Switzerland	2	0	1	3
Japan	6	6	9	21
Korea	8	5	12	25
Spain	7	6	8	21
Italy	7	17	5	29
Israel	13	2	0	15
Brazil	2	7	6	15
Finland	6	6	5	17
Taiwan	19	10	1	30
UK	4	5	4	13
Vietnam	8	7	6	21
USA	3	3	2	8
Austria	1	6	1	8

In addition to some countermeasure practices, such as using a mix of item types (i.e. perceptual scales and objective data) in each section of the questionnaire, or mixing items for the same scale from different parts of the questionnaire sections, the research teams asked more than one respondent in each plant to fill in a questionnaire with the goal of triangulation of information and to avoid common method bias problems (Danese et al., 2019). The adequacy of the sample was tested through the Keiser-Meyer-Olkin (KMO) test. Further, Harman`s single factor test indicates that the total variance explained by a single factor was 0.3687 indicating that there is no clear evidence for common method bias (Podsakoff et al., 2003).

4.2. Measures

For this study, only those questionnaire sections that included questions related to sustainability affairs and the success of NPD were considered. Regarding sustainability practices, respondents were requested to 'indicate the degree to which their plant is engaged in the initiative/practices' by listing several examples (see Appendix A). As for NPD success, the respondents were asked to consider the success of the products recently launched by the firm in terms of reaching firm operational and market NPD goals. Accordingly, the multiple item constructs were developed as follows:

- In the line with the concept behind NRBV, the Internal sustainability practices (ISP) of this study refers to a firm´s evaluation of the efficiency of its own processes not only through prevention and controlling practices but also environmental improvement through the reduction of environmental accidents and disposal of excess materials or equipment (Montabon et al., 2007).
- External Collaborative Sustainability Practices (ESPc) include interorganisational collaborative practices between focal firms and their suppliers (Danese et al., 2019).
- External Monitoring Sustainability Practices (ESPm) refers to sustainability related supplier assessment practices imposed by focal firms (Danese et al., 2019).
- The external success of the NPD (ENPD) construct refers to the external (or market) dimension of NPD success (García et al., 2008) that includes customer satisfaction and overall commercial success items.
- The internal success of the NPD (INPD) construct refers to the internal (or operational) dimension of NPD success (García et al., 2008) that includes time to market, ease of manufacturing, and unit manufacturing cost items.

The description and the items integrating composites can be viewed in Appendix A. Finally, regarding control variables, previous research has sought to examine the moderating impact of firm size, sector, and country region on innovation outcome, particularly for NPD (Claudy et al., 2016; Kähkönen et al., 2017). Further, scholar in this field recommend taking into account the information of R&D spending as control variables since they may be related to NPD outcomes (Karaman Kabadurmus, 2020; J. Zhang & Wu, 2013). The following five firm-specific factors were included in the mode as control variables:

- The industry to which the sample plant belongs labelled as Industry. The industry control variables were created by coding dummy variable for each sector. Because of

dispersion of sector amongst firms, the mechanical sector with the highest homogeneous industry group (110 firms, 40% of the sample) was chosen to use as reference for control the analysis (Kähkönen et al., 2017).

- The level of development of the country in which the sample manufacturing firm is located labelled as Developed.
- Because the distribution of the number of employees as indicator of firm size was right skewed, the logarithm transformation was used to improve the normal distribution of the size.
- The percentage of plant sales from products introduced in the last five years labelled as R&D_Intensity.
- The number of employees work in R&D for new product design/redesign development practices labelled as R&D_Size.

Among these control variables, R&D Intensity, R&D_Size as well as firm size can be considered as a firm´s resources to allocate for NPD. The descriptive analysis and the correlation matrix are presented in the Table 2.

Table 2: Descriptive statistics and correlations matrix

Constructs	1	2	3	4	5	6	7	8	9	10
1. ISP	**0.730**									
2. ESPc	0.645	**0.843**								
3. ESPm	0.626	0.753	**0.784**							
4. ENPD	0.149	0.236	0.220	-						
5. INPD	0.193	0.296	0.287	0.643	-					
6. R&D_Size	0.164	0.171	0.074	0.027	-0.061	-				
7. R&D_Intensity	0.048	0.064	0.054	0.093	0.156	-0.028	-			
8. Firm_Size	0.325	0.237	0.209	0.000	-0.029	0.506	0.059	-		
9. Industry	-0.001	-0.057	-0.054	0.069	-0.022	-0.096	-0.083	-0.059	-	
10. Development	-0.128	-0.245	-0.238	-0.133	-0.197	0.032	-0.180	-0.160	-0.046	-
Mean	3.924	3.102	3.144	3.715	3.262	80.620	52.384	6.033	0.391	0.673
Std. Dev.	0.597	0.874	0.957	0.624	0.636	195.534	27.685	1.056	0.488	0.469

The square roots of the AVE are presented on the diagonal in bold. The numbers bellow the AVE values are the correlation between the relevant construct with another construct in the model.

4.3. Data analysis and results

To test the hypothesised relationship between the constructs, this study took advantage of the partial least square (PLS) method as a variance-based approach to structural equation modelling. Three reasons are behind the use of the PLS method for analysis of the data in this

study (D. X. Peng & Lai, 2012). First, PLS is considered as an appropriate tool to analyse a study with exploratory characteristics. In particular, this study analyses a relationship that has been minimally studied in the literature (i.e., the adoption of sustainability practices in buyer–supplier relationships and its effect on the success of NPD). Second, PLS allows researchers to estimate highly complex models in which exogenous variables are correlated and the magnitude of the moderating effect is important. Several trades-offs emerged from the analysis of the effect of adopting different sustainability practices and NPD success. In particular, the market outcome of NPD was correlated with the operational dimension. Third, PLS makes it possible to estimate both reflective and formative constructs within the same research model. This study tests the relationship of reflective independent variables (ISP, ESPm, and ESPc) with formative dependent variables (INPD and ENPD).

As for sample size, PLS follows the rule of 10 times the most complex relationship within the research model determined by (1) the construct with the largest number of formative indicators and (2) the largest number of independent variables influencing a dependent variable (D. X. Peng & Lai, 2012). In this study, the largest number of formative indicators is three and the largest number of independent variables that influence dependent variables is three. Accordingly, the sample size of 281 is more than the minimum sample size requirement as per the rule of 10 times PLS.

The PLS model of this study also embraces two stages: the assessment of the measurement model and the evaluation of the path model (Hair Jr et al., 2016). The former involves the valuation of reflective constructs in terms of indicator reliability, internal consistency, discriminant and convergent validity, and formative constructs in terms of collinearity among indicators as well as convergent validity. The latter evaluates the hypothesised relationship between constructs in terms of sign, magnitude, and significance.

4.4. Measurement assessment

To estimate the research model, SmartPLS 3.0 was used. At the first, the five main theoretical constructs (i.e., ISP, ESPc, ESPm, INPD, and ENPD) were grouped into three reflective constructs related to the sustainability practices (independent variables) and two formative constructs related to success of NPD (dependent variables). The reason to consider the dependent variables as formative constructs is because conceptually the success of NPD is defined by its indicator measures, such as cost, quality, or customer satisfaction, in which each indicator can have its own independent effect on the success and any change in one of

these indicators, for example, manufacturing quality, is not necessarily associated with, nor can it be replaced by, a change to other indicators such as manufacturing cost.

Since assessment criteria are different depending on the nature of constructs, two separate assessments are reported in this study for reflective and formative constructs. Table 3 presents the various criteria for reflective constructs, including the criteria for convergent validity of both indicators and constructs as well as the consistency reliability of the constructs. Regarding convergent validity, only two items had item loadings less than the threshold of 0.7 but higher than 0.4 (i.e., item loadings of S_Int01= 0.683, and S_Int05= 0.663). Because their removal would not have contributed any significant improvement to the composite reliability and average variance extracted (AVE) values, they were kept in the model (Hair Jr et al., 2016). In addition, the other item loadings were above 0.7 and all were significant at 0.000, demonstrating that convergent validity exists at the level of indicators (D. X. Peng & Lai, 2012). The AVE results show that all values are above the minimum value of 0.5 (see Table 3). In addition, the internal consistency reliability for evaluation of reflective measures was appraised through composite reliability and Cronbach's alpha (Hair Jr et al., 2016). In this model, both values were higher than the criterion of 0.700, indicating high reliability for all three constructs (see Table 3).

Regarding formative constructs, scholars have suggested that formative item weights (including weight, sign, and magnitude) and multicollinearity among items should be evaluated with an item level test, while discriminant validity and nomological validity of the formative constructs should be examined with a composite level test (D. X. Peng & Lai, 2012). The criteria for item weight should be higher than 0.10 (Andreev et al., 2009), while the collinearity statistics variance inflation factor (VIF) value should be less than 3.3 (Shmueli et al., 2019) to ensure the nonexistence of multicollinearity.

The results in Table 3 show that the criteria for both item weights and multicollinearity among items are fulfilled in this study. The nomological validity of formative constructs shows that for both NPD success constructs there is a significant and positive relationship with some of their antecedents (D. X. Peng & Lai, 2012).

Discriminant validity for reflective indicators was assessed through the Fornell–Larcker criterion (Henseler et al., 2014) by comparing the square root value of the AVE of each composite with its correlation with any other construct in the model. As presented in

Table 2, all square roots of AVE were greater than inter-construct correlations confirming the existence of discriminant validity amongst the constructs (Hair Jr et al., 2016).

For formative indicators, the procedure proposed by (D. X. Peng & Lai, 2012) for discriminant validity was followed and the average of intra-construct item correlations for each construct and its correlations with other constructs in the model were computed. The result of this study shows that the average of intra-construct item correlations for these two constructs (ENPD= 0.533 and INPD= 0.423) is greater than the average of their inter-construct correlations (ENPD= 0.312 and INPD= 0.355). In summary, the measurement model shows that all constructs are consistent, reliable, and valid.

Table 3. Measurement properties of constructs

Constructs	Indicators	Mean	Std. Dev.	Item loading	Item weight	T-Stat.	P-Value	Alpha Cronbach	Composite Reliability	Communality (AVE)	VIF
ISP								0.890	0.911	0.533	
	S-Int01	3.651	0.901	0.683		18.523					
	S-Int02	3.990	0.730	0.739		24.046					
	S-Int03	4.033	0.733	0.718		22.066					
	S-Int04	4.044	0.773	0.785		28.219					
	S-Int05	4.113	0.917	0.663		16.181					
	S-Int06	3.904	0.811	0.781		29.596					
	S-Int07	3.901	0.890	0.739		22.369					
	S-Int08	4.025	0.757	0.712		18.238					
	S-Int09	3.657	0.863	0.740		23.945					
ESPc								0.864	0.907	0.710	
	S-ExtC01	3.179	1.035	0.869		55.139					
	S-ExtC02	3.273	1.117	0.784		28.214					
	S-ExtC03	3.064	0.982	0.851		32.735					
	S-ExtC04	2.893	1.000	0.864		45.701					
ESPm								0.792	0.864	0.614	
	S-ExtM01	2.984	1.258	0.771		25.821					
	S-ExtM02	3.016	1.122	0.800		28.562					
	S-ExtM03	3.256	1.352	0.774		24.442					
	S-ExtM04	3.321	0.989	0.790		29.114					
ENPD											
	NPDS_Ext01	3.780	0.699		0.289	10.259	0.000				1.398
	NPDS_Ext02	3.650	0.723		0.816	42.561	0.000				1.398
INPD											
	NPDS_Int01	3.224	0.850		0.516	14.302	0.000				1.257
	NPDS_Int02	3.388	0.755		0.412	17.289	0.000				1.548
	NPDS_Int03	3.175	0.803		0.345	9.717	0.000				1.381

4.5. Structural model evaluation

The structural model with PLS-PM, as a non-parametric technique, is assessed through standard model estimation and relies on the bootstrapping procedure to test the path model relationships in terms of the statistical significance of the model parameters. Routine bootstrapping is recommended for the consideration of 5,000 resamples (Hair Jr et al., 2016).

However, the results of this study maintain consistency in terms of significance and magnitude after a resampling of 1,000, 2,000, and 5,000. The quality of the structural model was examined by evaluating multicollinearity issues through examining VIF values of all sets of predictor composites. All observed values including outer and inner VIF values were below the threshold of 3.3 (Shmueli et al., 2019), demonstrating that multicollinearity is not critical in our model.

The results of path model evaluation are presented in Table 4. A preliminary analysis reveals that different sustainability practices have different effects on two dimensions of NPD success. It can be observed that while collaborative practices have strong, direct, and positive effects on internal NPD success (ESPc -> INPD= 0.197), their effect on external success of new product seems to be positive and indirect (ESPc - > ENPD= 0.041). Accordingly, hypothesis H1 is supported partially since the adoption of collaborative external sustainability practices positively affects NPD success. Likewise, monitoring practices show a positive, strong, and significant effect on internal success of new products (ESPm -> INPD= 0.160) while it reports a positive and indirect effect on external (market) success of NPD (ESPm -> ENPD= 0.071). Accordingly, the estimation results could provide partial support for the hypotheses related to monitoring practices thus H2a and H2b were not fulfilled completely. Regarding the adoption of internal sustainability practices, estimation results show that while this kind of practice does not have a direct effect on NPD success (therefore, H3b cannot be supported), it has an indirect effect through the positive effect of the adoption of external sustainability practices (thus, H3a is supported).

On the other hand, the path coefficient between two measures of NPD success (internal and external), as well as between internal sustainability practices and both groups of external sustainability practices (collaboration and monitoring), is amongst the highest (0.638, 0.645, and 0.626, respectively). In accordance with the percentile method, the confidence interval does not need to include the value of 0 to ensure significance. In this sense, the path coefficients 1, 5, 6, and 7 have a statistically different effect from 0. Finally, as far as the size of the effects of the variables is concerned, the f2 value (Cohen, 1988) shows that the effect of both collaborative and monitoring approaches on internal measure of success are small compared to the size of the effect between two measures of success (INPD and ENPD) and the size of the effect between internal sustainability practices and both monitoring and collaboration practices (see Table 4).

