

Data-Driven Supply Chain Practice and Sustainable RMG Performance: The Mediating Roles of Organizational Agility and Eco-Efficiency Moderated by Green Absorptive Capacity

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Abstract

Amidst rapid global scaling of Bangladesh's RMG industry, achieving sustainability via effective digital transformation unlocks immense potential for accelerating SDG goal attainment progress to ensure long-term competitiveness. Grounded in the Dynamic Capabilities View and Absorptive Capacity Theory, this research examines the mechanisms where data-driven supply chain practices (DDSCP) influence sustainable RMG performance (SRP) through the mediating role of organizational agility and eco-efficiency. Employing a quantitative, cross-sectional design, data from 215 supply chain and operational managers in Bangladesh were analyzed using PLS-SEM. The findings challenge deterministic technological narratives where DDSCP directly affects SRP and is notably minimal. Instead, the true value of digitalization is realized through the significant mediating roles of organizational agility and eco-efficiency. Importantly, while Green Absorptive Capacity directly enhances sustainable performance, it does not moderate the DDSCP-SRP relationship, acting as an independent operational baseline rather than a digital synergist in this developing context. This research advances supply chain literature by demonstrating that digital tools alone are insufficient, they require agile organizational reconfiguration and rigorous eco-efficient routines to achieve sustainable excellence. These insights provide actionable strategies for manufacturers and policymakers navigating stringent global compliance paradigms.

Keywords: Data-driven supply chain, Sustainable performance, Organizational agility, Eco-efficiency, Green absorptive capacity, Dynamic capabilities, Ready-made garment (RMG) industry.

1. Introduction

1.1 Background of the Study

From ancient to modern, clothing and textiles have remained an integral part of civilization (Farhana et al., 2022). The Garment industry is anticipated to emerge from \$1.5 trillion in 2020 to \$2.25 trillion in 2025, driven by rising consumer demand worldwide (Papamichael et al., 2023). Sustainability involves providing opportunities to future generations, while Sustainable Garment Production ensures that environmental, economic, and social aspects are addressed throughout the manufacturing process (Shiju et al., 2023). By complying with environmental laws and adopting eco-friendly practices, organizations can achieve sustainable performance (Rehman et al., 2021; Ali et al., 2024). The necessity of work-intensive industries using untrained and partly trained labor in export-oriented economies in developing countries cannot be overlooked as they generate employment and play a prominent role in the equitable distribution of income (Islam, 2023). Bangladesh's RMG Industry is a prime example of this type of industry, which constitutes more than 80% of export earnings, has more than 4,600 manufacturing units, and employs 36% of production workers, representing more than 41 lakh workers (Islam, 2023). The tragic events of industrial accidents, such as the Rana Plaza and Tazrin garment factory building collapse that took more than 2,000 lives, have brought global attention, resulting in European and American buyers prioritizing structural integrity and occupational safety in their sourcing processes (Shiju et al., 2023).

Buyers' environmental requirements are seen strictly by suppliers when they are ambiguous about what is new and when it has to be done (Shumon et al., 2019). GSCM provides a strategy used for improving the environmental outcomes while maintaining economic development and sustainable practices in the supply chain process (Guha et al., 2025; Fahim et al., 2024). Industry 4.0 technologies like modular sewing, the IOT, sensor capabilities, real-time RFID tracking, SaaS ERP systems, and blockchain-based traceability offer great potential in improving product quality, regulatory compliance, and sustainability performance (Islam & Halim, 2022; Mim et al., 2024). Still, adoption is restricted by the inadequate infrastructure, financial adequacy and shortage of skilled workforce (Papamichael et al., 2023; Rafid et al., 2025)

Regardless of progress, the sustainability journey of the RMG sector is fraught with difficulties, including environmental demands from buyers, inadequate infrastructure, and a shortage of skilled workers (Rafid et al., 2025; Shumon et al., 2019). The rising buyer standards and escalating regulatory pressures have made significant variation in supply chain operations inevitable (Shumon et al., 2019; Papamichael et al., 2023).

A key part of this transformation is the understanding that sustainability cannot be realized with single-minded interventions. Data-driven supply chain practices, containing real-time tracking, information integration and advanced analytics, have become essential enablers (Islam & Halim, 2022; Mim et al., 2024); however, their impact is dependent on organizational capability to use data to make conscious decision-making and improvement (Rafid et al., 2025). For sustainable performance in RMG industries, three interrelated aspects are considered, which are environmental stewardship, economic viability, and social responsibility (Shiju et al., 2023). Compliance with the eco-based rules and regulations, economic competitiveness and safety and wellbeing of workers are required for achieving excellence in these dimensions (Ali et al., 2024; Rehman et al., 2021; Shiju et al., 2023). GSCM offers a strategic approach to integrate sustainability throughout the supply chain module (Fahim et al., 2024), and the ability to gather, analyze, and use information to track environmental performance and prove buyer compliance will be required (Shumon et al., 2019; Rafid et al., 2025).

