

# PROPOSING A CONCEPTUAL RESEARCH MODEL FOR LEAN AND GREEN SUPPLY CHAIN TO ACHIEVE SUSTAINABILITY PERFORMANCE.

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**Abstract**— A contemporary demand of the corporate environment consists in searching for a balance between profit growth, cost reductions and environmental considerations. Being Lean and Green is a trend that organizations are beginning to recognize as crucial in overcoming challenges and achieving economic, social, and environmental success. The Lean/Green supply chain management strategy enables the continuous improvement of all operations connected with the management of physical and informational flows, waste prevention, and human resource management. Thus, to address the research gap in previous studies, we examined the impact of a Lean Green Supply chain management system on sustainability performance.

This paper proposes a conceptual model, which incorporates aspects that have previously been examined separately. To this end, we will use a hybrid research approach consisting of not only two qualitative studies based on an interview guide, but also a quantitative study by using a questionnaire presented to SEMs. This work presents the major theoretical insights to help leaders alter variables that promote excellent workflow while respecting the environment and achieving goals effectively.

**Keywords**—lean practice, sustainability practice, process innovation, sustainability performance.

## I. INTRODUCTION

With a growing concern for the environment as a major determinant of any company's sustainability, it is important to study green behavior in the context of emerging economies. Based on both economic and non-economic aspects, a company's long-term performance is designated by its values and communication strategies (Schaltegger and agner, 2017). The implementation of corporate social responsibility is also reflected in the long-term performance of companies. In addition, the long-term sustainability of companies is assessed using three main components, namely economic performance indicators, social performance indicators, and environmental performance indicators (Muhammad et al, 2020). Supply chain management practices are closely related to customer satisfaction. They require the close coordination and integration of the business framework. The business process, which must be coherent, includes manufacturing, purchasing, marketing, logistics and information systems. Therefore, supply chain management practices focus on customer response, quality, and environmental sustainability (De et al, 2020). Often, audiences' responses to Lean principles and requirements can be different only when the Lean mindset is communicated effectively.

Companies must typically go on a non-linear voyage of discovery to effectively execute green supply chain activities, such as updating or adapting their products, developing new methodologies, and adopting new business models. Thus, to better understand the mediating function of innovation and lean methods while considering the influence of production practices on sustainability performance, this paper raises an important question:

Can process innovation and the implementation of Lean and Green practices improve sustainability performance?

The remainder of this paper is structured as follows. The literature review defines the key concepts. Then, the relationships between them are explained in order to clarify the hypotheses of our research and propose our conceptual model, as a combination of variables that have never been tested together before. Next, the adopted research methodology identifies our theoretical and managerial contributions. Finally, we summarize our paper and draw some conclusions.

## RESEARCH ISPIRATION:

Given the limited adoption of Lean techniques and the general lack of understanding about these approaches in many developing nations, it is increasingly vital to conduct a detailed analysis of Lean culture in practical contexts. This is particularly important for recognized Tunisian SMEs, where Lean concepts have the potential to revolutionize businesses. By rigorously assessing the adoption of Lean principles within these firms, we can gather valuable insights into their effectiveness, while also identifying the challenges and opportunities unique to this environment.

Moreover, there is an urgent need to enhance corporate awareness about the importance of implementing Lean techniques, especially in light of the pressing issue of renewable resource scarcity. Current renewable resources are already struggling to meet the demands of today's population, raising serious concerns about their sustainability. If current trends continue, the ability of these resources to support future populations will be significantly compromised, potentially leading to disastrous consequences.

Lean approaches offer a viable solution to the problem of resource scarcity by optimizing operations, eliminating waste, and improving efficiency. This strategy not only strengthens economic

competitiveness but also contributes to the broader goal of sustainability, ensuring that the limited resources available today can continue to support the objectives of future generations.

Adopting a Lean mindset is a crucial step that organizations, particularly those in developing countries, must take to meet current and future challenges. This requires a concerted effort to research, implement, and promote Lean concepts, focusing on their potential to improve resource efficiency and promote sustainable development.

Small and medium-sized enterprises (SMEs) are critical to supply chain sustainability because they strategically balance economic, environmental, and social aspects in their decision-making processes. Lean practices (LP), which are largely driven by economic concerns, have shown to be particularly effective in helping SMEs achieve sustainability goals. Their simplicity of adoption makes them a more appealing choice than process innovations (PI), which need cash and frequently rely on external variables like client desire or regulatory regulations to be adopted.