Table 4. Significance Testing Results of the Structural Model Path Coefficients and Total Effects

Path	Hypotheses	Path Coefficients (Direct Effect)	F2	P values	Confidence interval (2.5%, 95.5%)	Path Coefficients (Indirect Effect)	Total Effect
1.ESPc -> INPD	H1	0.198**	0.017	0.034	(0.011, 0.377)		0.198** (p=0.034)
2.ESPc -> ENPD	H1	0.041	0.001	0.637	(-0.128, 0.210)	0.125** (p=0.041)	0.167* (p=0.088)
3.ESPm-> INPD	H2a	0.160*	0.011	0.065	(-0.015, 0.332)		0.160* (p=0.065)
4.ESPm -> ENPD	H2b	0.024	0.000	0.748	(-0.127, 0.171)	0.102* (p=0.071)	0.126 (p=0.223)
5.INPD-> ENPD		0.634***	0.603	0.000	(0.553, 0.723)		0.634*** (p=0.000)
6.ISP -> ESPc	H3a	0.645***	0.711	0.000	(0.581, 0.709)		0.645*** (p=0.000)
7.ISP -> ESPm	H3a	0.626***	0.645	0.000	(0.559, 0.695)		0.626*** (p=0.000)
8.ISP -> INPD	H3b	-0.035	0.001	0.690	(-0.205, 0.140)	0.228*** (p=0.000)	0.193*** (p=0.001)
9.ISP -> ENPD	H3b	-0.019	0.000	0.812	(-0.181, 0.140)	0.164** (p=0.011)	0.145** (p=0.035)
Control Variables:							
10.R&D_Size -> ENPD		0.082**	0.008	0.046	(-0.003, 0.161)		0.082** (p=0.046)
11.R&D_Intensity -> ENPD		0.004	0.000	0.935	(-0.085, 0.087)		0.004 (p= 0.935)
12.Firm_Size (Log) -> ENPD		-0.026	0.001	0.645	(-0.141, 0.081)		-0.026 (p= 0.645)
13.Industry (Mechanical) -> ENPD		0.094**	0.015	0.039	(0.005, 0.183)		0.094** (p= 0.039)
14.Developed -> ENPD		0.004	0.000	0.927	(-0.086, 0.101)		0.004 (p=0.927)

*p < 0.10; **p < 0.05; ***p < 0.01

As for controlling variables, the results of the present study reveal that only the R&D_Size which controls for the number of employees working on new product design/redesign development has a significant relationship with NPD success. Further, the chosen sector (mechanical) reports a positive and significant association with NPD success. Finally, the coefficient of determination (R2) of endogenous dependent constructs demonstrates the proportion of the variance for each dependent construct explained by its indicators. In this study, the R2 values for endogenous constructs of ESPc, ESPm, ENPD, and INPD are 0.416, 0.392, 0.428, and 0.098 respectively. The summary of result for hypothesis testing is presented in Table 5.

Table 5. Summary of hypothesis testing

Hypothesis	Result (Direct Effect)	Result (Indirect Effect)
H1	Partially Supported	Supported
H2a	Supported	
H2b	Not Supported	Supported
H3a	Supported	
H3b	NotSupported	Supported

5. Discussion and Conclusions

The aim of this study was to analyse how and to what extent the adoption of sustainability practices can affect the success of new products. To address this issue, this study argues that each set of sustainability practices (internal, external collaborative, and external monitoring) implemented by the firm has a different effect on NPD success. Under theoretical frameworks of NRBV, social capital and transaction cost and using a PLS-SEM approach, empirical findings confirm that various sustainability practices adopted by a focal firm have different effects for both operational dimensions (internal) and for market dimensions (external) of new products' success. More specifically, estimations demonstrate that the adoption of external sustainability practices directly improves the success of new products in terms of operational (internal) outcomes and indirectly reinforces the markets (external) measure of new products success. This result is aligned with the knowledge, experience, resources, and technology sharing benefits obtained by establishing social capital in buyer-supplier relationship.

Despite the primary expectation for a negative link between monitoring approaches and internal NPD success in virtue of transactional cost associated with that type of practices, the evidence confirms our hypothesis and reveals that the adoption of assessment-based attitude towards regulation and standard, can assure suppliers compliance and their implementation of proactive strategies which in result foster the technical attributes of NPD. Our result is consistent with the previous notion that the compliance performance of suppliers is related to green product innovation development (Lee & Kim, 2011).

On the other hand, the results report that adopting practices aimed to reduce input consumption and emissions have an indirect effect on the success of new products through the positive effect on the adoption of external sustainability practices. One possible reason for the negative insignificant result for direct effect of internal practices with internal (operational aspect) NPD success might be that in contrary with reactive environmental strategies such as pollution control or improving the workforce environment through indoor air quality, the proactive environmental practices targeted in improvement of energy efficiency or pollution prevention do not yield immediate benefits for a firm. Further, the negative insignificant result for the association of these practices with external (market dimension) NPD success also can be explained through the requirements of initial investment in technology, training and re-defining organizational processes which may offset the overall commercial success of the NPD at the beginning stage (Laari et al., 2016). However, these

findings indicate that a focal firm´s sustainability orientation (internally and externally) enable NPD success.

To be concluded, the distinction between internal and external dimensions contributes to significant improvement in the understanding of how NPD success works in relation with sustainability in manufacturing. While the adoption of sustainability practices explains the success of new products related to cost, quality and ease of manufacturing by only 9.80%[3], the explanation power is 42.80% when also considering market dimension of success in line with (García et al., 2008). Moreover, the adoption of external sustainability practices is reinforced by the adoption of internal sustainability practices. The results highlight that in the context of NPD and sustainability initiatives, the participation of internal functions and external supply chain agents is required (Hemonnet-Goujot et al., 2019) and, therefore, actions including collaborative and monitoring sustainability practices with suppliers can positively influence the performance of products. Hence, trust and close relationships built on a basis of collaboration in sustainability among the supply chain is a determinant for NPD success. As a result, this paper sheds new light on the alignment of sustainable supply chain management and innovation performance (NPD), thus contributing to a better picture regarding the relation between sustainability in the supply chain and NPD. Moreover, these results have also several implications for theory and practice.

For practitioners, this study highlights that adopting sustainability practices has a positive external effect on firm performance. In particular, evidence shows that the use of both inter-firm monitoring and collaboration with suppliers have positive effects on new products, not only improving aspects related to the production process but also in terms of commercial success in long term. These results are an invitation for managers to invest in sustainability, adopting a proactive approach using sustainability in a broader way. Moreover, when firms evaluate their suppliers to make their supply chains more environmentally and socially responsible, enable their suppliers to develop new products with environmental appeal, and reap the advantages that stem from better organizational (environmental, social, and operational) performance. Firms willing to enhance their new

[3] The association only considers the individual effect of sustainability practices on NPD success. There are many other factors affecting NPD success, the effects of which have not been included in the model. These include lean practices (e.g., Oliveira et al., 2018); employee involvement (e.g., Rangus & Slavec, 2017); employees´ collective motivation (e.g., Zhao & Chadwick, 2014); and early supplier integration (e.g., Goldberg & Schiele, 2018).

products´ operational features may enjoy benefits investing in the adoption of sustainable approaches in their relational social networks while intending to improve their image, reputation and overall commercial success can find benefits from complimentary of internal and external sustainability strategies. Contrary to the previous studies which only consider the significance of green suppliers collaboration for NPD success (Kähkönen et al., 2017; Neutzling et al., 2018; Wang et al., 2021), in this study, we observed that both monitoring and collaborative sustainability practices independently strengthen NPD success. Furthermore, this paper debates the nature of the sustainability-oriented relationship by illuminating the unique impact of different collaborative and monitoring practices on different measures of NPD success, and thus could bring forth useful insights for managers. For example, as for focal firms´ managers, technically and financially, it might be important to know which type of sustainability practices influence the success of NPD (and how), and which aspects of success will be affected. Having a better image of the association of sustainability and NPD helps these managers to develop their corporate strategies more appropriately.

The challenge is therefore twofold. First, to carry out the necessary internal investments in sustainability aligned with the environment, people, and performance (TBL), which do not always allow firms to observe short term benefits. By doing so, the objectives of the organisation would be aligned not only with obtaining benefits but also with reinforcing the commitment to the environment and to people (Neutzling et al., 2018). The positive significant effect of R&D_Size control variable indicates that if managers develop and cheer up the spirit of commitment to sustainability in their employees then sustainable oriented employees working in R&D can act as a motivation for sustainability related knowledge sharing with external partners (suppliers) during new product development process. In addition, this paper demonstrates the positive effects of adopting a more advanced approaches to sustainability, because as observed, investing in internal sustainability practices enhance the development of supply chain relationships, which are a determinant for the success of new products.

Second, managers face the challenge of managing the trade-offs between their inhouse sustainability related operations and collaboration and control with suppliers. This result supports the idea of complementarity of different sustainability practices adopted and implemented by focal firms. Within the preview of NRBV and social capital theories, such sustainability- focused relational interactions facilitate knowledge exchange, technological

and resources sharing under respectful and trust ambient for joint practices (NPD). The strong significant effect on the market dimension (external) of new product success attains when the internal practices and collaborative approaches with suppliers implemented (ISP->ESPc->INPD->ENPD with coefficient of 0.164 and p=0.011). In the other words, manufacturing firms in jointly efforts with their suppliers by integrating environmental consideration in development of new products can improve the operational features of new products which in turn enhances the value for customers and strengthens the market attributes of the success.

For academia, this study shows the existence of positive externalities through adopting sustainability practices regarding the success of new product. Understanding these effects requires an investigation of the intersection of different but related frameworks. For instance, linking social capital with NRBV perspectives, the development of new products through sustainability-oriented collaborative relationships between a focal firm and its suppliers develops a required capability to convert such interaction to more value for customers through fostering trust, mutual respect, and knowledge and capabilities sharing possibilities between parties which eventually promotes NPD success. However, while a sustainability-oriented relationship requires a certain level of commitment and behaviour towards sustainability by suppliers, the transaction cost theory prevents the existence of a cost-related monitoring mechanism implemented by a focal firm to monitor compliance performance of suppliers. This highlights that understanding the effects of sustainability on performance needs to consider a broad perspective which looks at the interlinking of different theoretical approaches which may complement each other and help to improve the understanding of a complex phenomenon. Accordingly, this paper suggests the interconnection of the NRBV, social capital and transaction cost theories as useful theoretical lenses for differentiating the impact of sustainability-oriented, supply chain management on NPD success.

Moreover, the empirical evidence also suggests new lines for future research on the sustainability–NPD link. However, a first limitation of the paper is that effective involvement of supply chain members (internal and external) is supposed to be affected by sustainability practices but is not directly measured. Involvement of supply chain members has been indicated as a determinant of NPD success, however, the link between involvement and sustainability orientation was not. Future research should consider the mediating/moderating effect of sustainability on supply involvement to explain NPD success. Another limitation is

that the sustainability orientation was considered as the drivers of the link between sustainability practices and NPD success, however the effect of this factor was not examined. Future research may take into account the mediating effect of sustainability orientation in this association. Further, while this research has advanced our understanding about the relationship between sustainability and NPD success, the study is conditioned by the cross-sectional nature of the data; future research should look for conclusive results using longitudinal analysis. Finally, the link between sustainability and NPD success could be affected by contextual factors. Hence, further research in future studies should consider small versus large firms, developed versus developing countries, or manufacturing versus service companies.

6. References

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2016). Sustainability-oriented Innovation: A Systematic Review. *International Journal of Management Reviews*, *18*(2), 180–205. https://doi.org/10.1111/ijmr.12068

Ageron, B., Gunasekaran, A., & Spalanzani, A. (2012). Sustainable supply management: An empirical study. *International Journal of Production Economics*, *140*(1), 168–182. https://doi.org/10.1016/j.ijpe.2011.04.007

Ahmad, S., Wong, K. Y., Tseng, M. L., & Wong, W. P. (2018). Sustainable product design and development: A review of tools, applications and research prospects. *Resources, Conservation and Recycling*, *132*(October 2017), 49–61. https://doi.org/10.1016/j.resconrec.2018.01.020

Andreev, P., Maoz, H., Heart, T., & Pliskin, N. (2009). Validating formative partial least squares (PLS) models: Methodological review and empirical illustration. *ICIS 2009 Proceedings - Thirtieth International Conference on Information Systems*.

Brulhart, F., Gherra, S., & Marais, M. (2017). Are environmental strategies profitable for companies? The key role of natural competences from a resource-based view. *Management Decision*, *55*(10), 2126–2148. https://doi.org/10.1108/MD-12-2016-0893

Busse, C., Schleper, M. C., Niu, M., & Wagner, S. M. (2016). Supplier development for sustainability: contextual barriers in global supply chains. *International Journal of Physical Distribution and Logistics Management*, *46*(5), 442–468. https://doi.org/10.1108/IJPDLM-12-2015-0300

Buysse, K., & Verbeke, A. (2003). Proactive environmental strategies: A stakeholder management perspective. *Strategic Management Journal*, *24*(5), 453–470. https://doi.org/10.1002/smj.299

Carey, S., Lawson, B., & Krause, D. R. (2011). Social capital configuration, legal bonds and performance in buyer-supplier relationships. *Journal of Operations Management*, *29*(4), 277–288. https://doi.org/10.1016/j.jom.2010.08.003

Chen, Y., & Chen, I. J. (2019). Mixed sustainability motives, mixed results: the role of

compliance and commitment in sustainable supply chain practices. *Supply Chain Management*, *24*(5), 622–636. https://doi.org/10.1108/SCM-10-2018-0363

Cheng, C. C. J. (2020). Sustainability Orientation, Green Supplier Involvement, and Green Innovation Performance: Evidence from Diversifying Green Entrants. *Journal of Business Ethics*, *161*(2), 393–414. https://doi.org/10.1007/s10551-018-3946-7

Chiarini, Andrea. 2012. *Lean Organization: From the Tools of the Toyota Production System to Lean Office*. Berlin and Heidelberg: Springer Science & Business Media, vol. 3.