Although there is an identified need for data-driven practices, there is a limited understanding of how RMG firms can convert data-driven practices into better sustainability results. However, their impact on sustainable performance relies on organization's capability to perceive environmental change, seize opportunities, and transform operations (Islam & Halim, 2022; Mim et al., 2024; Rafid et al., 2025). Organizational agility is the company's awareness to adapt to the needs of its clients and to the changes of the market, and eco-efficiency capabilities are the resource optimization, waste cut, and energy efficiency that result from the use of data. Understanding and adapting to the external environment is crucial for keeping up with new sustainability regulations (Shumon et al., 2019; Papamichael et al., 2023). The future sustainability of the RMG sector is paramount for Bangladesh, as it contributes to over 80% of export revenues and employs millions (Islam, 2023; Rahman & Al-Hasan, 2019). Effective utilization of data-driven practices is essential for the competitiveness of the sector and adapting to buyer expectations, while infrastructure gaps, financial limitations, and skilled worker shortages hinder progress (Shumon et al., 2019; Rafid et al., 2025). This study tries to highlight these challenges by examining mechanisms of how data-driven practices impact sustainable RMG performance, exploring the role of mediators, organizational agility and eco-efficiency, and providing the understanding of the relationship between DDSCP, OA, ECO and SRP within the RMG sector.

1.2 Problem Statement

In reaction to the growing pressures of modern tech integration and viability of the environment, the global Ready-Made Garments (RMG) industry is under an unprecedented influence to become more sustainable

and resilient. But there is a challenge for organizations to integrate green practices with advanced digital tools to improve adaptability of the SC (Alabdali et al., 2025; Cianciotta et al., 2026; Debnath et al., 2024). The supply chains must be rendered viable in this unstable and modest market, and this can be achieved through the process of digitalization, as claimed by Sharma et al., (2025). The task of converting sustainability action into results is significant. Literature in sustainable supply chain management suggests a positive relation between sustainable performance of the company (Cantele et al., 2023). However, companies have limited resources to devote to strategies and initiatives, and managers are faced with the dilemma of what sustainability initiatives to pursue (Cantele et al., 2023). Management practices that are implementing initiatives with green benefits have different dimensions where outcomes for the ecological and financial performance of companies (Carvalho et al., 2017; Iqbal, 2026). The study thus challenges deterministic narratives by providing examples of how digitalization does not necessarily equate to sustainability but requires adaptation to the local context and stakeholder engagement (Piispanen & Hentunen, 2026).

Underpinning this challenge is the understanding that data is not enough (Kumar et al., 2022). Although many characteristics have been discussed in previous studies, there have still not been solid sources that big data analytics can contribute to the process of making decisions to improve the overall performance of sustainable supply chain management (Tseng et al., 2019). Eco-efficiency is considered a vital measurement framework to simultaneously assess the ecological and the financial challenges of a company (Tseng et al., 2014). Zhou et al. (2021) also confirms that the increase in the level of green absorptive capacity strengthens organizations by transforming external original knowledge. This indicates that GAC is an important process that can convert external sustainability knowledge (from buyers, regulators and others) into better environmental performance. Although a wide range of practices are known to be important such as data-driven, agility, eco efficiency, and absorptive capacity, there are still significant gaps in literature. Similarly, there is a lack of a comprehensive overview of the technology execution that can guide SCs towards sustainability and make them smart (Sharma et al., 2025). This gap highlights the need to have an integrated framework that can reflect the interplay of data-driven practices and organizational capabilities.

This study addresses the following gaps by investigating three research questions:

RQ1. Does Data-Driven Supply Chain Practice (DDSCP) have a direct positive impact on Sustainable RMG Performance (SRP)?

RQ2. Do Organizational Agility and Eco-Efficiency mediate the connection between DDSCP and SRP?

RQ3. Does Green Absorptive Capacity moderate the direct connection between DDSCP and SRP, strengthening the positive effect when capacity is high?

2. Literature Review and Theoretical Underpinning

2.1 Theoretical Underpinning

2.1.1 Dynamic Capabilities View (DCV)

DCV offers a powerful theoretical perspective to comprehend how organizations build and maintain their competitive advantages in dynamic environments. DCV pertains to a firm's ability to create, absorb, and recombine the skills in response to the rapid environmental changes (Dangelico et al., 2017; Teece et al., 1997). Dynamic capabilities (DC) are needed for a firm to adjust to digital opportunities and changes in consumer demand and are not easily replicable, thus providing a main source of competitive advantage (Teece, 2007). Teece (2007) identified three key activities that constitute the micro foundations of dynamic capabilities: perceiving opportunities and threats, shaping or capturing opportunities and retaining competitiveness through reconfiguration and conversion of the resource base (Hong et al., 2018; Kırıcı & Seifert, 2015). DC was also defined by Wu et al. (2013, p. 256) as a “special kind of organizational capabilities that enable firms to systematically sense and seize sustainable development opportunities from the rapidly changing stakeholders’ expectations, so as to simultaneously achieve economic, environmental and social benefit.”