Despite these obstacles, PI continues to be an important contributor to supply chain sustainability, while its adoption is dependent on resource availability and external influences. The effective application of Green Supply Chain Management (GSCM) methods relies heavily on innovation. This study, which employs dynamic capacity theory, gives important insights into how GSCM processes adapt and change in the complex and ever-changing world of supply chains.

This study investigates how both LP and PI contribute to SMEs' sustainability, with LP being more accessible owing to its economic appeal, whilst PI requires extra external assistance. The effective integration of these practices, helped by innovation and perhaps policy-driven financial incentives, is critical for SMEs seeking to establish a truly sustainable supply chain. This study aims to fill certain research gaps noted by Graça Miranda Silva, Paulo J. Gomes, Joseph Sarkis (2019), and Prasanta Kumar Dey et al. (2019).

To do this, we combined the essential factors from previous studies and developed a unique research model, which we will thoroughly examine. Our goal is to see if the combinations of these elements yield consistent outcomes in the setting of a developing country. Furthermore, we intend to investigate how these factors react when applied in a new situation, so adding to a more thorough understanding of their effect across many environments.

## II. LITERATURE REVIEW

Green supply chain management (GSCM) refers to the distribution of products and services from suppliers and producers to end users while considering information, monetary, and material flows in the environment (Zhu et al., 2012). Supply chain management (SCM) is associated with an environmental perspective of GSCM, which includes material sourcing and selection, product design, manufacturing processes, distribution of final products to customers, and disposal of expired products (Srivastava, 2007). Due to consumer demands and legal requirements, monitoring and evaluating environmental management represents the initial stage of GSCM, which results in the adoption of proactive measures involving several reverse activities such as refurbishment, recycling, reworking, reuse and remanufacturing (Ali and Haseeb, 2019).

### A. Process Innovation

Process innovation refers to the implementation of a new or significantly improved production or delivery method in order to increase (=enhance) productivity.

It gives the firm an overall cost advantage over its competitors, allowing it to achieve a higher margin rate. This process includes significant changes in techniques, equipment and/or software (Adams et al., 2016). Cleaner production is an example of process innovation for environmental sustainability. In this context, Hullova et al. (2016) investigated the dynamics beyond the introduction of two forms of innovation by studying cases where cost-reducing innovation requires the development of new products, while the introduction of a new product necessitates changes in the manufacturing process.

### B. Lean practices

Lean practices (LP) have been adopted by many manufacturing and service companies to reduce waste without sacrificing quality or performance. There is a growing interest in linking Lean practices with the environment (Martínez-Jurado and Moyano-Fuentes, 2014). LP is economically and environmentally focused because, philosophically speaking, Lean focuses on reducing waste by optimizing resources across the organizational value chain. However, the environmental and social

sustainability may not be fully achieved even if Lean focused on economy, as some environmental and social practices can be costly (Inman and Green, 2018).

Previous work has successfully linked LP with sustainability (Martinez-Jurado and Moyono-Fuentes, 2014). LP facilitate the adoption of green manufacturing principles and improve the environmental performance of numerous manufacturing firms (Piercy and Rich, 2015). Even though LP contribute to environmental sustainability (Vinodh et al., 2011), the results are still inconclusive, as both positive (King and lenox, 2001) and negative (Rothenberg et al., 2001) relationships exist. In addition, the relationship between LP and social management is also inconclusive.

### C. *Lean/sustainable production practices*

The production process is critical to maintain a balance in the development of commodities. This process can be made more resilient using improved technologies (Meera and Chitramani, 2016). Choosing a cleaner production method allows organizations to reduce the number of toxic materials released during the process. However, due to a variety of challenges, it is hard to implement this method. Organizations are often unaware of these technological breakthroughs, the application of which can lead to greater efficiency in their production operations in terms of environmental protection (Yu et al., 2019). In addition, cleaner production methods contribute to financial, social, and environmental sustainability (Bhandari et al., 2019). Therefore, technology adoption for cleaner production plays a key role in facilitating the deployment of Green Supply Chain Management. In both research and practice, sustainable production is a much-debated topic (Taisch et al., 2014). Current trends show the way to ensure sustainable production: laws emphasizing social responsibility, local economic dynamics, and consumers increasingly interested in purchasing products and services linked to economically feasible as well as socially and environmentally responsible methods (Faccio et al., 2020). Businesses should use sustainable production to improve performance while reducing environmental damage and promoting social solidarity in the future (Kleindorfer et al., 2005).

