EFFECTS OF DYNAMIC CAPABILITIES ON FRUGAL INNOVATION: A CONCEPTUAL FRAMEWORK FOR SUSTAINABLE SUPPLY CHAIN APPLICATION

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Abstract
Recently, supply chain operations have been influenced by three concepts such as sustainable supply chain, dynamic capabilities, and disruptive innovation. First, sustainability has become a necessary goal for businesses and a powerful strategy for competitive advantage. Sustainable innovations along the supply chain are increasingly important regarding firm competitiveness to respond to rapid changes in the market. Secondly, disruptive innovations are particularly adopted by firms, because they aim to provide product or process to a new set of customers (or customers with new sets of requirements). Big data and predictive analytics are one of them and may have the ability to generate considerably more business and social value while significantly reducing the use of scarce resources. This disruptive innovation could improve the ability to help with the sustainability of sourcing decisions, and reduce environmental footprint are increasingly recognized. Thirdly, developing dynamic capabilities such as absorptive capacity both in firms and in supply chains are also integral to responding to dynamic markets and customer needs. Dynamic capabilities are collective resources (financial and technical assets coordinated with knowledge and competencies) which are essentially change-oriented, helping firms redeploy and reconfigure. Any innovation (whether process or product oriented) must then rely on such capabilities. The main objective of this paper is to develop a conceptual framework through a literature review, to identify the features of disruptive innovations applied to the sustainable supply chain, and to analyze the role of dynamic capabilities. We will focus on how certain dynamic capabilities such as absorptive capacity affect the impact of the utilization of big data analytics on sustainable supply chain on frugal processes, which has not been investigated in depth.

Keywords:
Dynamic capabilities, absorptive capacity, sustainable supply chain innovation, disruptive innovations, frugal innovation, big data and predictive analytics.

1 INTRODUCTION
Companies are constantly facing to do more with less. The pressure to reduce costs while at the same time enhancing performance is a consistent trend today. These challenges are crushing the profit margins and creating headaches for supply chain manager and organizations as well. Added to this, a significant number of consumer goods firms and retail leaders also indicated the importance of sustainability in their plans through transparency and environmental considerations [1].

These challenges are the motor of interest of this work, and we think that researchers and practitioners should work together through collaboration to seek and invest in sustainable and innovative solutions.

The aim of this research is to explore how disruptive innovations can affect supply chain sustainability. Our inquiry is driven first by a systematic review of pertinent literature so that the existing body of knowledge in this area can be identified. Through a comprehensive analysis of the literature, salient theoretical constructs/variables that conceptually define the concepts and business practices of the sustainable supply chain (SSCM) are identified.

To knuckle down this academic approach, we have been allowed to develop through a literature review and a conceptual framework that will help us to identify the main features and to explore definitions of the concepts involved.

2 LITERATURE REVIEW

2.1 Sustainability and the supply chain perspective
In 1987, the World Commission on Economic Development promoted the term ‘sustainable development’ in its well refers report as: “a development that meets the needs, of the present without compromising the ability of future generations to meet their needs [2].” This commission affirmed that sustainable development required the simultaneous adoption of environmental, economic, and equity principles. Unfortunately, the macroeconomic, societal definition of sustainability is difficult for organizations. The application of this provides little guidance regarding how organizations might identify future versus present needs. The determination of technologies and resources will be necessary to understand the effective balance between organizational responsibilities and the multiple stakeholders such as shareholders, employees, other organizations in the supply chain, and broader stakeholders including society and the natural environment [3].

On the contrary, the organizational definitions of sustainability in the engineering literature have been more encompassing, and have explicitly incorporated the social, environmental, and economic dimensions of the macro point of view. In this manner, its define organizational sustainability as, “a wise balance among economic development, environmental stewardship, and social equity”[4].

There is a growing need for integrating environmentally sound choices into supply-chain management.

Reviews on sustainability in a supply chain or operational context have largely centered on a broad and strategic overview. The authors [5] define SSCM: “as the management of material, information, and capital flow as well as cooperation among companies along the supply chain while taking goals from all three dimensions of sustainable development, i.e., economic, environmental and social into account which are derived from customer and stakeholder requirements.” Strictly speaking, to meet the requirement of sustainability practices in the supply chain, a company must be able to comply with the triple bottom line that was mentioned above. However, it is
important to stress here that in the SSCM literature fails to capture all the three aspects. SSCM until now has primarily focused just on economic and environmental aspects, and there is an under-explored around the social and human aspect of sustainability that’s need to be explored in depth [5][6][7].