The use of DCV for supply chain management has become quite famous, especially when in a dynamic business environment, internationalization, computerization, and prompt product introduction, as well as calamities, require higher capabilities from the supply chains (Hong et al., 2018). Consequently, employing the DCV and building supply chain capabilities with the help of supply chain partners has started to gain ground in a commercial environment where supply chains rival with one other (Defee & Fugate, 2010). The present study falls in the stream of literature which views agility as a capability, which enables the organization to build or combine and reorganize the capabilities associated with efficiency and effectiveness (Aslam et al., 2018; Baškarada & Koronios, 2018). In this theoretical context, the Data-Driven Supply Chain Practice (DDSCP) and OA can be defined as dynamic capabilities that help businesses to perceive, understand and respond to the changes in the environment, exploit new opportunities, and restructure resources to ensure viability of performance in Ready-Made Garment (RMG) sector which is very volatile.

This conceptualization serves as a basic starting point to study the interplay between data-driven practices and agility to foster sustainable results in the dynamic market environment.

2.1.2 Absorptive Capacity Theory (ACT)

Absorptive capacity (AC) inception is in a paper published by Cohen and Levinthal (1990) who define it more from the foundation of what a firm can do “to recognize the value of new information, assimilate it, and apply it to commercial ends”. Zahra and George (2002) also recognized two different dimensions of potential AC (acquisition & assimilation) and two other realized AC (transformation & exploitation), where acquisition is the firm's ability to identify and acquire knowledge from a foreign source. GAC is an enterprise capacity to acquire, assimilate, transform and leverage environmentally friendly knowledge for creation of value in the green-based view (Chen et al., 2014). The concept serves as an important component in the process of fusing, transferring and employing an outer source of knowledge (Cohen et al., 1990). The GAC enables businesses to gain access to external environmental knowledge that influences internal knowledge to improve the innovation results (Mo et al., 2022). Externally, environmental characteristics and changes act as activation triggers (Zahra & George, 2002) that impact organizations' ACAPs; thus, the ability to first absorb and then apply green knowledge is essential for sustainability-challenged firms.

The implications of absorptive capacity are not limited to organizational outcomes but also extend to supply chain and sustainability situations. To substantiate this perspective, Alkalha et al. (2019) showed that the importance of AC is significant in progressing the overall supply chain performance. Companies with a highly developed AC bend to implement green technologies and green practices more efficiently, which helps in the implementation of GSCM (Albort-Morant et al., 2018). Additionally, the implementation of sustainability values can enhance the sustainable performance of organizations, and the standards are based on ACAP (Saenz et al., 2014). Based on this theoretical foundation, GAC is therefore a key organizational capability to identify, absorb and leverage green external knowledge. For the Ready-Made Garment sector, GAC involves the internalization of external environmental knowledge, collection of both internal and external environmental knowledge and utilization of the combined environmental knowledge for sustainable performance outcomes. In a context where the demand for greener practices in the apparel sector is growing in terms of regulations and stakeholders' requirements, the capability to implement and collect green knowledge is especially crucial.

2.2 Data-Driven Supply Chain Practice (DDSCP)

In the era of information, DDSCP has become a game changer that empowers organizations to use the immense power of data and information for strategic decision-making. The concepts of '5V's' have been used to describe large data in the following way: large amount of data, several resources and layouts of data, Regularity of data generation, trust and reliability of data from several data sources and economical value produced from data (Fosso Wamba et al., 2015). Businesses with an infrastructure that can handle big data can transform the performance of the overall supply chain (Waller & Fawcett, 2013). The data-driven supply chain positively influences information-sharing capabilities, managing, activity execution and openness throughout the supply chain (Wei et al., 2020). Moreover, it has been observed that Big Data Analytics is improving the performance of the business value chain affiliating with the three pillars of sustainable development as per the UN which are Environment, Economy, and Social (Raut et al., 2019; Waller & Fawcett, 2013).

Furthermore, DDSCP involves a complex technological setup and demands inter-organizational information sharing. For example, RFID technology allows identification and tracking of products and can produce huge amounts of operational and even strategic data throughout the supply chain module. Nevertheless, attaining efficacy and productivity improvements in the supply chain requires data from various operational areas of an organization and with various supply chain partners (Yu, 2015). For instance, each manufacturer in the supply chain could have a better demand prediction and supply planning process utilizing their own information, as well as information from suppliers and customers, including information about raw materials, deliveries, promotions, and inventories (Chavez et al., 2017).