Claudy, M. C., Peterson, M., & Pagell, M. (2016). The Roles of Sustainability Orientation and Market Knowledge Competence in New Product Development Success. *Journal of Product Innovation Management*, *33*, 72–85. https://doi.org/10.1111/jpim.12343

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences. Abingdon*. United Kingdom: Routledge.

Cousins, P. D., & Lawson, B. (2007). The effect of socialization mechanisms and performance measurement on supplier integration in new product development. *British Journal of Management*, *18*(3), 311–326. https://doi.org/10.1111/j.1467-8551.2007.00514.x

Croom, S., Vidal, N., Spetic, W., Marshall, D., & McCarthy, L. (2018). Impact of social sustainability orientation and supply chain practices on operational performance. *International Journal of Operations and Production Management*, *38*(12), 2344–2366. https://doi.org/10.1108/IJOPM-03-2017-0180

Danese, P., Lion, A., & Vinelli, A. (2019). Drivers and enablers of supplier sustainability practices: a survey-based analysis. *International Journal of Production Research*, *57*(7), 2034–2056. https://doi.org/10.1080/00207543.2018.1519265

De Stefano, M. C., & Montes-Sancho, M. J. (2018). Supply chain environmental R&D cooperation and product performance: Exploring the network dynamics of positional embeddedness. *Journal of Purchasing and Supply Management*, *24*(4), 288–303. https://doi.org/10.1016/j.pursup.2018.10.003

Du, S., Yalcinkaya, G., & Bstieler, L. (2016). Sustainability, Social Media Driven Open Innovation, and New Product Development Performance*. *Journal of Product Innovation Management*, *33*, 55–71. https://doi.org/10.1111/jpim.12334

Elkington, J. (1998). Partnerships from cannibals with forks: The triple bottom line of 21st-century business. *Environmental Quality Management*, *8*(1), 37–51.

Fish, L. A. (2015). *Managerial best practices to promote sustainable supply chain management & new product development*. InTech.

García, N., Sanzo, M. J., & Trespalacios, J. A. (2008). New product internal performance and market performance: Evidence from Spanish firms regarding the role of trust, interfunctional integration, and innovation type. *Technovation*, *28*(11), 713–725. https://doi.org/10.1016/j.technovation.2008.01.001

Geng, R., Mansouri, S. A., & Aktas, E. (2017). The relationship between green supply chain management and performance: A meta-analysis of empirical evidences in Asian emerging economies. *International Journal of Production Economics*, *183*(December 2015), 245–258. https://doi.org/10.1016/j.ijpe.2016.10.008

Gerstlberger, W., Præst Knudsen, M., & Stampe, I. (2014). Sustainable development strategies for product innovation and energy efficiency. *Business Strategy and the*

Environment, *23*(2), 131–144. https://doi.org/10.1002/bse.1777

Gimenez, C., & Sierra, V. (2013). Sustainable Supply Chains: Governance Mechanisms to Greening Suppliers. *Journal of Business Ethics*, *116*(1), 189–203. https://doi.org/10.1007/s10551-012-1458-4

Gimenez, C., & Tachizawa, E. M. (2012). Extending sustainability to suppliers: A systematic literature review. *Supply Chain Management*, *17*(5), 531–543. https://doi.org/10.1108/13598541211258591

Gmelin, H., & Seuring, S. (2014). Determinants of a sustainable new product development. *Journal of Cleaner Production*, *69*, 1–9. https://doi.org/10.1016/j.jclepro.2014.01.053

Gmelin, H., & Seuring, S. (2018a). Social and Environmental Dimensions of Organizations and Supply Chains. *Social and Environmental Dimensions of Organizations and Supply Chains*. https://doi.org/10.1007/978-3-319-59587-0

Gmelin, Harald, and Stefan Seuring. 2018b. Sustainability and New Product Development: Five Exploratory Case Studies in the Automotive Industry. In *Social and Environmental Dimensions of Organizations and Supply Chains*. Cham: Springer, pp. 211–32.

Goldberg, J., & Schiele, H. (2018). Early Supplier Integration: Assessing Supplier Innovation Ideas. *IEEE Engineering Management Review*, *46*(3), 94–102. https://doi.org/10.1109/EMR.2018.2866379

González-Benito, J., & González-Benito, Ó. (2006). A review of determinant factors of environmental proactivity. *Business Strategy and the Environment*, *15*(2), 87–102. https://doi.org/10.1002/bse.450

Gualandris, J., Klassen, R. D., Vachon, S., & Kalchschmidt, M. (2015). Sustainable evaluation and verification in supply chains: Aligning and leveraging accountability to stakeholders. *Journal of Operations Management*, *38*, 1–13. https://doi.org/10.1016/j.jom.2015.06.002

Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Hallstedt, S. I., Thompson, A. W., & Lindahl, P. (2013). Key elements for implementing a strategic sustainability perspective in the product innovation process. *Journal of Cleaner Production*, *51*, 277–288. https://doi.org/10.1016/j.jclepro.2013.01.043

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, *20*(4), 986–1014.

Hemonnet-Goujot, A., Manceau, D., & Abecassis-Moedas, C. (2019). Drivers and Pathways of NPD Success in the Marketing–External Design Relationship. *Journal of Product Innovation Management*, *36*(2), 196–223. https://doi.org/10.1111/jpim.12472

Henseler, J., Ringle, C. M., & Sarstedt, M. (2014). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Jabbour, C. J. C., Jugend, D., De Sousa Jabbour, A. B. L., Gunasekaran, A., & Latan, H. (2015). Green product development and performance of Brazilian firms: Measuring the role of human and technical aspects. *Journal of Cleaner Production*, *87*(1), 442–451. https://doi.org/10.1016/j.jclepro.2014.09.036

Jansson, J., Nilsson, J., Modig, F., & Hed Vall, G. (2017). Commitment to Sustainability in Small and Medium-Sized Enterprises: The Influence of Strategic Orientations and

Management Values. *Business Strategy and the Environment*, *26*(1), 69–83. https://doi.org/10.1002/bse.1901

Jin, Z., Navare, J., & Lynch, R. (2019). The relationship between innovation culture and innovation outcomes: exploring the effects of sustainability orientation and firm size. *R and D Management*, *49*(4), 607–623. https://doi.org/10.1111/radm.12351

Kähkönen, A. K., Lintukangas, K., Ritala, P., & Hallikas, J. (2017). Supplier collaboration practices: implications for focal firm innovation performance. *European Business Review*, *29*(4), 402–418. https://doi.org/10.1108/EBR-04-2016-0058

Karaman Kabadurmus, F. N. (2020). Antecedents to supply chain innovation. *International Journal of Logistics Management*, *31*(1), 145–171. https://doi.org/10.1108/IJLM-04-2019-0096

Laari, S., Töyli, J., Solakivi, T., & Ojala, L. (2016). Firm performance and customer-driven green supply chain management. *Journal of Cleaner Production*, *112*, 1960–1970. https://doi.org/10.1016/j.jclepro.2015.06.150

Lawson, B., Krause, D., & Potter, A. (2015). Improving Supplier New Product Development Performance: The Role of Supplier Development. *Journal of Product Innovation Management*, *32*(5), 777–792. https://doi.org/10.1111/jpim.12231

Lee, K. H., & Kim, J. W. (2011). Integrating suppliers into green product innovation development: An empirical case study in the semiconductor industry. *Business Strategy and the Environment*, *20*(8), 527–538. https://doi.org/10.1002/bse.714

Lee, S. Y. (2015). The effects of green supply chain management on the supplier's performance through social capital accumulation. *Supply Chain Management*, *20*(1), 42–55. https://doi.org/10.1108/SCM-01-2014-0009

Lintukangas, K., Kähkönen, A. K., & Hallikas, J. (2019). The role of supply management innovativeness and supplier orientation in firms' sustainability performance. *Journal of Purchasing and Supply Management*, *25*(4), 100558. https://doi.org/10.1016/j.pursup.2019.100558

Marshall, D., McCarthy, L., Heavey, C., & McGrath, P. (2015). Environmental and social supply chain management sustainability practices: Construct development and measurement. *Production Planning and Control*, *26*(8), 673–690. https://doi.org/10.1080/09537287.2014.963726

Mazzola, E., Bruccoleri, M., & Perrone, G. (2015). Supply chain of innovation and new product development. *Journal of Purchasing and Supply Management*, *21*(4), 273–284. https://doi.org/10.1016/j.pursup.2015.04.006

Moldavska, A., & Welo, T. (2017). The concept of sustainable manufacturing and its definitions: A content-analysis based literature review. *Journal of Cleaner Production*, *166*, 744–755. https://doi.org/10.1016/j.jclepro.2017.08.006

Montabon, F., Sroufe, R., & Narasimhan, R. (2007). An examination of corporate reporting, environmental management practices and firm performance. *Journal of Operations Management*, *25*(5), 998–1014. https://doi.org/10.1016/j.jom.2006.10.003

Nepal, B. P., Yadav, O. P., & Solanki, R. (2011). Improving the npd process by applying lean principles: A case study. *EMJ - Engineering Management Journal*, *23*(3), 65–81. https://doi.org/10.1080/10429247.2011.11431910

Neutzling, D. M., Land, A., Seuring, S., & Nascimento, L. F. M. do. (2018). Linking

sustainability-oriented innovation to supply chain relationship integration. *Journal of Cleaner Production*, *172*, 3448–3458. https://doi.org/10.1016/j.jclepro.2017.11.091

Nidumolu, R., Prahalad, C. K., & Rangaswami, M. R. (2009). Why sustainability is now the key driver of innovation. *Harvard Business Review*, *87*(9), 56–64.

Obal, M., Morgan, T., & Joseph, G. (2020). Integrating sustainability into new product development: The role of organizational leadership and culture. *Journal of Small Business Strategy*, *30*(1), 43–57.

Oliveira, G. A., Tan, K. H., & Guedes, B. T. (2018). Lean and green approach: An evaluation tool for new product development focused on small and medium enterprises. *International Journal of Production Economics*, *205*(April), 62–73. https://doi.org/10.1016/j.ijpe.2018.08.026

Pagell, M., & Wu, Z. (2009). Building a more complete theory of sustainable supply chain management using case studies of 10 exemplars. *Journal of Supply Chain Management*, *45*(2), 37–56. https://doi.org/10.1111/j.1745-493X.2009.03162.x

Paulraj, A., Chen, I. J., & Blome, C. (2017). Motives and Performance Outcomes of Sustainable Supply Chain Management Practices: A Multi-theoretical Perspective. *Journal of Business Ethics*, *145*(2), 239–258. https://doi.org/10.1007/s10551-015-2857-0

Peng, D. X., & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, *30*(6), 467–480. https://doi.org/10.1016/j.jom.2012.06.002

Petersen, K. J., Handfield, R. B., & Ragatz, G. L. (2003). A model of supplier integration into new product development. *Journal of Product Innovation Management*, *20*(4), 284–299. https://doi.org/10.1111/1540-5885.00028

Podsakoff, P. M., MacKenzie, S. B., Lee, J. Y., & Podsakoff, N. P. (2003). Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies. *Journal of Applied Psychology*, *88*(5), 879–903. https://doi.org/10.1037/0021-9010.88.5.879

Pujari, D. (2006). Eco-innovation and new product development: Understanding the influences on market performance. *Technovation*, *26*(1), 76–85. https://doi.org/10.1016/j.technovation.2004.07.006

Putnam, Robert D. 1995. Tuning in, tuning out: The strange disappearance of social capital in America. *PS: Political Science & Politics* 28: 664–83.

Rangus, K., & Slavec, A. (2017). The interplay of decentralization, employee involvement and absorptive capacity on firms' innovation and business performance. *Technological Forecasting and Social Change*, *120*, 195–203. https://doi.org/10.1016/j.techfore.2016.12.017

Rossi, M., Germani, M., & Zamagni, A. (2016). Review of ecodesign methods and tools. Barriers and strategies for an effective implementation in industrial companies. *Journal of Cleaner Production*, *129*, 361–373. https://doi.org/10.1016/j.jclepro.2016.04.051

Sancha, C., Wong, C. W. Y., & Gimenez, C. (2019). Do dependent suppliers benefit from buying firms' sustainability practices? *Journal of Purchasing and Supply Management*, *25*(4), 100542. https://doi.org/10.1016/j.pursup.2019.100542

Shi, V. G., Koh, S. C. L., Baldwin, J., & Cucchiella, F. (2012). Natural resource based green

supply chain management. *Supply Chain Management*, *17*(1), 54–67. https://doi.org/10.1108/13598541211212203

Shmueli, G., Sarstedt, M., Hair, J. F., Cheah, J. H., Ting, H., Vaithilingam, S., & Ringle, C. M. (2019). Predictive model assessment in PLS-SEM: guidelines for using PLSpredict. *European Journal of Marketing*, *53*(11), 2322–2347. https://doi.org/10.1108/EJM-02-2019-0189

Tuli, P., & Shankar, R. (2015). Collaborative and lean new product development approach: A case study in the automotive product design. *International Journal of Production Research*, *53*(8), 2457–2471. https://doi.org/10.1080/00207543.2014.974849

Wang, J., & Dai, J. (2018). Sustainable supply chain management practices and performance. *Industrial Management and Data Systems*, *118*(1), 2–21. https://doi.org/10.1108/IMDS-12-2016-0540

Wang, Y., Modi, S. B., & Schoenherr, T. (2021). Leveraging sustainable design practices through supplier involvement in new product development: The role of the suppliers' environmental management capability. *International Journal of Production Economics*, *232*(September 2020), 107919. https://doi.org/10.1016/j.ijpe.2020.107919

Wlazlak, P., Säfsten, K., Hilletofth, P., & Johansson, G. (2018). Integration of Suppliers' Workflows in the OEMs' New Product Development Process. *Procedia Manufacturing*, *25*, 479–486. https://doi.org/10.1016/j.promfg.2018.06.127

Wong, C. Y., Wong, C. W. Y., & Boon-itt, S. (2020). Effects of green supply chain integration and green innovation on environmental and cost performance. *International Journal of Production Research*, *58*(15), 4589–4609. https://doi.org/10.1080/00207543.2020.1756510

Woo, C., Kim, M. G., Chung, Y., & Rho, J. J. (2016). Suppliers' communication capability and external green integration for green and financial performance in Korean construction industry. *Journal of Cleaner Production*, *112*, 483–493. https://doi.org/10.1016/j.jclepro.2015.05.119

Wu, G. C., Ding, J. H., & Chen, P. S. (2012). The effects of GSCM drivers and institutional pressures on GSCM practices in Taiwan's textile and apparel industry. *International Journal of Production Economics*, *135*(2), 618–636. https://doi.org/10.1016/j.ijpe.2011.05.023

Zhang, J., & Wu, W. ping. (2013). Social capital and new product development outcomes: The mediating role of sensing capability in Chinese high-tech firms. *Journal of World Business*, *48*(4), 539–548. https://doi.org/10.1016/j.jwb.2012.09.009

Zhao, Z. J., & Chadwick, C. (2014). What we will do versus what we can do: The relative effects of unit-level NPD motivation and capability. *Strategic Management Journal*, *35*(12), 1867–1880.