### D. *Sustainability performance*

Firms have difficulties in maintaining their economic, environmental, and social performance due to this pressure (Zailani et al., 2015). A company's sustainability performance must establish a strong relationship between economic, environmental and social performance in order to build a sustainable competitive advantage (Thoo et al., 2013). Organizational sustainability consists of three major parts, namely economic performance, environmental performance and social performance (Shrivastava, and Shrivastava, 2016).

Sustainability performance investigates different issues, such as examining the potential negative effects of economic transactions on the environment in both developing and developed countries (Koo et al., 2014); meeting the social well-being as defined by Maslow's hierarchy of needs (Seth et al., 2016); and ensuring the conservation of natural resources, both renewable and nonrenewable, to meet and preserve the needs of future generations (Koo et al., 2014). Previous research has suggested that organizational sustainability lies at the intersection of economic, environmental, and social performance (Shrivastava, and Shrivastava, 2016). This view is consistent with Elkington's (1998) concept of triple bottom line. Therefore, in this study, sustainability performance is examined from three perspectives. The definitions of sustainability performance concepts are as follows. Sustainability performance refers to the intersection of economic, environmental, and social elements (Carter and Rogers (2008), Paulraj (2011); Foerstl et al. (2015); Montabon et al. (2016); Schmidt et al. (2017).)

#### Mobilization theory

Dynamic capability theory: A dynamic capability is defined as "the ability of an organization to integrate, build, and reconfigure internal and external competencies to cope with rapidly changing environments" (Teece et al., 1997). It is also integrated as a process, or a set of processes related to resource management (Eisenhardt & Martin, 2000).

From a dynamic capability's perspective, Teece (2007) noted that continuous learning supports the development of concurrent and subsequent innovations, and the development of concurrent and prior capabilities facilitates the development of additional competencies. Dynamic capabilities theory is an extension of the resource-based worldview (RBV). The latter focuses on resource selection, whereas dynamic capabilities concentrate on resource development and renewal. In this respect, Hitt et al (2016) explain how physical and intangible resources are pooled to create capabilities. Dynamic capability theory is also integrated into RBV to show how to gain a competitive advantage in the supply chain (Squire et al 2009).

Supply chain dynamic capability, based on dynamic capability theory, is able to adjust the supply chain. It is a new and popular concept in recent years, but its substance is difficult to grasp (Defee and Fugate., 2010).

According to Kirci and Seifert (2016), dynamic capabilities serve as the foundation of a long-term competitive advantage in Supply Chain Management (SCM) for companies. Since SCM is coupled with the dynamic capability theory, it is important to study the long-term supply chain development based on the aforementioned theory.

Dynamic capabilities contribute to maintaining high performance by adjusting the mix of resources to gain and maintain a competitive advantage (Teece et al., 1997). As a result, they can maintain a high level of performance over an extended period of time (Bititci et al., 2011). This high level of performance can then be translated into financial benefits (Hohenstein et al., 2015).

### III. DYNAMIC CAPACITY THEORY

#### IV. THE RELATIONSHIP BETWEEN VARIABLES

We will examine the relationship between many factors in our research after reviewing the related literature in the first section. In this vein, we will investigate the effect of Lean practices on the dependent variable, the effect of production practices on sustainability performance, the effect of process innovation on sustainability performance, the mediating effect of process innovations and sustainability practices on sustainability performance, and the effect of production practices on Lean practices and sustainability performance, by taking into account the theoretical background and references.

##### Lean practice and sustainability performance

Organizations working on integrated practices have used Lean practices in various industries to improve efficiency and competitiveness. Several benefits of Green supply chain management (GSCM) have been reported in the literature. These benefits can be derived from the diffusion of Lean practices (Viles et al., 2021).

Ikumapayi et al. (2020) point out that the next step in waste management productivity consists in promoting and motivating waste generators to minimize GSCM and improve overall socioeconomic circumstances.

Variable outcomes can be attributed to a variety of factors, including data used in the analysis part and the definitions of operational performance. In our study, we define the benefits of GSCM as positive economic improvements, such as reduced material costs and reduced energy consumption costs. We also define the associated negative economic outcomes, like increased investment, increased operational costs, increased training costs, and high costs of environmentally friendly materials. Unlike previous studies, this data focuses on economic and financial performance indicators that are more operational in nature, than overall company performance indicators, such as stock price, market share, return on assets, and return on investment.