2.3 Sustainable RMG Performance (SRP)

For RMG, sustainable performance is defined as the triple-bottom-line (TBL) which represents social, environmental and financial indicators of organizational performance (Slaper & Hall, 2011). The TBL approach is based on the economic boom, environmental quality and social equity aspects (Elkington & Rowlands, 1999; Nogueira et al., 2025) and sustainable performance is an integrated result. SP considers the perspectives of multiple parties including the shareholders or interest groups, and you need a 3-dimensional measurement to take them into account (Mamun & Rabby, 2025; Le, 2022). Environmental performance is a measure of the manufacturing plants' ability to reduce air pollutants, effluent waste and solid waste and to reduce the use of dangerous and toxic materials (Zhu et al., 2008). The ability of the production plant to reduce the cost of purchased raw materials, energy consumption, waste processing, waste disposal and environmental incident fines can be linked to the economic performance (Zhu et al., 2008). Social performance provides social responsibility (Blomgren, 2011; Fuzi et al., 2013; Rupa & Saif, 2022), social

risk reduction, maximization of social wealth, and local community involvement, while also increasing the quality of the workforce and social responsibility.

The idea of achieving sustainable performance is especially relevant in the case of the Bangladeshi RMG sector after the various incidents that happened in that industry. Following the event of Rana Plaza collapse, there are calls for government ruling in production, workplace safety and security matters in the apparel sector of Bangladesh (Islam et al., 2026). Despite significant progress in transparency, manufacturing safety, and accountability of the value chain, knowledge is still lacking about how to restructure the RMG sector sustainably (Fahim et al., 2024). The connection between each sustainable performance dimension is interlinked so optimizing or improvising one would make the other performance measure better (Ivanov, 2022; Shah et al., 2026). This implies that improved environmental performance can lead to improvements in economic performance by reducing costs, and social performance can increase brand value and the trust of stakeholders, which can in turn support to overall sustainable performance in the RMG sector.

2.4 Organizational Agility (OA)

In today's world of volatile, turbulent and uncertain competitive environments (VUCA), organizational agility (OA) has become an important capability of organizations (Walter, 2021). OA can be referred to as capacity to withstand turbulence and to prosper through the business opportunities that exist in the organization (Lu & Ramamurthy, 2011; Mikalef & Pateli, 2017). OA means the capacity to 'seize and sense' threats and opportunities quickly, easily and dexterously (Tallon & Pinsonneault, 2011). Prior literature indicates that companies that can respond swiftly and creatively to transform in their business eco systems have been able to enhance their overall performance (Ferrier, 2001; Overby et al., 2006) and react to the change. One of the key ideas of OA is that the business can quickly reconfigure to structure a new product and bring it to market (Wang et al., 2014; Irfan et al., 2019; Wheeler, 2002).

However, for organizational agility there are various dimensions that allow an organization do well in a dynamic and unpredictable environment. The key abilities of a dynamic organisation are responsiveness, competence, flexibility and speed (Zhang & Sharifi, 2000). Rapidity, initiative, reactivity, flexibility, cooperation, adaptability, and technology and information systems are the dimensions of OA (Zhang, 2011). Flexibility is process driven and concerned with operational change competencies, while agility is strategic and is about the process of rapidly sensing and responding to external stimuli (Fayezi et al., 2017). From an SCM perspective, agility refers to companies can recognize changes in the market, reconfigure their supply chain activities, and respond to disruption effectively. Agility, as a dynamic capability that involves sensing, responsiveness, and strategic flexibility, is important for businesses to stay competitive in the fast-paced and

dynamic RMG industry, where shifting consumer preferences, regulatory compliance, and supply chain uncertainties require quick and effective responses.

2.5 Eco-Efficiency (ECO)

ECO has become an important concept for organizations that wish to balance their economic performance with their environmental responsibility. ECO accommodates both financial and ecological aspects and can unify the conveniences of the environment to increase the assets quality and environmental system (Shubin et al., 2017; Jonkman et al., 2019). ECO is an index that is usually applied to efficiency improvements in relation to a particular product, sector or city and is defined as an apportion of the economic output to the environment (Bian et al., 2020). Zhang et al. (2008) recognized ECO as the economically value-added ration with the ecological impacts. Koskela and Vehmas (2012) listed five classifications of definitions of eco-efficiency. The first one is an issue of 'more from less', that is, more physical output with less resource use (Patwary & Rabby, 2025). The following two types, in chronological order, look at ECO as a relationship between the economic output and the environmental output in terms of productivity or intensity. The fourth definition introduces ECO as a management approach, and the fifth definition offers specific instructions for enhancing eco-efficiency within a firm (Carvalho et al., 2017).