Appendix A

Variables	Items	Description	Mean	Std. Dev.	Mean Ave.
ISP					3.924
	S-Int01	Water efficiency	3.651	0.901	
	S-Int02	Reducing waste in internal processes (e.g., improving yield or efficiency)	3.990	0.730	
	S-Int03	Improving the workforce environment (e.g., indoor air quality)	4.033	0.733	
	S-Int04	Pollution prevention (eliminating emissions or waste)	4.044	0.773	
	S-Int05	Pollution control (scrubbing, waste treatment)	4.113	0.917	
	S-Int06	Decreasing the likelihood or impact of an environmental accident	3.904	0.811	
	S-Int07	Complying with an industry-wide code of conduct	3.901	0.890	
	S-Int08	Environmental improvements in the disposition of your organization's scrap or excess material (re-use, recycling, etc.)	4.025	0.757	
	S-Int09	Environmental improvements in the disposition of your organization's equipment	3.657	0.863	
ESPc					3.102
	S-ExtC01	Encouraging suppliers to improve the environmental performance of their processes	3.179	1.035	
	S-ExtC02	Providing design specification to suppliers in line with environmental requirements (e.g., green purchasing, blacklist of raw materials)	3.273	1.117	
	S-ExtC03	Co-development with suppliers to reduce the environmental impact of the product (e.g., eco-design, green packaging, recyclability)	3.064	0.982	
	S-ExtC04	Involvement of suppliers in the re-design of internal processes (e.g., remanufacturing, reduction of by-products)	2.893	1.000	
ESPm					3.144
	S-ExtM01	Requesting that your suppliers sign a code of environmental conduct	2.984	1.258	
	S-ExtM02	Visiting suppliers' plants or ensuring that they are not using sweatshop labor	3.016	1.122	
	S-ExtM03	Ensuring that suppliers comply with child labor laws	3.256	1.352	
	S-ExtM04	Incorporating environmental considerations in evaluating and selecting suppliers	3.321	0.989	
ENPD					3.715
	NPDS_Ext01	Customer satisfaction	3.780	0.699	
	NPDS_Ext02	Overall commercial success	3.650	0.723	
INPD					3.262
	NPDS_Int01	Time to market	3.224	0.850	
	NPDS_Int02	Ease of manufacturing	3.388	0.755	
	NPDS_Int03	Unit manufacturing cost	3.175	0.803	

Abbreviation: ISP, Internal sustainability practices; ESPc, Supplier collaboration practices; ESPm, Supplier monitoring practices; ENPD, External NPD success; INPD, Internal NPD success; Std. Dev., Standard deviation; Mean Ave, Average of mean.

PART III: CONCLUSION, CONTRIBUTION AND LIMITATION

1. Conclusion

In this doctoral thesis, we have conducted a comprehensive analysis of sustainability in operations management, with a particular focus on the intricate dynamics of the buyer-supplier relationship. Despite concerted efforts to raise awareness regarding the significance of sustainability, manufacturing firms are still contributing to substantial resource consumption and environmental burdens. In light of this, a deeper understanding of sustainability, its approaches, determinants, and far-reaching consequences becomes indispensable through the provision of empirical analyses.

This investigation underscores the pivotal role played by sustainability orientation within manufacturing focal firms. This orientation exerts a profound influence, not solely on the firms' individual performance, but remarkably on the sustainability performance of the entire supply chain. Behind this orientation are sustainability drivers from different internal and external sources. These drivers catalyzing sustainability adoption within manufacturing firms encompass customers, governmental regulators, managers, employees, and owners/shareholders whose values, beliefs, and perceptions are inherently shaped by the national culture of the manufacturing plant's location.

National culture holds a crucial position in determining the behaviors, attitudes, and decision-making processes within organizations and societies. It serves as a lens through which individuals interpret the world around them. Within the context of sustainability adoption, cultural dimensions exert substantial influence on how businesses and individuals undertake environmental, social, and ethical considerations. Cultural dimensions, such as power distance, uncertainty avoidance, and collectivism-individualism provide insights into how different societies prioritize hierarchy, risk tolerance, collaboration, individual freedom, and self-determination. These dimensions can significantly impact the acceptance and integration of sustainability practices within manufacturing firms. Understanding and acknowledging these cultural dimensions is crucial when formulating strategies for sustainability adoption. By aligning sustainability initiatives with cultural values and addressing possible conflicts, manufacturing firms can facilitate smoother transitions towards more environmentally and socially responsible practices, fostering positive impacts on both their operations and the broader society. By demonstrating the potential for national culture to

function as both an enabler (facilitator) and a barrier (hindrance) across different dimensions, this doctoral thesis emphasizes the significance of contextual elements in comprehending the determinants of sustainability adoption.

Moreover, the adoption of sustainability practices by sustainability-oriented focal firms yields positive outcomes for focal companies by improving their environmental and regulatory performance. However, these outcomes alone do not guarantee a competitive edge over industry rivals. In the pursuit of competitiveness, manufacturing focal firms must recognize that true advantage lies in the advancement of their manufacturing performance while upholding the implementation of sustainability requirements. For this purpose, they must integrate sustainability requirements with manufacturing paradigms such as lean and agile manufacturing, six sigma, and others. This integration underlines the need for a sustainability-focused relationship with key suppliers.

While monitoring approach serves as assessment activities for manufacturing focal firms in their interactions with suppliers, resulting in achievements for suppliers in terms of sustainability compliance performance and for manufacturing focal firms in mitigating the risk of supplier misconduct, this thesis places a distinct emphasis collaborative mechanism and propose a hybrid approach combining both mechanisms. Collaborative undertakings between focal manufacturing firms and suppliers, particularly those centered on sustainability-focused initiatives such as new product development through sustainable manufacturing practices, offer a conduit for reciprocal learning. This mechanism allows suppliers to tap into the knowledge and technologies of their focal counterparts, while manufacturing firms benefit from aligned manufacturing paradigms that resonate with sustainability imperatives.

Within this context, sustainability-oriented focal firms, due to their influential position, can enhance the sustainability performance of key suppliers. This is achieved by exerting pressures and stipulating specific sustainability activities, while also serving as a source of inspiration and encouragement for suppliers to imitate similar sustainability-driven practices. However, to attain mutual excellence, particularly in terms of manufacturing performance, sustainability-oriented focal firms are required to align their suppliers' orientation with their own. This alignment necessitates actions that go beyond mere monitoring and controlling. It demands the focal firms to engage in collaborative endeavors with their suppliers on manufacturing projects and adopt the role of supply chain leadership with a hybrid approach to transactional and transformational styles. By assuming leadership responsibilities, through investments in supplier training, the enhancement of transparency,

information sharing, the provision of consultancy, the establishment of long-term relationships with key suppliers, and the empowerment of their employees, these focal firms can effectively facilitate and strengthen this alignment.

By fostering synchronization between focal manufacturing firms and their suppliers regarding the values, visions, principles, and practices of sustainability, companies can produce new products using eco-friendly raw materials, manufactured through environmentally responsible processes, and causing minimal harm to the environment and society. This not only enhances the operational and commercial success of the new product but also helps the competitive prowess of manufacturing firms to be fortified. This dual achievement consequently contributes to the realization of Sustainable Development Goals (SDGs), particularly SDGs 9, 12, and 17 within the manufacturing sector.

In sum, the empirical revelations of this dissertation resoundingly affirm that the journey toward sustainability holds great value. This thesis posits that the implications of the findings can wield substantial influence in shaping the perspectives and actions of managers, policymakers, and practitioners involved in the governance of manufacturing firms and their supply chains. By disseminating these insights, the aim is to contribute substantively to the knowledge base and operational paradigms within this field, thus fostering a trajectory of sustainable and responsible approaches across manufacturing operations and supply chain management. It is important to acknowledge that the culmination of this thesis does not mark the end of this expedition; rather, it signifies a noteworthy but incremental step along the broader path that awaits within the academic realm. In this role, this work envisions itself as an integral part of a collective endeavor that strives to confront the multifaceted challenges our world faces related to environmental, social, and economic sustainability. The mission remains steadfast: to play a pivotal role in guiding both industry and society at large toward the realization of imperative sustainable development objectives and the creation of a more sustainable and responsible future for all.

The summary of the conclusions of the four studies is presented in the Table 3.1.

Table 3.1: Summary of the four studies

Article	Research Question	Theories	Methodology and Database	Main Results	Main Contribution
Study 1	RQ1: How and to what extent do different sets of sustainability practices improve sustainability outcomes?	NRBV TCT	PLS-SEM Sample from the HPM	1- The effect of sustainability practices on outcomes depends on the type of practices. 2- This study underscores the importance of internalizing of sustainability (implementation).	1- Shedding light on the individual impact of each SSCM practices. 2- Advancing the understanding of how sustainability contributes to CA by including the implementation and sustainability outcomes in the link between SSCM practices and CA.
	RQ2: How does the implementation of sustainability practices advance the attainment of competitive advantage?			3- CA is achieved from sustainable manufacturing outcome through collaboration with suppliers	3- By considering different theoretical backgrounds, this study contributes to these theories and improve the understanding of the interplay between these theories.
Study 2	RQ3: How do the driving forces of sustainability operate in the adoption of sustainability practices at a cross-cultural level? RQ4: How does national culture moderate the relationship between sustainability drivers and the adoption of sustainability practices?	IT	OLS-Regression Sample from the HPM, 3 dimensions of NC from The GLOBE project, Statistics of the World Bank	1- Sustainability Drivers differently drive sustainability adoption. 2- External contextual factors such as national culture matters in the adoption of sustainability. 3- The moderation effect of NC varies depending on the specific combination of sustainability drivers and sustainability practices. 4- Different perception of driving pressures due to deep-rooted cultural forces, leading to varied extents of sustainability adoption.	1- Providing insight about the adoption of sustainability at cross-national/cross-cultural level. 2- Advancing the understanding about the role of external factors such as NC on sustaianbility adoption. 3- By bridging between two streams (SSCM and NC), this study advances the understanding of the influential effect of driving forces in different cultural settings. 4- The findings of this study explain the observed heterogeneity in sustainability adoption across the world.
Study 3	RQ5: How can manufacturing firms enhance the sustainability performance of their suppliers? RQ6: What role does SCL play in moderating the relationship between a manufacturing firm´s sustainability practices and the sustainability performance of suppliers?	IT	PLS-SEM Sample from the HPM, Statistics of the World Bank	1- Buying firms´ SSCM practices with suppliers (monitoring and collaboration) can enhance supplier sustainability performance. 2- Not only the power, but also proactiveness (sustainability vision) of buying firms is matter in isomorphic behavior of suppliers. 3- Leadership in supply chain promotes the development of sustainability capability in suppliers.	1- Shedding new light on the impact of controlling and collaborative mechanisms with suppliers 2- Addressing the challenges behind managing sustainability in buyer-supplier relationship, this study advances the understanding of how isomorphic behavior of buying firms can be translated to isomorphic behavior in suppliers. 3- Providing empirical evidence on the moderating role fo supply chain leadership
Study 4	RQ7: Do different bundles of sustainability practices contribute to corporate success in terms of new product development (NPD) success?	NRBV TCT SCT	PLS-SEM Sample from the HPM	1- Different sustainability practices have different contribution to NPD success. 2- Although external SSCM practices directly enhance NPD success, but the true efficacy lies in internalizing sustainability concerns. 3- NPD success is achieved by integrating sustainability concerns into manufacturing projects with suppliers.	1- Shedding light on the individual impact of each SSCM practices. 2- Examining the interplay of different “theoretical frameworks”, which may mutually complement one another, contributes to advancing the understanding of these theories and their applications/interrelations.

2. Contribution

2.1.Contributions to the literature

This dissertation makes distinct contributions to the domain of sustainability within operations management literature, in each of the studies developed, which are next discussed. But, as a whole, this dissertation enriches the literature by in-depth analyzing of the link between sustainability adoption, its underlying determinants and consequences within manufacturing firms. By delving into the motivations behind the adoption of sustainability practices, this study expands insight into why manufacturing firms adopt sustainability. Moreover, it uncovers the importance of the sustainability within buyer-supplier relationship, clarifying how this partnership fosters superior performance through the attainment of sustainability outcomes.

From academic standpoint, the empirical examination of these overlooked relationships in the literature (i.e., the link between sustainability practices and competitive advantage, the cross-cultural assessment of sustainability adoption, the interplay between buyers´ sustainability adoption and suppliers sustainability performance, and the connection between sustainability practices and NPD success) not only permits the bridging of the identified gaps but also serves to fulfill the need for further investigation and the provision of empirical evidence. Hence, this endeavor contributes to the extant literature and deepens the knowledge about the conditions under which manufacturing firms and their suppliers adopt sustainability practices. This approach, on one hand, enables us to assess how manufacturing firms´ performance is influenced by such adoption behaviors and which factors either reinforce or hinder it. On the other hand, it necessitates considering a broad perspective that examines the interplay of different theoretical approaches, which may mutually complement one another, and contribute to advancing the understanding of this complex phenomenon.