2.2 Disruptive Innovation:
A disruptive innovation is an innovation that creates a new market and value network and eventually disrupts an existing market and value network, displacing established market leading firms, products, and alliances.

According to [8] the criterion of newness demonstrates that innovations involve the following four aspects:

- **Sciences/technology:** as well as the state of the knowledge in physics and the behavioral sciences. In other words, it refers to changes in technological principles (e.g. Big Data and Predictive Analytics) embedded in an innovation [8]–[10]. This aspect can take either micro/macro perspective.

- **Organizational:** aspect assesses the changes that are required within a company to accommodate and innovation. As a result, this aspect measures how well the organization's capabilities manage innovation and the changes related to the product, the service or the process and the structure itself [9], [11], [12]. This aspect is limited to the microsphere because it refers just to a company-wide level.

- **Environmental/social:** This aspect takes macro-sphere because it refers to changes that innovations may produce in a company's environment [10], such as suppliers and competitors. In this aspect, behavioral and attitudinal changes of individuals outside the firm are considered as well as regulatory and infrastructure changes [13].

- **Market aspects** refer to an alteration of the benefits of innovation as perceived by other companies, consumers and customers [8], [11], [13]. This aspect can take either micro/macro perspective.

Some researchers differentiate on the following typologies [14]–[17]:

- **Product/Service Innovation:** The restoration and elongation of the spectrum of products (e.g. Tile, Cricet Bracelet) or services (e.g. Apple pay, Amazon dash) and the related markets.

- **Process innovation:** Also known as a maker movement [18], is the endowment of new methods of manufacturing, sourcing, and distribution (e.g. Frugal Innovation and Additive Manufacturing).

- **Business Models Innovation:** Is about fundamentally rethinking your business around a customer need, and then realigning your resources, processes and profit formula with this new value proposition (e.g. Dell's innovation of a new distribution model by allowing online customization that capitalized on improving internet technology).

- **Organizational Innovation:** Is the introduction of changes in work organization managerial practices, employee competencies (e.g. Platform Disruption).

2.3 Cutting Edge Technologies: Big Data and Predictive Analytics

Big Data and Predictive Analytics (BDPA), defined as: “a holistic approach to manage, process and analyze data in terms of high volume, variety, velocity and value in order to create actionable insights for sustained value, delivery, measuring performance and establishing competitive advantages [19], [20].” It has emerged as both a strategic and operational tool that may bring fundamental changes to supply chain sustainability and innovation [21]–[24]. Big data and predictive analytics are one of the fastest evolving fields due to the convergence of Internet of Things (IoT), cloud computing, and fast-cycling mobile devices [25]. As stated by [14], [26], advances in information technology enabled the supply chain revolution. Nowadays, data is so easy to collect (e.g., RFID, barcodes, loyalty cards) and low-cost to stores, that big data is enabling a new source of customer intimacy and competitive advantage.

Big data and predictive analytics would be an opportunity to knock down some challenges that industry is facing (e.g. improve customer experience, making sense of large amounts of unused business data, improve inaccurate or misleading revenue forecast and models, focus on micro decisions, etc.). These shows big data and predictive analytics practical, relevant value. Moreover, some researchers can easily see how big data and predictive analytics apply to SCM but sometimes find it more difficult to serve the direct connection of big data to SCM [22]. Through these considerations, we were able to confirm existing literature mentioning studies that give broad guidelines of IT as an enabler of frugal innovation. The model presented is an innovation-based and not firm performance-based [27]. Similarly, there is a link between big data and predictive analytics for supply chain and organizational performances but is missing studies in data connectivity, and information sharing, as well as the assimilation as a capability that impact on supply chain performances and organizational performances [24]–[28].