Although useful, ECO has been critiqued for its lack of highlighting social aspects of sustainable development (Ehrenfeld, 2005; Korhonen & Seager, 2008). Regardless, the social aspect is a fundamental segment that has not been embedded into eco-efficiency in day-to-day activities in sustainable development (Tseng et al., 2020). Theorizing of this activity is important, because companies try to make their operations efficient by ensuring eco-efficiency (Heikkurinen et al., 2019). This extended perspective realizes that real eco-efficiency is only achieved with cooperation throughout the entire supply chain. As stakeholders are increasingly calling for sustainable practices throughout the apparel supply chain, eco-efficiency practices, including resource optimization, waste reduction, and energy-efficient operations, are crucial for minimizing environmental impact and ensuring economic viability, especially in the Ready-Made Garment (RMG) sector.

2.6 Green Absorptive Capacity (GAC)

GAC is a key organizational capability, which facilitates companies to acquire environmental knowledge and helps them achieve their sustainable goals. GAC is a subset of a broader idea, dynamic capabilities – the ability of the organization to adapt to a changing environment. The GAC of an organization can be seen as a form of learning which results in external information and expertise being incorporated (Riikkinen et al.

2017). GAC presents a company's competence to see, understand and use external environmental or green knowledge, very important for its integration or reinforcement with the existing literature (Gluch et al., 2009). GAC is specifically the extent of identification, understanding and integration of environmental knowledge to implement sustainable innovations (Ghobakhloo et al., 2021). Ali et al. (2023); Shehzad et al. (2024); Yasir et al. (2023) suggested that high absorptive capacity firms are likely to have good performance in environmental practice. GAC can improve an organization's capacity to identify and leverage environmental information, fostering better firm performance and thus a competitive advantage based on innovation (Baquero, 2024).

GAC has been suggested to provide a green organization capability and a sense of the right direction (Qu et al., 2022). Qu et al. (2022) propose that it helps in integration and configuration of green resources and capabilities, while Ibrahim et al. (2024) show that it leads to better environmental performance. It contributes for example to the development of environmentally friendly wrapping and reconstruction processes, and to minimize the negative impact of companies' manufacturing on the environment (Qu et al., 2022). Lastly, GAC is about enhancing an organization's sustainability performance. According to the previous study, taking up green energy makes organizations aware of the environmental factors and what they can do to combat green inertia (Pacheco et al., 2018). Through this, GAC can support organizations purposefully incorporate, integrate, adapt and apply environmental knowledge to support the attainment of sustainable goals and the enhancement of overall sustainability performance of organizations in the RMG sector.

3. Hypothesis Development and Conceptual Framework

3.1 Data-Driven Supply Chain Practice and Sustainable RMG Performance

This digital age has leveraged data-oriented supply chain activities as a significant catalyst for sustainable practices by leveraging advanced digital capabilities, including big data analytics and blockchain-based systems, which have enabled the optimization of vast operations in supply chain. Technologies like these remarkably contribute to tackling the sustainability challenges in the RMG sector arising from adhering to global compliance requirements, resource-intensive production, and increased stakeholder expectations by providing firms with the ability to monitor operations continuously and implement evidence-based initiatives for sustainability across their supply chain module (Rahman et al., 2024; Al Amin & Baldacci, 2024). This data-driven prioritization technique helps in developing an eco-robust value chain framework, for instance, the blockchain technology itself enables green supply chain management frameworks that help provide immutable and real time records of sustainability related activities beginning from raw material sourcing till last stage of garment production (Al Amin & Baldacci, 2024). As per the findings of M. B. Amin et al.

(2025), the strength of initiatives taken based on structured data in supply chain, can be amplified through complementing organizational capabilities like Green HR practice, circular economic initiatives, and a culture of knowledge sharing (Tazin, 2022). Past studies have confirmed that integrating sustainable supply chain practices with dynamic organizational capabilities, supported by technological advancement and data-driven decision-making, has significantly strengthened competitive advantage among Bangladeshi RMG manufacturers, highlighting the strategic value of data-informed sustainability management (Uddin et al., 2023). Thus, a strong hypothesis can be presented in the following manner:

H1: DDSC Practice has a significant and positive effect on Sustainable RMG Performance.