In doing so, the present research builds upon the development of theoretical arguments that leverage diverse theories, including transaction cost theory, the natural resource-based view, social exchange theory, supply chain leadership theory, the theory of social exchange, and institutional theory. This work contributes to individual theories by injecting innovative perspectives that reveal alternative applications and enrich the understanding of these theories.

Additionally, it advocates for the interconnection of different but related theories as invaluable lenses for explaining such a comprehensive analysis. The theories reviewed in this

research help practitioners (and academia) gain insights into how firms can contribute to the dynamic interactions of various factors influencing sustainability at the corporate level. Using several distinct but related theories in this study helps academia and practitioners improve their comprehension and interpretation of these theories, as well as map the application of theories specifically in the field of operations management and SSCM.

Additionally, the distinction between various sustainability practices (internal, external monitoring and external collaboration) and the creation of an individual construct for them not only shed light on the specific impact of these practices individually, but also provides evidence of the unique effect of each mechanism involving suppliers (monitoring and collaboration). This is particularly significant in highlighting the role of monitoring practices which are generally assumed to be less effective. The inclusion of different factors such as national culture, supply chain leadership and implementation in this study demonstrates the significance of mediating/moderating factors when attempting a comprehensive analysis of the association between sustainability adoption, its drivers and consequences. And lastly, taking a sample from multi-industry multi-country HPM Project, permits the empirical examination of hypotheses on a cross-cultural, cross-national level, promoting generalizability and facilitating robust conclusions and comparisons. In the following the main contribution of each empirical study is briefly explained.

As previously discussed, the first study and its complementary counterpart, the fourth study, examined the relationship between sustainability adoption and performance. By taking insight from diverse theoretical lenses and underscoring the importance of collaboration between buyer-supplier on sustainability issues, our studies therefore introduce fresh perspectives on the nexus between sustainability practices and firms´ superior performance. Moreover, by going further in linking sustainability practices to competitive advantage through the inclusion of sustainability outcomes and implementation as well as by taking into account NPD success, our studies provide a comprehensive picture of this relationship in which a tradeoff between distinct sustainability practices, more sustainability-focused measures of sustainability outcomes, distinct operational and market success of NPD are considered. This enables us to advance the previous studies in this field and to provide compelling evidence on the debate of why firms should be green/sustainable. Additionally, the fourth study contributes to the literature by providing insights into the alignment between sustainability practices and the success of manufacturing firms allowing to enhance the understanding of the relation between sustainability in supply chain and NPD which is least examined in the literature.

The second study contributes to a better comprehending of the triggers that prompt manufacturing firm to embrace sustainability practices, ultimately leading the firms to thrive in sustainability performance. As previously indicated, our approach involved an inside-out perspective on the sustainability concerns within manufacturing firms by analyzing those relationships which are overlooked in the literature. Therefore, we have delved deeper into the driving forces of sustainability at cross-national/cross-cultural level. This approach allowed us to tackle the issues regarding the diversity responses of firms to the institutional pressures more concretely by assessing the role of contextual factors such as a national culture on those heterogeneity challenges. Our main contributions, beyond the robust findings, is that each sustainability driver has a distinct impact on different sets of environmental sustainability practices. Moreover, the heterogeneity in the adoption and implementation of sustainability practices can be associated with the context of manufacturing firms. Specifically, national culture can serve as facilitator (enabler) for certain sustainability drivers, such as owner/shareholder pressures, and as an obstacle (barrier) for other sustainability drivers, such as employee pressures, manager pressures and customer pressures.

The third study contributes to the challenges of managing sustainability beyond firms' boundaries. Our study's first contribution is that this article extends the previous scholarly studies on this field and provides insight into the understating of how sustainability vision of manufacturing buying firms can be translated to the sustainability performance of suppliers through the adoption of different sustainability practices. Additionally, by differentiating among diverse sustainability practices, this study provides evidence on which organizational sustainability practices are more beneficial for suppliers' sustainability performance. Lastly, by considering the moderating role of SCL, this study fulfils the need for more investigation and provides evidence on the underexamined link between a buying firm´s sustainability practices, supplier´s sustainability performance and SCL.

2.2.Implications to the managers

This dissertation has delved into the sustainability adoption behaviours and their consequences, underscoring their crucial characteristics, outcomes and impacts on firm performance. The notable findings obtained across the four empirical studies hold significant implications for managers and policymakers alike.

For managers, this research offers valuable insights when formulating sustainability visions and strategies within their own organizations, as well as extending these practices on to their suppliers. As we have extensively described the attributes and benefits associated with sustainability adoption, proving a solid foundation for decision making. Moreover, this study deals with the challenges faced by managers, who are under intensive pressures for managing sustainability issues in their supply chain. This study demonstrates the positive externalities of the sustainability adoption and delivers a message to them: Internalizing sustainability pressures and imperatives across their planning, production and process; is vital for realizing certain sustainability outcomes. However, the attainment of competitive advantage and the enhancement of NPD success necessitate to externalize these pressures and approaches to other upstream/downstream business activities, particularly among key suppliers. Nevertheless, the achievement of superior performance markedly contingent upon the effective implementation of these sustainability practices. This underlines the critical role of employees who place sustainability practices and disseminate sustainability values and requirements within companies and throughout the supply chain. Consequently, managers must prioritize and invest greater efforts in empowering employees, fostering their involvement, and promoting the adoption of green human resources practices. Such measures reinforce the foundation for successful sustainability implementation and the cultivation of a truly sustainable organizational culture.

In addition, extending sustainability efforts beyond the firm´s boundaries present a set of challenges. Throughout this dissertation, we have uncovered that, in addition to the pressures stemming from the power of buying firms, their sustainability visions- reflecting in their proactivity in the engagement to sustainability- play a pivotal role in determining supplier sustainability performance. This can be further amplified when focal firms undertake the role of supply chain leadership, that helps suppliers to enhance their sustainability performance through fostering the development of supplier competencies. Moreover, by enlightening the distinct impact of collaborative and monitoring practices on diverse measures of firm performance (i.e., sustainability outcomes, NPD success, and supplier sustainability performance), this study delves into the multi-faceted nature of these strategies and bring forth useful insights for managers. As a result, managers are provided with an invaluable preemptive understanding of the distinct effects each strategy triggers. This study offers them the opportunity to have prior understanding of the consequences of each strategy as they make choice on their internal capabilities.

Furthermore, by illuminating how internal practices foster sustainability outcomes for focal manufacturing firms, how collaborative approaches brings advantages for both focal firms and their suppliers and how monitoring practices catalyze accountability in suppliers, this study addresses the challenges managers face in the trade-off of diverse sustainability-focused strategies. This endeavor suggests and affirms the idea of complementarity between different sustainability approaches. This newfound clarity aids managers in navigating the complex essence of sustainability implementation, enabling them to shape their strategies internally and along with their suppliers with foresight and purpose.

2.3.Implications to the policy makers

Although the second study is interesting for managers as they can understand the firm´s adoption behavior inspired by different sustainability drivers in different cultural setting, we consider that this study is the ones that have a greater contribution to policy makers. Knowing about the effect of national culture helps policy makers to develop more appropriate policies tailored to the culture dominated in their nations. As we observed, different sustainability drivers can be hindered by specific cultural attributes. Thus, it has the potential to guide policy makers in crafting tailored and culturally sensitive strategies that resonate with the prevailing values and norms of their nations. This study also has a message for shareholders and owners. Integrating the compensation of managers with the green performance of the firm can ensure that their sustainability demands will be met, since we have learnt from this study that in the presence of all sustainability drivers, managers give more priority to the legitimacy by customers and regulators than legislation demanded by shareholders/owners.

In general, the integration of sustainability principles within industrial activities including NPD holds substantial implications for policy makers striving to promote Sustainable Development Goals within their nations. This dynamic intersection not only drives business competitiveness but also aligns with broader societal and environmental goals. By recognizing the pivotal role of industrial activities in shaping a sustainable future, policy makers can design frameworks that encourage and incentivize companies to infuse sustainable considerations into their operation processes as well as product innovation processes. Such policies could foster an environment where sustainable product design and development become integral components of corporate strategies. The strategic coupling of sustainability and industrial activities can result in the creation of products that not only meet market demands but also contribute positively to environmental well-being. As policy makers

delve into the realm of operations management, they have an opportunity to advocate for sustainable production and eco-friendly innovation through regulations, incentives, and collaborative initiatives that drive industries towards a more sustainable trajectory. Furthermore, policy makers can facilitate industry collaboration and standards by setting guidelines that encourage the adoption of sustainability practices within the supply chain. By recognizing the global competitiveness that stems from sustainable manufacturing (and sustainable innovation), policy makers can position industries as leaders in this realm through well-aligned regulations and incentives.

3. Limitations

Like all studies, this one has encountered certain limitations, mainly relating to the sample characteristics. One limitation relies on the usage of secondary data sources. For example, the HPM project data is a cross-sectional data, and testing our hypotheses using longitudinal data could provide more insights. In addition, the focus of sustainability in the HPM data mostly is on environmental affairs while the other two aspects of sustainability (i.e., social and economic) are missed. Although such lacking knowledge has not affected the results of our empirical studies but inhibited us from examining their contingency impacts in our studies, forcing us to recognize them as a limitation in our articles.

Furthermore, the HPM data includes a “slim” information about the role of digitalization in manufacturing known as industry 4.0. Especially, the information about industry 4.0 in the HPM dataset is limited to the scale related to information system and information technology. It restricted us to extend our approaches to examine the association between sustainability and industry 4.0, in particular sustainability, digitalization and eco-innovation which has received an increased academic interest recently.

In addition, the HPM data has a lack of sufficient information about institutional environment and contextual attributes of firms. Similarly, there is a lack of information about the internal capabilities of manufacturing firms such as organizational culture or leadership style which limited us to build up those scales according to their literature. Besides, the measures to create institutional pressures are narrow, restricting to empirically examine the different institutional drivers.

Finally, the HPM data includes information solely about manufacturing buying firms, however, it does not provide information about their position on the supply chain. We believe

that more detailed databases about the position of buyer and supplier in the supply chain are needed which could improve our understanding of the buyer-supplier sustainability paradox. More specifically, the information about the suppliers is missing in the HPM database. For instance, the type of supplier corporations, their location and size, and through which tier they are related to the manufacturing firms.

4. Future Research

We encourage future research to delve deeper into the subjects covered in this Doctoral Thesis. Any future work in this domain in the form of a research study can contribute to existing knowledge.

In regard to the first article, our results confirm that reactive practices are beneficial for companies seeking compliance with regulations, standards, and industry codes of conduct by acquiring certificates or aiming to improve their environmental performance through the adoption of pollution control measures to reduce waste and enhance the disposition of their organization's scrap and equipment. However, if companies aim for superior performance, such as gaining a competitive advantage, they should go further by undertaking more proactive practices that help improve their production process in terms of quality, flexibility, and delivery. This result reinforces the idea of sustainability with the application of advanced manufacturing systems such as Lean Practices, Agile Practices, Six Sigma, etc.

We encourage future research to expand upon our model in this study and elaborate on how such an approach to sustainability adoption has a different impact on the competitive advantage of manufacturing focal companies. The distinction between internal reactive and proactive practices versus external reactive and proactive practices allows researchers to observe the individual impact of these approaches adopted by focal companies within their own organizations and along with their suppliers. The suggested research questions are “How do internal reactive sustainability practices differ in their impact on the sustainability superior performance compared to internal proactive sustainability practices? or “what is the comparative influence of external reactive practices versus external proactive practices on the competitive advantage of manufacturing focal companies?”.

Additionally, according to the Resource-Based View (RBV) and Natural Resource-Based View (NRBV) theories, these environmental strategies can lead to superior performance by contributing to the development of specific corporate capabilities. In our

study, those capabilities are "implementation" (or the internal routine of sustainability practices) as organizational capability and "sustainability outcomes" as an operational capability. Future research may consider other organizational capabilities such as Lean or, in line with social exchange theory, some relational capabilities such as trust, information sharing, or mutual learning.

Furthermore, while the alignment between manufacturing paradigms and sustainability can be considered as a tool for attaining superior performance and competitiveness, an interesting path could extend the traditional manufacturing approach to encompass Industry 4.0 and digitalization. This approach would entail investigating the dynamics of the relationship between digitalization and sustainability. Therefore, the future research can propose the research questions including “how does the association between industry 4.0 and sustainability work?” and “which digitalization technologies are more relevant in term of sustainability adoption?”.

Within this framework, another future research could address the barriers and enablers of the adoption of sustainability practices in the era of digitalization. This could involve posing research questions such as: “what are the barriers and enablers of sustainability within industry 4.0?” and “how does the adoption of digitalization technologies help manufacturing firms to overcome the barriers and achieve values in terms of sustainability?”. Additionally, it is interesting to elaborate “how do digitalization technologies help to enhance collaboration between parties for sustainable manufacturing performance?”. This avenue of inquiry would shed light on the mechanisms through which digitalization fosters cooperation for sustainability-related objectives. Focusing on the concept of triple bottom line perspective (Elkington, 1998); it would be compelling to consider sustainability performance across environmental, social, and economic dimensions.