2.4 Force Breaking the Trends: Frugal Innovation

New technologies and trends are emerging that will change the sustainable chain design and management. As part of this analysis, we explore frugal innovation that is a maker movement and represents potential changes in the sustainable supply chain design. According to [29], frugal innovation integrates the specific needs of the bottom of the pyramid markets as a starting point and works backward to develop solutions, which often end up very different from existing solutions in developed markets. As such, frugal innovations involve not only new technologies but also innovative ways of altering traditional value creation and capture mechanism through value chain elements reconfiguration, reshaping business models, reengineered products, and services, the inclusion of poor into the economic markets and extreme focus on affordability constraints. Initially, [30] used the term disruptive technology, then extended the concept to disruptive innovation to emphasize the need for the new business model [31]. Similarly, [32] emphasize that frugal innovation is the ability to generate considerably more business and social value while significantly reducing the use of scarce resources. Frugal innovation is a strategy in which firms are being compelled by cost-conscious and eco-aware consumers, employees, and governments to create offerings that are simultaneously affordable, sustainable, and of high quality. According to [33], frugal innovation may have different impacts on sustainability. Firstly, frugal innovation has a significant social impact by offering basic services in the food, health, information and communication technology, water and transportation sectors for large markets in developing countries. Secondly, frugal innovation drives poverty reduction by opening new markets, entrepreneurial opportunities and access to global knowledge. Thirdly, the ecological impact which refers to the use of less material for both production
and maintenance and the support of local materials use is a spill-over effect. The ecological impact is mostly focused on single aspects of sustainability as restricting the uses of hazardous substances or the use of renewables. Through these considerations, we can confirm existing literature mentioning the link between sustainability and frugal innovation [34]. However, the studies give broad guidelines of performances of the firm, but it doesn’t provide any clear detail regarding the sustainable supply chain performances.

2.5 Dynamics Capabilities

Dynamic capabilities are essentially change-oriented capabilities that help firms redeploy and reconfigure their resource base to meet evolving customer demands and competitor strategies [35]. A newer source of competitive advantage in conceptualizing how firms can cope with environmental changes [36]. The dynamic capabilities framework was born out of the resource-based view of the firms [37]. According to [38], dynamic capabilities (DCs) are: “A subset of the competencies which allow the firm to create new products and processes and respond to changing market circumstances.”

The principal aim of the DCs approach is to construe the root of company’s advantage in a long-term perspective and to support managers in maintaining the company success over time [39]. Moreover, several authors have maintained the contribution of DCs to improve competitive advantages both directly and indirectly [40], [41]. Some researchers highlighted a few capabilities as an enabling factor that could foment innovation, by mentioning continuous improvement, learning, problem-solving, and product development. Further, there are studies that demonstrate the influence of Dynamic Capabilities in creating Disruptive Innovation. To demonstrate this, the author used the Innovation Lifecycle on Dynamic Capabilities [42]. Alike, there are studies that examine a DCs such as Absorptive Capacity that mediates the relationship between organizational compatibility and innovation in a relational context [43]. But despite all these studies, many large firms still fail to develop disruptive innovations due to the lack of the right capabilities to support innovation [14][42].

3 CONCEPTUAL FRAMEWORK

Our proposition is a conceptual framework that links performances and innovation. Also, these links include further elements as shown in Fig 1 below.

![Figure 1. Conceptual framework.](image)

The first element considers the drivers of the innovation [44], [45]: these are the factors that motivate the adoption of supply chain innovation and sustainability. These drivers are described for any innovation explained before as well as specifically for supply chain sustainability, and for this reason, they have been included in the conceptual framework. The identified drivers have been divided into two groups, according to the observations of [44], [45]:

a) Internal drivers: These elements encompass the personal commitment of leaders, middle management, policy entrepreneurs, and investors.
   i. Organizational Factors (e.g. investor pressure, improve quality, employee involvement, desire to reduce costs, manage economic risk)

b) External drivers: These elements involved the impact from external factors that included the following:
   i. Regulatory appears to be a strong driver for sustainable supply chain sustainability and innovation projects, particularly if companies are proactive and innovative in their approach to regulatory compliance (e.g. legislative and regulatory compliance, ISO 14000 certification).
   ii. Customers exert pressure on the organization to engage in sustainable practices (e.g. pressure by customers to SSCM, marketing pressures, collaborates with customers).
   iii. Competition as potential sustainable innovation leaders may be able to state industry norms or legal decree and so clearly have the ability to drive in sustainable innovation (e.g. gaining competitive advantage, improve firm performance).
   iv. The societal driver includes increasing public awareness, consumer demand for environmentally friendly products and services and focusing improvements on areas with the most impact. Exist a lack of research that identified suppliers as a driver. However, integration and collaboration in supply chain sustainability and innovation can support more effective sustainability issues (e.g. collaborate with supplies, supply integration)
   v. Suppliers have not been investigated in depth. These elements encompass the impact of suppliers as specifically for supply chain sustainability and innovation. These drivers are described for any innovation explained before as well as specifically for supply chain sustainability, and for this reason, they have been included in the conceptual framework. The identified drivers have been divided into two groups, according to the observations of [44], [45]:

   Figure 1. Conceptual framework.