3.2 Data-Driven Supply Chain Practice, Organizational Agility and Eco-Efficiency

Organizational agility is referred to as the ability of an organization to predict uncertain and unpredictable changes in the environment and adjust its resources and processes rapidly to market dynamics. Data-driven supply chain practices have become particularly important enablers in supply chain ecosystems by facilitating timely, evidence-based decision-making, information processing, and coordinated responses. Moreover, by using advanced tools and technologies such as machine learning, big data analytics, AI, and digital information systems, organizations strengthen their agility by improving responsiveness and operational flexibility (Arannya et al., 2022). Empirical evidence confirms the direct positive relationship between data analytics and supply chain agility by showing big data analytics capability (BAC) as a pivotal mechanism through which operational functions in supply chain are enhanced, which is strengthened by top management support and supply chain digitization (Hawlder, 2026). This positive connection is also agreed upon, by the dynamic capabilities' framework, on the basis of which organizations' ability to reconfigure and integrate resources both internally and externally during rough situations can be enhanced by analytically driven transformation and simultaneously support exploratory and exploitative studies to strategically respond to not only small changes but also big changes in the surroundings (Rahman et al., 2024; Munir et al., 2023). Furthermore, IT provides a technological foundation, including IT infrastructure and IT assimilation, to develop overall agility by improving communication, operational co-ordination, and processing of large amounts of information to respond to uncertain market needs smartly (Wang et al., 2024; Irfan et al., 2019). Beyond exploring technological capabilities, a strong learning organization that fosters a culture of collaboration in gathering data-driven insights and sharing that knowledge across the supply chain

network and significantly takes part in strengthening relationships among suppliers, resulting in proactive and coordinated decision-making to enhance organizational agility and corporate sustainability (Iseri et al., 2025). So, the proposed hypothesis can be:

H2: Data-Driven Supply Chain Practice positively influences Organizational Agility.

Eco-efficiency is the ability to reduce damage to the environment along with generating higher economic value through efficiently using resources, managing waste, improving recycling, and adopting sustainable operational practices in a firm (Helal et al., 2024). In supply chain management today, data-driven initiatives taken in organization's supply chain framework have surfaced above as a crucial approach, linking digital technologies, advanced analytics, and intelligent decision-making to improve activities across the supply chain network and improve activities through continuous real-time monitoring, optimizing resource consumption, measuring performance, and certifying those that promote environmental stewardship and operational efficiency, resulting in the achievement of long-term sustainability objectives amidst the large data processing challenges (Schilling & Seuring, 2023). Big-data, IoT, and AI among these digital technologies create an interconnected ecosystem to support the sustainability goals where big-data analytics play an indirect role in strengthening decision taking capability providing and processing large datasets gathered by real-time monitoring feature of the IoT and AI and finally blockchain technology that tracks progress of activity or transaction in every step of the work and thus ultimately enhancing the circular economy practices facilitating minimization of resource and energy related wastage (Riggs et al., 2023; Mrad & Belgaroui, 2025). In addition to using digital technologies, enhancing organizational capabilities also requires eco-innovative initiatives and financial and institutional mechanisms. For instance, when green finance is integrated with digital technologies, it aligns financial goals with broader environmental goals, encouraging institutions to support implementation by creating regulatory frameworks and incentives that facilitate sustainable supply chain practices (Kholaf & Tang, 2024). Although some studies show mixed environmental outcomes, in most cases the connection between data-driven supply chain practices and eco-efficiency is positive, in the sense that environmental sustainability can be achieved to some extent (Nureen et al., 2023; Siddiqi et al., 2024). Thus, based on the total discussion the proposed hypothesis is:

H3: Data-Driven Supply Chain Practice positively influences Eco-Efficiency.

3.3 Organizational Agility, Eco-Efficiency and Sustainable RMG Performance.

Organizational agility is widely considered a strategic feature of firms to rapidly anticipate environmental changes and uncertain market situations, respond effectively, and continuously adapt its resources and

processes to maintain its position. This capability is even more crucial in Bangladesh's RMG sector, where customer demand and preferences are constantly changing (Fahim et al., 2024). In addition, regulatory factors evolve because of rapid globalization. Organizations can demonstrate a higher level of agility by fostering flexibility, quicker decision-making, innovation, and responsiveness, which help them implement sustainable initiatives effectively (Kwasek et al., 2025). From the perspective of Dynamic capabilities, organizational agility, as an intermediary, links organizational resources to superior performance outcomes. Furthermore, research investigating information system (IS) capabilities identifies organizational agility as the higher-order ability fully mediating the relationship existing within information system capabilities and firm performance (Li et al., 2022; Felipe et al., 2019). This manufacturing flexibility as a core dimension of organizational agility, and by aligning it with adaptive workforce capabilities, firms can respond effectively and efficiently to environmental uncertainties, demand fluctuations, and operational disruptions, thereby contributing significantly to sustainable performance in the labor-intensive RMG sector (Khan & Kwan, 2025; Felipe et al., 2019), therefore, the proposed hypothesis is:

H4: OA positively influences Sustainable RMG Performance.