In this context, Artificial Intelligence (AI), as algorithms and mathematical-based models, is expected to streamline managerial tasks for automation, decision-making, and data analysis (Di Vaio et al., 2020). However, previous findings on the connection between AI and sustainability present mixed results. On one hand, the application of AI to sustainable innovation demonstrates a positive impact (Ardito, 2023), suggesting that AI can serve as a key enabler of complex, new, and data-related business models, providing a crucial tool to enhance operational performance and efficiency (Ahmad et al., 2021). On the other hand, scholars address its drawbacks, particularly its ethical challenges (Hermann, 2022), highlighting that its application may create a substantial carbon footprint with uncertain

behavioral responses to complex sustainability issues (Nishant et al., 2020). Considering these controversies, AI may act as either an enabler or a barrier to sustainability development goals (Vinuesa et al., 2020), creating an opportunity for further investigation to advance knowledge in this research domain (Di Vaio et al., 2020). In this context, De Giovanni (2020) suggests implementing an AI system to assist and support the decision-making process across the supply chain, promoting intelligent solutions to the issues. Therefore, one potential area for future research could be an analysis of "how does AI help manufacturing companies respond to the challenges of sustainability throughout their supply chain?".

As far as the second paper, the previous studies have acknowledged that the adoption of sustainability is a process of mindset not only influenced by external motives but also it strongly relies on the firms´ internal elements that can affect the decision-making process. Therefore, an investigation into the influential factors contributing to the diversity of adoption behaviors was imperative. In our study, national culture was taken into the account for explaining the heterogeneity in the adoption of sustainability. However, internal dynamics of the firms such as organizational culture and managerial competencies have also the potential to differentiate companies in terms of their approaches to sustainability adoption. Our findings have raised questions concerning "how does the organizational culture of a firm impact on the sustainability adoption behavior of the firm?". In addition, it is interesting to elaborate "how does the interplay between a firm´ organizational culture and national culture effect on sustainability adoption?" and "how do firm level attributes such as leadership style of managers drive sustainability adoption?".

Additionally, we believe that it is a matter of interest to understand how the position of buying firms in the supply chain, whether they serve directly to the end customer/client (B2C) or to other businesses (B2B), influences this association. This differentiation is crucial for explaining the pressures received from clients, as the sensitivity of an end consumer differs from that of another business entity. Therefore, we invite researchers to expand our model in this study by incorporating the position of buying companies as control variables into the model, to comprehend how it affects the hypothesized relationship of the study. The results of the suggested future study may provide evidence of which type of customer (end-user vs. another business) serves as a stronger source of driving pressures. This understanding will contribute to advancing the comprehension of the sources of institutional pressures on buying companies.

Regarding the third article, the role of institutional pressures has not been examined empirically. It will be interesting if our model to be extended to the future research by inclusion of institutional pressures and supply chain leadership. Therefore, the future research may address the research questions about "how different institutional pressures (i.e., coercive, normative and mimetic pressures) do drive sustainability performance of suppliers?". Additionally, we propose future research to follow our clustering analysis explained in the study by distinguishing between manufacturing buying companies in terms of high proactivity (or the most "successful" companies) versus low proactivity (or less successful companies). Perhaps, examining institutional pressures as a mediating factor in the link between the adoption of sustainability practices by focal companies and suppliers' sustainability performance would illuminate how the success of the firms in terms of being more sustainable determines suppliers' adoption behavior. The research question could be framed as follows: "How does the success of firms in achieving sustainability impact suppliers' adoption behavior?" The results for mediating variables (institutional pressures) could uncover which type of pressures exerted from the buying firms' proactiveness will be translated into sustainability behaviors on the supplier side.

Moreover, in this study the sustainability performance of suppliers is a perception of buying firms by evaluating the sustainability performance of their key suppliers. Hence, exploring other ways of measuring the sustainability performance of suppliers could augment the knowledge about the supplier sustainability performance challenges. Moreover, the country-specific setting has not considered in this relationship, Thus, it is interesting if the role of national culture, specifically cultural distance to be explored by addressing the question that "how does the cultural distance between buyer and supplier effect on supplier´s sustainability performance?" and "how can SCL compensate the potential adverse impact of cultural distance?".

In addition, we recommend future research to expand our model by incorporating the distinction between buying companies that serve end customers (B2C) and those that serve other businesses (B2B). The position of buying companies can enter into the model as control variables. Companies with direct contracts with end-users/customers may be expected to exhibit more proactive supply chain relationships with a higher priority on sustainability. The results of the proposed study could contribute to understanding of how the sensitivity of the customer (as an end-user or customer versus as a business) influences the actions of buying companies in establishing sustainability-focused mechanisms in their relationships with suppliers and how the level of isomorphism for suppliers may vary.

On the other hand, the literature has already recognized the importance of sustainability in multi-tier supply chain management, with a focus on institutional theory (including works by Wilhelm et al., 2016; Sauer and Seuring, 2018; Nath et al., 2019; Nath and Eweje, 2021; Grimm et al., 2023). A critical issue in multi-tier SSCM is the (de)coupling and institutional logics for sustainability implementation (Nath and Eweje, 2021). Conflicting institutional logics may lead sub-suppliers to exhibit a decoupling response to institutional pressures for the adoption of sustainability practices (Jamalnia et al., 2023). Such conflicts may give rise to two strategies by sub-suppliers: a consensual strategy to lower sustainability criteria and a concealment strategy to hide their involvement in illegal and unethical practices from institutional actors (Nath et al., 2020), highlighting the need for substantial monitoring and assessment by focal companies across their supply chain.

Another potential avenue for future research is to empirically address this issue in a two-tier supply chain and examine “which mechanisms undertaken by focal companies (internal practices, monitoring, or collaboration) can enhance the sustainability performance of sub-suppliers?”. From an institutional theory perspective, sub-suppliers will face collective coercive, normative, and mimetic pressures from two sources: pressures transferred from suppliers to sub-suppliers originating from buying companies and pressures stemming from their own institutional environment. It is interesting to deeply analyze the mediating role of institutional pressures in this association. The proposed future research would uncover the individual effects of those mechanisms and the role of collective institutional pressures in shedding light on the dark side of the supply chain. Incorporating leadership into the model, it would be interesting to analyze which leadership style with suppliers and sub-suppliers is effective (Jia et al., 2018).

In this context, Jamalnia et al. (2023) underscore the facilitating role of Industry 4.0 technologies, such as big data analysis techniques, to overcome the issues of information asymmetry and increase the traceability of sustainability in the supply chain. Following the study of Jamalnia et al. (2023), we encourage future research to analyze "how does the adoption of digitalization technologies enhance the sustainability performance of sub-suppliers?". Furthermore, it would be interesting for future research to examine "to what extent are decoupling issues resolved if digital technologies, such as big data, are used in a multi-tier supply chain?".

Turning to the fourth paper, our findings support the potential for achieving new product success by incorporating sustainability approaches into buyer-supplier relationships. In this study we measured the sustainability orientation of focal manufacturing firms through

adopting and implementing of sustainability practices. However, according to Claudy et al., (2016), sustainability culture and sustainability practices collectively reflect an organization's holistic approach to integrating sustainability into its core values, operations, and interactions with supply chain actors. Hence, by classifying the sustainability orientation into two dimensions: soft dimension such as sustainability culture and sustainability leadership and hard dimension such as sustainability practices, the future research may expand our model and investigate on "how does the incorporation of both soft and hard dimensions of sustainability orientation of focal manufacturing firms influence NPD success (performance)?". Considering the potential of Industry 4.0 to facilitate the production of more sustainable new products, another promising avenue for future research lies in investigating the intricate interplay between eco-innovation approaches (including both products and processes), digitalization, and NPD´s success (performance). This leads to the research question such as "how does the integration of eco-innovation strategies interact with digitalization to impact the success of NPD?". Furthermore, as explained earlier, automation technologies of industry 4.0, such as AI, can contribute to achieving better sustainability results by monitoring processes and improving the optimization of lean systems. This aligns with the objectives of sustainable manufacturing practices. The result of this study underscores the importance of collaborative competences for NPD success. An interesting future research could be investigating the questions: "Can digitalization technologies, specifically AI, replace collaborative competences?" and "how do 4.0 technologies (AI) impact social capital?".

Additionally, another opportunity for future research is to elaborate the nexus between the circular economy and NPD success, by considering "how can the integration of circular economy concern in NPD, for instance through the design for circular economy (DCE), enhance NPD success?". Moreover, the prior research in this field recognizes that the management implications of adopting design practices for circular economy remains relatively unexplored highlighting the need for more investigation around how companies approach to the circular economy (Diaz et al., 2022). Addressing this research gap, it would be interesting if future research to deeply explore the association between team structure and design for circular economy, by addressing a research question of "how should the NPD team, for instance R&D team, be organized for the circular economy?".

In the context of global trends where sustainability, performance, and value creation are diverging, urgent calls for worldwide action in line with the UN SDGs are compelling traditional industries to embrace more high-tech strategies within the realm of Industry 4.0.

However, Industry 4.0 is profit centred and concerns technology-driven productivity, scholars criticize it as a not proper framework for achieving sustainable development (Ghobakhloo et al., 2022). They argue that Industry 4.0 focuses less on the original principles of social fairness and sustainability but more on digitalization and AI-driven technologies for increasing the efficiency and flexibility of production (Xu et al., 2021). Simultaneously, Industry 5.0 mandates a pivotal focus on prioritizing the well-being of industry workers at the heart of the production process.

The concept of industry 5.0 provides different focus. It centres around human-centric manufacturing, and technological advancements should promote human well-being in social smart factories as stated by Lu et al. (2022). Industry 5.0 is understood to recognize the power of industry to achieve societal goals beyond jobs and growth, to become a resilient provider of prosperity, by making production respect the boundaries of our planet and placing the wellbeing of the industry worker at the center of the production processes. It represents a transformative model to develop a hyperconnected and data-driven industrial ecosystem that values sustainable development goals (Javaid et al., 2020). In other word, industry 5.0 supports industry in its long-term service to humanity within planetary boundaries and aims to promote resilience economic, socio-environmental sustainability, and human-centricity under the sustainable development agenda. The human-centricity micro-objectives of Industry 5.0, for example, consist of employment growth, workplace dignity, employee autonomy, and job satisfaction.

Nevertheless, it's unclear how Industry 5.0 contributes to SDGs and second, the boundaries, core principles, and functionality of Industry 5.0 are vastly understudied (Ghobakhloo et al., 2022). Given these circumstances, research and innovation must support industries by providing quick responses to the arisen challenges in manufacturing´s long-term service to humanity within planetary boundaries (Xu et al., 2021). It opens an avenue for further research in this area. For instance, future research would address the question of "how is the nexus of industry 5.0 and sustainability from a TPL perspective?", "what are the barriers and enablers of sustainability within industry 5.0?" and "how does the adoption of industry 5.0 help manufacturing firms to overcome the barriers and achieve values in terms of social sustainability?".

Overall, our study emphasizes the significance of human resources, including middle managers and employees, in placing sustainability values within firms as well as throughout the network of supply chain actors, particularly within buyer-supplier relationships. This underlines the crucial role played by the new product development team, which serves as the

bridge for making relation with suppliers as well as for implementing sustainability initiatives. This perspective opens up an interesting avenue for exploring the team's structure in the context of adopting sustainability practices internally and along with suppliers. Furthermore, it provides an opportunity for further examination of the role of team´s structure on the achieving success with new products. Therefore, the future research could address the research questions such as "what is the role of team structure in adopting and implementing sustainability practices in buyer-supplier relationship?" and "what is the role of team´s structure in influencing new product success?". Moreover, it is worth investigating "how does the team's structure facilitate the involvement of both upstream and downstream segments of the supply chain?". Finally, we encourage researchers to delve into the research that examines "how does this involvement promote the development of sustainability-oriented new products?".

A summary of the suggested future research is presented in the Table 3.2.

Table 3.2: Summary of the suggestions for future research

Article	Suggestion for future research	Proposed Research Questions:
Study 1	1- Focusing on TBL perspective. 2- Adopting reactive-proactive approach 3- Consider other organizational capabilities (Lean, Trust, Learning etc.) 4- Considering Industry 4.0 and digitalization concept 5- Specifically, paying attention to Artificial Intelligence technologies	• How do internal reactive sustainability practices differ in their impact on the sustainability superior performance compared to internal proactive sustainability practices? • What is the comparative influence of external reactive practices versus external proactive practices on the competitive advantage of manufacturing focal companies? • How does the association between industry 4.0 and sustainability work? • Which digitalization technologies are more relevant in term of sustainability adoption? • What are the barriers and enablers of sustainability within industry 4.0? • How does the adoption of digitalization technologies help manufacturing firms to overcome the barriers and achieve values in terms of sustainability? • How do digitalization technologies help to enhance collaboration between parties for sustainable manufacturing performance? • How does AI help manufacturing companies respond to the challenges of sustainability throughout their supply chain?
Study 2	1- Focusing on internal dynamics of the firms 2- Considering the position of buying firms in the supply chain as a control variable	• How does the organizational culture of a firm impact on the sustainability adoption behaviour of the firm? • How does the interplay between a firm´ organizational culture and national culture effect on sustainability adoption? • How do firm level attributes such as leadership style of managers drive sustainability adoption?
Study 3	1- Empirically examining the institutional pressures (mediating effect) 2- Measuring supplier sustainability performance from the other perspectives. 3- Conducting a clustering analysis (Reactive-proactive) 4- Considering country level factors such as cultural distance 5- Considering the position of buying firms in the supply chain as a control variable 6- Adopting (de)coupling approach in multi-tier supply chain 7- Considering industry 4.0 concept in (de)coupling issues	• How do different institutional pressures (i.e., coercive, normative and mimetic pressures) drive sustainability performance of suppliers? • How does the success of firms in achieving sustainability impact suppliers' adoption behaviour? • How does the cultural distance between buyer and supplier effect on supplier´s sustainability performance? • How can SCL compensate the potential adverse impact of cultural distance? • Which mechanisms undertaken by focal companies (internal practices, monitoring, or collaboration) can enhance the sustainability performance of sub-suppliers? • How does the adoption of digitalization technologies enhance the sustainability performance of sub-suppliers? • To what extent are decoupling issues resolved if digital technologies, such as big data, are used in a multi-tier supply chain?