   The second element is frugal innovation considers as a process innovation and maker movement, has been chosen because it can generate considerably more business and social value while significantly reducing the use of scarce resources. It’s about solving and even transcending the paradox of “doing more with less.” Frugal innovation is a game-changing strategy in which firms are being compelled by cost-conscious and eco-aware consumers, employees, and governments to create offerings that are simultaneously affordable, sustainable, and of high quality. Even more than a strategy, frugal innovation is a whole new mindset, a flexible approach that perceives resource constraints not as a debilitating challenge but as a growth opportunity.

   The third element considers the relevance of sustainable supply chain management. The issue of sustainability in the supply chain is gaining attention in both academic literature and industry practice as an area of opportunity. Companies across geographic and industry boundaries are implementing sustainability initiatives in the supply chain in response to pressures from consumers, regions of operation, investors, and even employees. One of the key aspects of sustainability is the holistic view that was applied in understanding the total impacts of products and services and focusing improvements on areas with the most impact. A sustainable supply chain is one that includes measures of profit and loss as well as social and environmental dimensions [46], [47]. Such
conceptualization has been referred by Elkington, 1997 to as the triple bottom line: financial, social, and environmental performance. SSCM until now has been primarily focused on economic and environmental aspects, and there is an under-explored around the social and human aspect of sustainability in business practices that have not been investigated in depth. The fourth element considers the relevance of dynamic capabilities, such as absorptive capacity which is presented by some authors, for example, [39], [48]–[51] as an enabling factor for innovation. By being an enabling factor, in this study absorptive capacity is presented as mediating factor on the relationship between disruptive innovation and the performances of sustainable supply chain inside the company. As a mentioned above, there are studies that are linking DCs with sustainable supply chain practices, and DCs influences in creating disruptive innovation [42], [52]. However, despite the fact that dynamic capabilities have received meaningful attention since [39], [40], [53], little apprehension has been dedicated to identifying which DCs can help firms in implement innovation and success.
The fifth element considers the relevance of new technologies. Advances in information technology enabled the sustainable supply chain [14][50]. Data sciences technologies such as big data and predictive analytics were chosen in the study because they are impacting many areas and are changing the rules of the game [54]. Leveraging big data with predictive analytics have proven useful because they get us closer to definitions and predictions of individual consumer behavior [55]. Understanding the uses and implications of big data and predictive analytics will be urgent as frugal innovation makes traditional models of production, distribution, and demand obsolete in some products areas. Our study to date has helped to identify some preliminary research questions that need to be addressed:

- How frugal innovation and big data analytics can be used by managers to meet internal needs and adjust the changes in sustainability?
- How will big data analytics affect sustainable supply chain design and operations on frugal companies?
- How are frugal companies complementing new technologies as big data and predictive analytics within absorptive capacity? And how do these adoptions affect their sustainable performances?

4 CONCLUSIONS
The present paper works on the potential applicability of theory in real life. In particular, the conceptual framework appears general enough to gather the main dynamic capabilities as well as the key categories and SSCM performances for the firm. Through these considerations, we were also able to confirm the link between frugal innovation, sustainability, data sciences and dynamic capabilities. As with any work, this study presents contributions and limitations. Firstly, this paper contributes to the frugal innovation literature and extends it by highlighting the role of Data Sciences in enabling frugal innovation. Secondly, it provides a theoretical base by integrating the extant literature on absorptive capacity theory, and dynamic capabilities with frugal innovation concepts. The strongest possible limitation, as well as value of the present study, concerns the adoption of mixed method approach, which allows us just to formulate propositions and not to validate or reject them. The adoption of a single case study will give us the opportunity to develop further research to either increase the sample dimension or develop an action research methodology for validating the framework in depth within a real company.

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6 REFERENCES


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