Bangladesh's RMG industry, where sustainability challenges revolve around environmental damage, pollution, excessive use of resources, and growing stakeholder expectations, sustainable practices are achieved through the implementation of eco-efficiency, which is seen to contribute fundamentally in generating higher economic value and minimizing environmental impacts by reducing waste and ensuring proper utilization of resources (M. A. Amin & Baldacci, 2025). Green supply chain management (GSCM) and circular practices strongly reflect this strong relationship between eco-efficiency and sustainable performance. In addition, numerous pieces of evidence from LEED-certified RMG organizations in Bangladesh support the view that circular practices help enhance green knowledge sharing and strengthen the likelihood of achieving sustainable outcomes and economic competitiveness (M. B. Amin et al., 2025). Additional evidence of a strong connection between eco-efficiency and sustainable performance in the RMG industry is provided by the principles of lean manufacturing, which encourage practices such as just-in-time production, continuous quality improvement, waste elimination, helping manufacturers optimize the overall production process and minimize unnecessary resource consumption (Saha et al., 2022). So far, the literature has consistently shown that eco-efficiency benefits sustainable RMG performance through efficiently using limited inputs, the reduction of unnecessary waste, and the inclusion of various eco-friendly initiatives, including circular economy practices, eco-robust supply chain strategies, blockchain-based real-time information monitoring, and transparency. In addition, learning manufacturing mechanisms and quality-focused digital transformation collectively enhances the firm's ability to deliver superior ecological,

economic, and social results. Thus, eco-efficiency is not just an objective but a strategic tool that can help companies within the RMG achieve both productivity and long-term sustainability. A strong hypothesis reflecting this relationship between eco-efficiency and sustainable RMG performance has therefore been given below:

H5: Eco-Efficiency positively influences Sustainable RMG Performance.

3.4 Organizational Agility as Mediator

Organizational resources are not enough to achieve better performance unless they are transformed into adaptive organizational capabilities that can help firms adapt to the changing environmental conditions (Islam et al., 2025). DDSC practices can be considered a primary foundation for providing real-time data, analytical capabilities, and digital intelligence to organizations, which can only ensure strong, sustainable initiative implementation by facilitating organizational agility that enables organisations to respond rapidly, in a coordinated and flexible way to satisfy stakeholder expectation in terms of economy, environmental and regulatory factors leading to improvements in sustainable performance (Usman et al., 2025). Some of the noteworthy, advanced technologies playing a role in enhancing such sustainable practices are the big data analytics, predictive analytics, and digital information systems supporting better customer integration, internal coordination, and better collaborative knowledge generation, allowing companies to quickly manage supply chain resources to boost organizational responsiveness. Prior studies show that organizational agility is a significant mediating capability that links organizational resources and sustainability outcomes by connecting SCMA and SP, enabling firms to adapt their operations quickly to the needs of environmental uncertainty and continuous change (Munir et al., 2023). Thus, agile organizations perform better in multidimensional challenges in terms of sustainability by effectively utilizing resources, managing stakeholders, and being more resilient through enhanced coordination, flexibility, and responsiveness (Meng et al., 2023). Thus, proposed hypothesis is:

H6: OA mediates the association between DDSCP and SRP.

3.5 Eco-Efficiency as Mediator

According to the RBV and DCT perspective, data-driven supply chain practices offer organization's more advanced analysis and digital intelligence for better decision making but will not necessarily result in sustainable performance. Instead, puts heavy reliance on DDSCP insights to enhance resource utilization, reduce waste and optimize environmental performance. Eco-efficiency thus plays a pivotal role as a mediating variable by which the data-driven supply chain practices can be translated into environmentally

and economically efficient performance of the RMG. Through advanced data analytics, and intelligent decision-making, data-driven supply chain practices optimize resource usage, leading to more eco-efficient operations (Piprani et al., 2023). Additionally, data-driven capabilities can have a large indirect positive impact on SRP. Big data analytics capabilities are not about making the supply chain more sustainable, but about enhancing SCM capabilities and making the transition to a circular economy easier (Mamun, 2026). These organisational capacities enhance resource efficiency, waste prevention and management of the environment, which in the end lead to sustainable performance. For this reason, eco-efficiency act as one of the key channels through which data-informed supply chain practices lead to a suite of wider sustainability results (Riggs et al., 2023).

Analytical features also enhance eco-efficiency through eco-innovation and sustainable environmental improvement. Advanced features enable organisations to perform life cycle assessments, track environmental performance, pinpoint waste opportunities and generate innovative solutions to enhance resources (Cao et al., 2022; Mrad & Belgaroui, 2025; Riggs et al., 2023). In Bangladesh RMG sector, transparency, technology incorporation, and stakeholder collaboration are found to be important aspects of eco-robust SCM strategies that can help to enhance the environmental efficiency and long-term sustainable performance. These practices help organizations track resource usage better, enforce environmental regulations, and continuously advance their sustainability operations (Amin & Baldacci, 2025). From the overall discussion, the relevant hypothesis can be:

H7: Eco-Efficiency mediates the connection between DDSCP and SRP.