Study 4	1- Distinction between sustainability orientation (hard and soft) 2- Adopting industry 4.0 approach 3- Adopting circular economy approach	• How does the incorporation of both soft and hard dimensions of sustainability orientation of focal manufacturing firms influence NPD success (performance)? • How does the integration of eco-innovation strategies interact with digitalization to impact the success of NPD? • Can digitalization technologies, specifically AI, replace collaborative competences?" • How do 4.0 technologies (AI) impact social capital? • How can the integration of circular economy concern in NPD for instance through the design for circular economy (DCE) enhance NPD success? • How should the NPD team, for instance R&D team, be organized for the circular economy?
General Proposal	➢ Industry 5.0 approach ➢ Role of Human Resources	• How is the nexus of industry 5.0 and sustainability from a TPL perspective?", • What are the barriers and enablers of sustainability within industry 5.0? • How does the adoption of industry 5.0 help manufacturing firms to overcome the barriers and achieve values in terms of social sustainability? • What is the role of team structure in adopting and implementing sustainability practices in buyer-supplier relationship? • What is the role of team´s structure in influencing new product success? • How does the team's structure facilitate the involvement of both upstream and downstream segments of the supply chain? • How does this involvement promote the development of sustainability-oriented new products?".

5. References

Acevedo Amaya, M. R., Ortega-Jiménez, C. H., Machuca, J. A. D., & Alfalla-Luque, R. (2020). Industry 4.0: Current trend and future scope for further research in high performance manufacturing. *Proceedings of the LACCEI International Multi-Conference for Engineering, Education and Technology*, 0–10. https://doi.org/10.18687/LACCEI2020.1.1.303

Adams, R., Jeanrenaud, S., Bessant, J., Denyer, D., & Overy, P. (2016). Sustainability-oriented Innovation: A Systematic Review. *International Journal of Management Reviews*, *18*(2), 180–205. https://doi.org/10.1111/ijmr.12068.

Ahmad, T., Zhang, D., Huang, C., Zhang, H., Dai, N., Song, Y., & Chen, H. (2021). Artificial intelligence in sustainable energy industry: Status Quo, challenges and opportunities. *Journal of Cleaner Production*, 289, 125834.

Ahmad, S., Wong, K. Y., Tseng, M. L., & Wong, W. P. (2018). Sustainable product design and development: A review of tools, applications and research prospects. *Resources, Conservation and Recycling*, *132*(October 2017), 49–61. https://doi.org/10.1016/j.resconrec.2018.01.020

Allenbacher, J., & Berg, N. (2023). How assessment and cooperation practices influence suppliers' adoption of sustainable supply chain practices: An inter-organizational learning perspective. *Journal of Cleaner Production*, *403*(October 2022), 136852. https://doi.org/10.1016/j.jclepro.2023.136852.

Ardito, L. (2023). The influence of firm digitalization on sustainable innovation performance and the moderating role of corporate sustainability practices: *An empirical investigation. Business Strategy and the Environment*.

Azadegan, A., Golara, S., Kach, A., & Mousavi, N. (2018). Corporate environmental investments: A cross-national study on managerial decision making. *International Journal of Production Economics*, *199*(September 2016), 47–64. https://doi.org/10.1016/j.ijpe.2017.09.010

Bai, C., & Satir, A. (2022). A critical content-analysis of sustainable supplier development literature and future research directions. *Journal of Cleaner Production*, *365*(May), 132443. https://doi.org/10.1016/j.jclepro.2022.132443

Barney, J. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Bello-Pintado, A., Machuca, J. A. D., & Danese, P. (2023). Stakeholder pressures and sustainability practices in manufacturing: Consideration of the economic development context. *Business Strategy and the Environment*, *March 2022*, 1–19. https://doi.org/10.1002/bse.3355

Bortolotti, T., Boscari, S., & Danese, P. (2015). Successful lean implementation: Organizational culture and soft lean practices. *International Journal of Production Economics*, *160*, 182–201. https://doi.org/10.1016/j.ijpe.2014.10.013

Cagno, E., Neri, A., Howard, M., Brenna, G., & Trianni, A. (2019). Industrial sustainability performance measurement systems: A novel framework. *Journal of Cleaner Production*, *230*, 1354–1375. https://doi.org/10.1016/j.jclepro.2019.05.021

Cantele, S., & Zardini, A. (2018). Is sustainability a competitive advantage for small businesses? An empirical analysis of possible mediators in the sustainability–financial

performance relationship. *Journal of Cleaner Production*, *182*, 166–176. https://doi.org/10.1016/j.jclepro.2018.02.016

Caprar, D. V., & Neville, B. A. (2012). "Norming" and "Conforming": Integrating Cultural and Institutional Explanations for Sustainability Adoption in Business. *Journal of Business Ethics*, *110*(2), 231–245. https://doi.org/10.1007/s10551-012-1424-1

Carter, C. R., Kaufmann, L., & Ketchen, D. J. (2020). Expect the unexpected: toward a theory of the unintended consequences of sustainable supply chain management. *International Journal of Operations and Production Management*, *40*(12), 1857–1871. https://doi.org/10.1108/IJOPM-05-2020-0326

Chacón Vargas, J. R., Moreno Mantilla, C. E., & de Sousa Jabbour, A. B. L. (2018). Enablers of sustainable supply chain management and its effect on competitive advantage in the Colombian context. *Resources, Conservation and Recycling*, *139*(September), 237–250. https://doi.org/10.1016/j.resconrec.2018.08.018

Cheng, C. C. J. (2020). Sustainability Orientation, Green Supplier Involvement, and Green Innovation Performance: Evidence from Diversifying Green Entrants. *Journal of Business Ethics*, *161*(2), 393–414. https://doi.org/10.1007/s10551-018-3946-7

Chwialkowska, A., Bhatti, W. A., & Glowik, M. (2020). The influence of cultural values on pro-environmental behavior. *Journal of Cleaner Production*, *268*. https://doi.org/10.1016/j.jclepro.2020.122305

Claudy, M. C., Peterson, M., & Pagell, M. (2016). The Roles of Sustainability Orientation and Market Knowledge Competence in New Product Development Success. *Journal of Product Innovation Management*, *33*, 72–85. https://doi.org/10.1111/jpim.12343

Cornejo-Cañamares, M., Medrano, N., & Olarte-Pascual, C. (2021). Environmental objectives and non-technological innovation in Spanish manufacturing SMEs. *Journal of Cleaner Production*, *296*. https://doi.org/10.1016/j.jclepro.2021.126445

Cousins, P. D., Lawson, B., Petersen, K. J., & Fugate, B. (2019). Investigating green supply chain management practices and performance: The moderating roles of supply chain ecocentricity and traceability. *International Journal of Operations and Production Management*, *39*(5), 767–786. https://doi.org/10.1108/IJOPM-11-2018-0676

Dai, Jing, Cantor, D. E., & Montabon, F. L. (2017). Examining corporate environmental proactivity and operational performance: A strategy-structure-capabilities-performance perspective within a green context. *International Journal of Production Economics*, *193*(August), 272–280. https://doi.org/10.1016/j.ijpe.2017.07.023

Dai, Jun, Xie, L., & Chu, Z. (2021). Developing sustainable supply chain management: The interplay of institutional pressures and sustainability capabilities. *Sustainable Production and Consumption*, *28*, 254–268. https://doi.org/10.1016/j.spc.2021.04.017

Danese, P., Lion, A., & Vinelli, A. (2019). Drivers and enablers of supplier sustainability practices: a survey-based analysis. *International Journal of Production Research*, *57*(7), 2034–2056. https://doi.org/10.1080/00207543.2018.1519265

Das, D. (2018). The impact of Sustainable Supply Chain Management practices on firm performance: Lessons from Indian organizations. *Journal of Cleaner Production*, *203*, 179–196. https://doi.org/10.1016/j.jclepro.2018.08.250.

De Giovanni, P. (2021). Smart Supply Chains with vendor managed inventory, coordination, and environmental performance. *European Journal of Operational Research*, 292(2),

515-531.

Diaz, A., Reyes, T., & Baumgartner, R. J. (2022). Implementing circular economy strategies during product development. *Resources, Conservation and Recycling*, 184, 106344.

DiMaggio, P.J., Powell, W.W., 1983. The iron cage revisited: institutional isomor- phism and collective rationality in organizational fields. American Sociological Review 48, 147e160.

Di Vaio, A., Palladino, R., Hassan, R., & Escobar, O. (2020). Artificial intelligence and business models in the sustainable development goals perspective: A systematic literature review. *Journal of Business Research*, 121, 283-314.

Dubey, R., Gunasekaran, A., Childe, S. J., Papadopoulos, T., & Helo, P. (2019). Supplier relationship management for circular economy: Influence of external pressures and top management commitment. *Management Decision*, *57*(4), 767–790. https://doi.org/10.1108/MD-04-2018-0396

Elkington, J. (1998). Partnerships from cannibals with forks: The triple bottom line of 21st-century business. *Environmental Quality Management*, *8*(1), 37–51.

Emerson, R.M., 1976. Social exchange theory. Annual Review of Sociology 2, 335–362.

Ghobakhloo, M., Iranmanesh, M., Mubarak, M. F., Mubarik, M., Rejeb, A., & Nilashi, M. (2022). Identifying industry 5.0 contributions to sustainable development: A strategy roadmap for delivering sustainability values. *Sustainable Production and Consumption*, 33, 716-737.

Giannakis, M., Dubey, R., Vlachos, I., & Ju, Y. (2020). Supplier sustainability performance evaluation using the analytic network process. *Journal of Cleaner Production*, *247*, 119439. https://doi.org/10.1016/j.jclepro.2019.119439

Gimenez, C., & Tachizawa, E. M. (2012). Extending sustainability to suppliers: A systematic literature review. *Supply Chain Management*, *17*(5), 531–543. https://doi.org/10.1108/13598541211258591

Gosling, J., Jia, F., Gong, Y., & Brown, S. (2016). The role of supply chain leadership in the learning of sustainable practice: toward an integrated framework. *Journal of Cleaner Production*, *137*, 1458–1469. https://doi.org/10.1016/j.jclepro.2014.10.029

Granovetter, M.S. (1992), "Economic institutions as social constructions: a framework for analysis", Acta Sociologica, Vol. 25 No. 1, pp. 3-11.

Grimm, J. H., Hofstetter, J. S., & Sarkis, J. (2023). Corporate sustainability standards in multi-tier supply chains–an institutional entrepreneurship perspective. International journal of production research, 61(14), 4702-4724.

Hair Jr, J. F., Hult, G. T. M., Ringle, C., & Sarstedt, M. (2016). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

Hart, S. L. (1995). A natural-resource-based view of the firm. *Academy of Management Review*, *20*(4), 986–1014.

Hermann, E. (2022). Leveraging artificial intelligence in marketing for social good—An ethical perspective. *Journal of Business Ethics*, 179(1), 43-61.

Hermundsdottir, F., & Aspelund, A. (2022). Competitive sustainable manufacturing - Sustainability strategies, environmental and social innovations, and their effects on firm performance. *Journal of Cleaner Production*, *370*(October 2021), 133474.

https://doi.org/10.1016/j.jclepro.2022.133474

Horak, S., Arya, B., & Ismail, K. M. (2018). Organizational Sustainability Determinants in Different Cultural Settings: A Conceptual Framework. *Business Strategy and the Environment*, *27*(4), 528–546. https://doi.org/10.1002/bse.2018.

Jamalnia, A., Gong, Y., & Govindan, K. (2023). Sub-supplier's sustainability management in multi-tier supply chains: A systematic literature review on the contingency variables, and a conceptual framework. *International Journal of Production Economics*, 255, 108671.

Javaid, M., Haleem, A., Singh, R. P., Haq, M. I. U., Raina, A., & Suman, R. (2020). Industry 5.0: Potential applications in COVID-19. *Journal of Industrial Integration and Management*, 5(04), 507-530.

Jayawardane, H., Davies, I. J., Gamage, J. R., John, M., & Biswas, W. K. (2023). Sustainability perspectives – a review of additive and subtractive manufacturing. *Sustainable Manufacturing and Service Economics*, *2*(June 2022), 100015. https://doi.org/10.1016/j.smse.2023.100015

Jia, F., Gong, Y., & Brown, S. (2019). Multi-tier sustainable supply chain management: The role of supply chain leadership. *International Journal of Production Economics*, *217*(July 2017), 44–63. https://doi.org/10.1016/j.ijpe.2018.07.022

Jia, M., Stevenson, M., & Hendry, L. (2021). A systematic literature review on sustainability-oriented supplier development. *Production Planning and Control*, *0*(0), 1–21. https://doi.org/10.1080/09537287.2021.1958388

Katsikeas, C. S., Leonidou, C. N., & Zeriti, A. (2016). Eco-friendly product development strategy: antecedents, outcomes, and contingent effects. *Journal of the Academy of Marketing Science*, *44*(6), 660–684. https://doi.org/10.1007/s11747-015-0470-5

Kim, S., Wagner, S. M., & Colicchia, C. (2019). The Impact of Supplier Sustainability Risk on Shareholder Value. *Journal of Supply Chain Management*, *55*(1), 71–87. https://doi.org/10.1111/jscm.12188

Kock, N. (2015). Common Method Bias in PLS-SEM. *International Journal of E-Collaboration*, *11*(4), 1–10. https://doi.org/10.4018/ijec.2015100101

Liu, L., Zhang, M., & Ye, W. (2019). The adoption of sustainable practices: A supplier's perspective. *Journal of Environmental Management*, *232*(November 2018), 692–701. https://doi.org/10.1016/j.jenvman.2018.11.067.

Lu, Y., Zheng, H., Chand, S., Xia, W., Liu, Z., Xu, X., ... & Bao, J. (2022). Outlook on human-centric manufacturing towards Industry 5.0. *Journal of Manufacturing Systems*, 62, 612-627.