##### *E. The adoption of Lean Practices by SME Leaders*

Adopting Lean Practices Leads to Better Resource Utilization or Additional Cost

- LP focus on resource efficiency and waste reduction.
- Lean methods as environmental and social practices can be costly.

However, we hypothesize the following:

- H 1a: Lean practices improve the sustainability performance of SMEs.

##### The impact of lean production practices on supply chain performance

An audit method is used to evaluate the implementation of production practices in the production cell. It is a systematic, independent, and documented procedure for collecting evidences and evaluating them objectively to determine the extent to which audit criteria are met (Chiesa et al., 1996).

Lean manufacturing, based on the principles and processes of the Toyota Production System (Powell et al., 2013), is one of the most powerful improvement approaches that aim at providing manufacturers with a new competitive advantage. Shah and Ward (2007) view lean manufacturing as an integrated socio-technical system that strives to eliminate waste by simultaneously reducing or minimizing supplier, customer, and internal variability.

The main thrust of Lean manufacturing is that these practices can work together to reduce waste in the organization, optimize core resources, and build a corporate culture to identify and implement not only lean manufacturing strategies that promote customer satisfaction (Chiaranza, 2003), but also customer satisfaction strategies (Karim and Arif-Uz-Zaman 2013). Lean production has been designed and



validated by large companies, resulting in a significant increase in production capacity and performance. (Belhadi, Touriki, and El Fezazi , 2017)

- H1b: GSCM production practices have a positive relationship with sustainability performance.

#### *F. The effect of process innovation on GSCM performance*

Based on the literature, there is broad agreement on the favorable impact of process innovation on several forms of performance, including customer satisfaction, operational performance, financial performance and competitive advantage (Brem et al., 2016).

Process innovation refers to the improvement of existing processes and/or the development of new processes that use environmentally friendly technologies or production equipment to avoid or reduce harm to the Environmental Public Health and Consumer Protection Commission (Orsato, R.J 2006).

The ability to implement process innovations is considered as a dynamic capability since process innovations are changing the way of doing things in the firm (Macher and Mowery, 2009).

The adoption of process innovations, on the other hand, encompasses all firm activities related to the recognition of a potentially beneficial innovation, the decision to be adopted and its incorporation into the firm's operating procedures.

#### *G. The perception of process innovation by SME managers*

Process innovation should contribute to the synergy between competitive strategies and supply chain strategies:

Process innovation must satisfy customers at optimum costs of quality.

Process innovation must promote the achievement of environmental and social objectives.

It would therefore be useful to know how SME managers perceive the relationship between PI and SP:

H2a. Process innovation helps SMEs improve PS.

H2b. Process innovation mediates the relationship between SGMC production practices and sustainability performance, and examines the combined effect of lean/green practices and process innovation on GSC performance.

The major findings of this study reveal that process innovation does not have a direct positive effect on green supply chain performance. However, other results show that process innovation has an "amplifying" effect, which contributes to SCI and green practices. In fact, it provides a higher rate of return on green supply chain performance when combined with process innovation activities.

#### *H. As a result, this work demonstrated a positive synergistic effect between process innovation and LM/green practices,*

in which the former reinforces the latter. Based on the literature, there have been no previous studies on the relationship between process innovation and LM/green practices and their potential impact on performance. Thus, it is impossible to demonstrate an alignment or misalignment of these results using an academic theory. However, as LM has already been shown to stimulate innovation, including process innovation (He et al, 2015), the synergistic beneficial effect of process innovation and Lean/green practices on CSG performance can be perceived in this study based on that theory. LM and green practices may be interchangeable and transferable across companies and supply chains due to their nature and current maturity. Yet, the advantages (=assets) of LM and green practices can be enhanced when implemented in a company's operations in a novel way.

The adoption of sustainability practices by leaders includes several dimensions:

Economic dimension

Environmental dimension

Social dimension

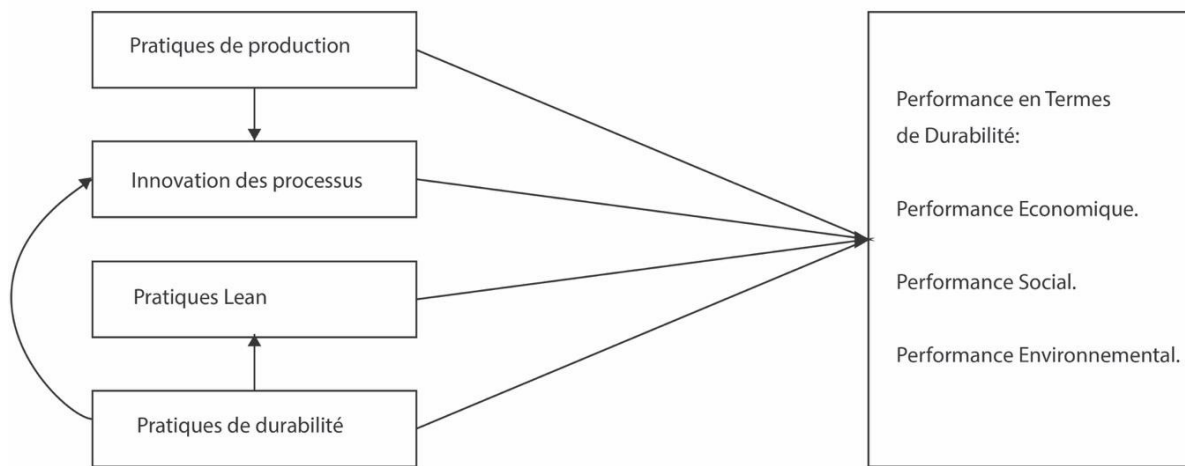
Therefore, in addition to testing the relationship between LP, PI and SP, the impact of SP on SP is also studied.

Hypothesis 3a: Sustainability practices improve the sustainability performance of SMEs.

Hypothesis 3b: Sustainability practices improve the sustainability performance of SMEs through the mediating effects of LP.

Hypothesis 3c: Sustainability practices enhance sustainability performance of SME through IP mediation effects.

We propose our research model based on the theoretical foundation established earlier based on our literature review:



THE CONCEPTUAL MODEL. (IN THE FIGURE: PRODUCTION PRACTICES, PROCESS INNOVATION, LEAN PRACTICES, SUSTAINABILITY PRACTICES, SUSTAINABILITY PERFORMANCE, ECONOMIC PERFORMANCE, SOCIAL PERFORMANCE, ENVIRONMENTAL PERFORMANCE)

#### V. RESEARCH METHODOLOGY

The present paper adopts a hypothetico-deductive method based on epistemological positioning as well as an adequate post-positivist posture. We also apply a hybrid research method (based on both mixed-qualitative and quantitative approaches). In this respect, we use two qualitative studies based on an interview. Out of 46 SMEs, a quantitative study is also utilized based on a survey (a questionnaire). We implement the AMOS software for data analysis.

#### *Theoretical contributions*

First, one of the major principles of Lean and green supply chain management is continuous improvement. To satisfy consumers' needs and reduce their impact on the environment, companies must continually seek ways to improve their operations. Second, the green supply chain requires sustainable practices, such as adopting clean technologies and ethical behaviors to minimize environmental impacts. Third, social responsibility is closely linked to lean management and green supply chain. Companies are responsible for reducing their impact on the environment while meeting their consumers' demands.

Finally, cost reduction is one of the major advantages of lean management and green supply chain. Companies can increase their profits by preserving the environment and maximizing available resources.

#### *Managerial implications*

First, it is important to adopt a customer-centric approach. In fact, Lean focuses on improving customer satisfaction through the continuous management of quality and manufacturing costs, while green supply chain aims to reduce carbon emissions and environmental impacts. Both methods prioritize the consumer. Second, the primary purpose of lean and green supply chain management is to eliminate all waste and inefficiencies in manufacturing and distribution operations. Thus, production costs are minimized, while available resources are optimized. Third, due to the complexity of the green supply chain, collaboration and partnerships are essential. To reduce carbon emissions and limit environmental impacts, companies must be able to collaborate. Finally, lean management and green supply chain require rapid adaptation to change. Companies must be able to quickly adapt to meet changing customer needs and deal with unexpected changes.

#### VI. CONCLUSION

The successful integration of green and lean practices into the corporate supply chain requires a comprehensive understanding to determine the set of practices that contribute most to the improvement of each component of sustainable performance. This is the main purpose of this research paper, which reviewed the existing literature in lean and green supply chain management. This study is important and relevant to other scientists in the same field because it has identified and classified the most salient green and lean practices associated with the upstream, internal and downstream supply chain. The proposed model will fill the gap in previous studies and highlight the combined effect of different variables to achieve sustainability performance.

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