Magon, R. B., Thomé, A. M. T., Ferrer, A. L. C., & Scavarda, L. F. (2018). Sustainability and performance in operations management research. *Journal of Cleaner Production*, *190*, 104–117. https://doi.org/10.1016/j.jclepro.2018.04.140

Micheli, G. J. L., Cagno, E., Mustillo, G., & Trianni, A. (2020). Green supply chain management drivers, practices and performance: A comprehensive study on the moderators. *Journal of Cleaner Production*, *259*, 121024. https://doi.org/10.1016/j.jclepro.2020.121024

Miras-Rodríguez, M. del M., Machuca, J. A. D., & Escobar-Pérez, B. (2018). Drivers that encourage environmental practices in manufacturing plants: A comparison of cultural

environments. *Journal of Cleaner Production*, *179*, 690–703. https://doi.org/10.1016/j.jclepro.2017.11.029

Mishra, P., & Yadav, M. (2021). "Environmental capabilities, proactive environmental strategy and competitive advantage: A natural-resource-based view of firms operating in India." *Journal of Cleaner Production*, *291*. https://doi.org/10.1016/j.jclepro.2020.125249

Miska, C., Szőcs, I., & Schiffinger, M. (2018). Culture's effects on corporate sustainability practices: A multi-domain and multi-level view. *Journal of World Business*, *53*(2), 263–279. https://doi.org/10.1016/j.jwb.2017.12.001

Mitra, S., & Datta, P. P. (2014). Adoption of green supply chain management practices and their impact on performance: An exploratory study of Indian manufacturing firms. *International Journal of Production Research*, *52*(7), 2085–2107. https://doi.org/10.1080/00207543.2013.849014

Mokhtar, A. R. M., Genovese, A., Brint, A., & Kumar, N. (2019). Supply chain leadership: A systematic literature review and a research agenda. *International Journal of Production Economics*, *216*(April), 255–273. https://doi.org/10.1016/j.ijpe.2019.04.001

Morita, M., Machuca, J. A. D., & Pérez Díez de los Ríos, J. L. (2018). Integration of product development capability and supply chain capability: The driver for high performance adaptation. *International Journal of Production Economics*, *200*(March), 68–82. https://doi.org/10.1016/j.ijpe.2018.03.016.

Nath, S. D., Eweje, G., & Bathurst, R. (2021). The invisible side of managing sustainability in global supply chains: evidence from multitier apparel suppliers. *Journal of Business Logistics*, 42(2), 207-232.

Nath, S. D., & Eweje, G. (2021). Inside the multi-tier supply firm: exploring responses to institutional pressures and challenges for sustainable supply management. *International Journal of Operations & Production Management*, 41(6), 908-941.

Nath, S. D., Eweje, G., & Sajjad, A. (2020). The hidden side of sub-supplier firms' sustainability–an empirical analysis. *International Journal of Operations & Production Management*, 40(12), 1771-1799.

Neutzling, D. M., Land, A., Seuring, S., & Nascimento, L. F. M. do. (2018). Linking sustainability-oriented innovation to supply chain relationship integration. *Journal of Cleaner Production*, *172*, 3448–3458. https://doi.org/10.1016/j.jclepro.2017.11.091.

Nishant, R., Kennedy, M., & Corbett, J. (2020). Artificial intelligence for sustainability: Challenges, opportunities, and a research agenda. *International Journal of Information Management*, 53, 102104.

Nguyen, N. P., & Adomako, S. (2021). Environmental proactivity, competitive strategy, and market performance: The mediating role of environmental reputation. *Business Strategy and the Environment*, *December 2020*, 1–13. https://doi.org/10.1002/bse.2729

Okoshi, C. Y., Pinheiro de Lima, E., & Gouvea Da Costa, S. E. (2019). Performance cause and effect studies: Analyzing high performance manufacturing companies. *International Journal of Production Economics*, *210*(April 2018), 27–41. https://doi.org/10.1016/j.ijpe.2019.01.003

Pang, R., & Zhang, X. (2019). Achieving environmental sustainability in manufacture: A 28-year bibliometric cartography of green manufacturing research. *Journal of Cleaner*

Production, *233*, 84–99. https://doi.org/10.1016/j.jclepro.2019.05.303

Paul J. DiMaggio and Walter W. Powell. (1983). The Iron Cage Revisited : Institutional Isomorphism and Collective Rationality in Organizational Fields Author (s): Paul J . DiMaggio and Walter W . Powell Published by : American Sociological Association Stable URL : https://www.jstor.org/stable/209510. *American Sociological Review*, *48*(2), 147–160.

Paulraj, A., Chen, I. J., & Blome, C. (2017). Motives and Performance Outcomes of Sustainable Supply Chain Management Practices: A Multi-theoretical Perspective. *Journal of Business Ethics*, *145*(2), 239–258. https://doi.org/10.1007/s10551-015-2857-0

Peng, D. X., & Lai, F. (2012). Using partial least squares in operations management research: A practical guideline and summary of past research. *Journal of Operations Management*, *30*(6), 467–480. https://doi.org/10.1016/j.jom.2012.06.002

Sancha, C., Wong, C. W. Y., & Gimenez, C. (2019). Do dependent suppliers benefit from buying firms' sustainability practices? *Journal of Purchasing and Supply Management*, *25*(4), 100542. https://doi.org/10.1016/j.pursup.2019.100542

Sarkis, J., & Zhu, Q. (2018). Environmental sustainability and production: taking the road less travelled. *International Journal of Production Research*, *56*(1–2), 743–759. https://doi.org/10.1080/00207543.2017.1365182

Sarstedt, M., Hair, J. F., Nitzl, C., Ringle, C. M., & Howard, M. C. (2020). Beyond a tandem analysis of SEM and PROCESS: Use of PLS-SEM for mediation analyses! *International Journal of Market Research*, *62*(3), 288–299. https://doi.org/10.1177/1470785320915686.

Sauer, P. C., & Seuring, S. (2019). Extending the reach of multi-tier sustainable supply chain management–insights from mineral supply chains. *International Journal of Production Economics*, 217, 31-43.

Schroeder, R. G., & Flynn, B. B. (2001). *High performance manufacturing : global perspectives* (p. 308).

Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, *16*(15), 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Singh, J., Pandey, K. K., Kumar, A., Naz, F., & Luthra, S. (2022). Drivers, barriers and practices of net zero economy: An exploratory knowledge based supply chain multi-stakeholder perspective framework. In *Operations Management Research*. Springer US. https://doi.org/10.1007/s12063-022-00255-x

Song, F. (Sophie), Montabon, F., & Xu, Y. (2018). The impact of national culture on corporate adoption of environmental management practices and their effectiveness. *International Journal of Production Economics*, *205*(September), 313–328. https://doi.org/10.1016/j.ijpe.2018.09.020.

Song, W., Ren, S., & Yu, J. (2019). Bridging the gap between corporate social responsibility and new green product success: The role of green organizational identity. *Business Strategy and the Environment*, *28*(1), 88–97. https://doi.org/10.1002/bse.2205.

Tachizawa, E. M., Gimenez, C., & Sierra, V. (2015). Green supply chain management approaches: drivers and performance implications. *International Journal of Operations*

& Production Management, 35(11), 1546-1566.

Tata, J., & Prasad, S. (2015). National cultural values, sustainability beliefs, and organizational initiatives. *Cross Cultural Management*, *22*(2), 278–296. https://doi.org/10.1108/CCM-03-2014-0028.

Tate, W. L., Dooley, K. J., & Ellram, L. M. (2011). Transaction Cost and Institutional Drivers of Supplier Adoption of Environmental Practices - Tate - 2011 - Journal of Business Logistics - Wiley Online Library. *Journal of Business Logistics*, *32*(1), 6–16.

Vachon, S., & Klassen, R. D. (2006). Extending green practices across the supply chain: the impact of upstream and downstream integration. *International journal of operations & Production Management*, 26(7), 795-821.

Vidal, N. G., Spetic, W., Croom, S., & Marshall, D. (2022). Supply chain stakeholder pressure for the adoption of sustainable supply chain practices: examining the roles of entrepreneurial and sustainability orientations. *Supply Chain Management, August 2021*. https://doi.org/10.1108/SCM-08-2021-0370.

Vinuesa, R., Azizpour, H., Leite, I., Balaam, M., Dignum, V., Domisch, S., ... & Fuso Nerini, F. (2020). The role of artificial intelligence in achieving the Sustainable Development Goals. *Nature communications*, 11(1), 1-10.

Wang, J., Zhu, L., Feng, L., & Feng, J. (2023). A meta-analysis of sustainable supply chain management and firm performance: Some new findings on sustainable supply chain management. *Sustainable Production and Consumption*, *38*(March), 312–330. https://doi.org/10.1016/j.spc.2023.04.015

Wang, Z., Wang, Q., Zhang, S., & Zhao, X. (2018). Effects of customer and cost drivers on green supply chain management practices and environmental performance. *Journal of Cleaner Production*, *189*, 673–682. https://doi.org/10.1016/j.jclepro.2018.04.071.

Wilhelm, M. M., Blome, C., Bhakoo, V., & Paulraj, A. (2016). Sustainability in multi-tier supply chains: Understanding the double agency role of the first-tier supplier. *Journal of operations management*, 41, 42-60.

Williamson, O.E. (1981), "The economics of organization: the transaction cost approach", The American Journal of Sociology, Vol. 87 No. 3, pp. 548-77.

World Commission on Environment and Development (1987), Our Common Future, Oxford University Press, New York, NY.

Xu, X., Lu, Y., Vogel-Heuser, B., & Wang, L. (2021). Industry 4.0 and Industry 5.0—Inception, conception and perception. *Journal of Manufacturing Systems*, *61*(October), 530–535. https://doi.org/10.1016/j.jmsy.2021.10.006

Zhang, M., Zeng, W., Tse, Y. K., Wang, Y., & Smart, P. (2021). Examining the antecedents and consequences of green product innovation. *Industrial Marketing Management*, *93*(April 2020), 413–427. https://doi.org/10.1016/j.indmarman.2020.03.028

Zhang, S., Wang, Z., & Zhao, X. (2019). Effects of proactive environmental strategy on environmental performance: Mediation and moderation analyses. *Journal of Cleaner Production*, *235*, 1438–1449. https://doi.org/10.1016/j.jclepro.2019.06.220

Zheng, L., & Iatridis, K. (2022). Friends or foes? A systematic literature review and meta-analysis of the relationship between eco-innovation and firm performance. *Business Strategy and the Environment*, *31*(4), 1838–1855. https://doi.org/10.1002/bse.2986

Annex 1: HPM Questionnaire for Sustainability scale of Environmental Practices/Initiatives

Please indicate the degree to which your plant is engaged in the following initiatives/practices:							
Item	Description	No extent whatsoever	Little extent	Moderate extent	Great extent	Very great extent	
ENVRTX01	Energy efficiency or renewable energy						
ENVRTX02	Water efficiency						
ENVRTX03	Reducing waste in internal processes (e.g., improving yield or efficiency)						
ENVRTX04	Improving the workforce environment (e.g., indoor air quality)						
ENVRTX05	Pollution prevention (eliminating emissions or waste)						
ENVRTX06	Pollution control (scrubbing, waste treatment)						
ENVRTX07	Remediation projects, such as cleanup or restoration from past practices						
ENVRTX08	Decreasing the likelihood or impact of an environmental accident						
ENVRTX09	Reduction/avoidance of land consumption						
ENVRTX10	Improvements in inbound transportation, such as fuel efficiency or load matching						
ENVRTX11	Improvements in outbound transportation, such as fuel efficiency or load matching						
ENVRTX12	Seeking or maintaining ISO14001 certification						
ENVRTX13	Complying with a customer's supplier code of conduct						
ENVRTX14	Complying with an industry-wide code of conduct						
ENVRTX15	Other compliance or auditing program focused on your plant (not on your suppliers)						
ENVRTX16	Carbon tracking/carbon footprint calculation of internal operations						
ENVRTX17	Carbon tracking/carbon footprint calculation of supply chain						
ENVRTX18	Working with customers to help them achieve environmental objectives						
ENVRTX19	Design of your organization's products for disassembly, recycling, reuse or durability						
ENVRTX20	Life-cycle analysis of the "cradle to grave" environmental impact of materials/products						
ENVRTX21	Environmentally preferable packaging for the products that you produce (recycled content, less volume, reusable packaging)						
ENVRTX22	Substituting environmental preferable direct materials or supplies for harmful or non-renewable ones						

ENVRTX23	Environmental improvements in the disposition of your organization's scrap or excess material (re-use, recycling, etc.)
ENVRTX24	Environmental improvements in the disposition of your organization's scrap or excess material (re-use, recycling, etc.)
ENVRTX25	Prolonging the useful life of equipment
ENVRTX26	Employee commuting issues (e.g., carpooling, bike garage)
ENVRTX27	Substituting environmentally preferable indirect materials for harmful or non-renewable ones
ENVRTX28	Environmentally preferable inbound packaging, such as (recycled content, less volume or reusable packaging
ENVRTX29	Encouraging suppliers to improve the environmental performance of their processes
ENVRTX30	Giving preference to materials with third party certifications, such as Green Seal, FSC or Energy Star
ENVRTX31	Requesting that your suppliers sign a code of environmental conduct
ENVRTX32	Purchasing from minority- or women-owned business enterprise (M/WBE) suppliers
ENVRTX33	Starting or maintaining a formal M/WBE supplier purchase program
ENVRTX34	Visiting suppliers' plants or ensuring that they are not using sweatshop labor
ENVRTX35	Ensuring that suppliers comply with child labor laws
ENVRTX36	Asking suppliers to pay a "living wage"
ENVRTX37	Using a third party to monitor working conditions at supplier facilities
ENVRTX38	Incorporating environmental considerations in evaluating and selecting suppliers
ENVRTX39	Providing design specification to suppliers in line with environmental requirements (e.g., green purchasing, blacklist of raw materials)
ENVRTX40	Co-development with suppliers to reduce the environmental impact of the product (e.g., eco-design, green packaging, recyclability)
ENVRTX41	Involvement of suppliers in the re-design of internal processes (e.g., remanufacturing, reduction of by-products)
ENVRTX42	Cooperative investments with suppliers in order to create a more environmentally sustainable logistics systems (e.g., closed-loop supply chain, reverse logistics)