3.6 Green Absorptive Capacity as Moderator

Green absorptive capacity is the capacity of a firm to identify, engage and use valuable environmental knowledge in improving environmental and business outcomes. As a dynamic ability, GAC allows companies to connect external knowledge from the environment with internal processes within the organization, leading to green innovation, sustainable learning, and continuous environmental enhancements (Asamoah et al., 2023; Kim et al., 2025). In RMG industry, where companies are undergoing pressure to meet international sustainability standards, companies having strong green absorptive capacity can make better use of environmental knowledge in formulating and applying sustainable supply chain practices. DDSCM practices therefore create a vast amount of information about resource usage, emissions, waste, supplier sustainability, and operational efficiency.

However, data is only useful for improving sustainable performance if organization's have the ability to understand and apply the data from an environmental perspective. Companies with high GAC can more effectively use data-driven insights to translate them into concrete sustainability actions, such as cleaner production processes, resource optimization, and environmentally responsible operations. (Asamoah et al., 2023). It also helps to transform data-driven insights into green innovation and eco-efficient operational practices by facilitating organizational learning and innovation, which helps businesses to leverage DDSCM practices to achieve sustainable benefits and improve their sustainability (Kim et al., 2025). In the conceptualization of dynamic capabilities, green absorptive capacity also improves organizational ambidexterity and adaptive capabilities strongly enabling companies to integrate the current know-how with the new environmental data and become more prepared to adjust to altering sustainability demands. Empirical findings in industrial and service sectors show that companies with higher levels of GAC are more likely to successfully exploit data-driven technologies to create sustainable results, suggesting that GAC can enhance the effectiveness of data-driven organizational capabilities (Kim et al., 2025; Rashid & Rasheed, 2025). So, the proposed hypothesis is:

H8: GAC significantly moderates the connection between DDSCP and SRP.

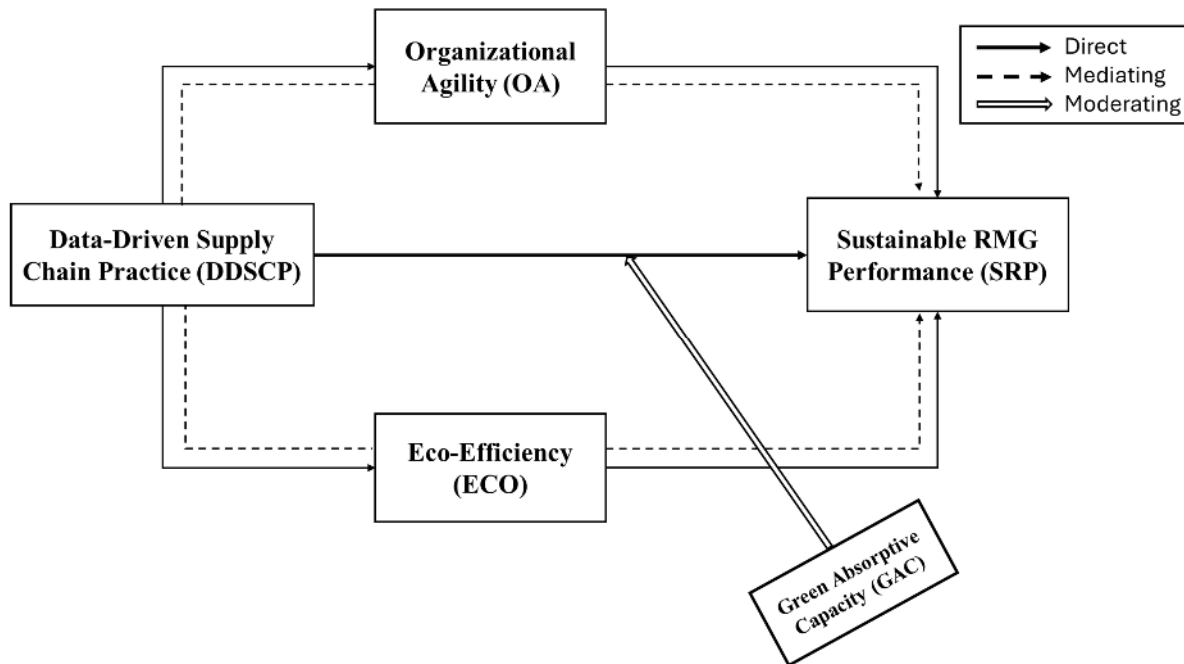
3.7 Conceptual Framework

The conceptual framework of this paper indicates all the direct relationship, mediating relationship and moderating relationship among the research variables. Using Dynamic Capabilities View and absorptive capacity theory the study tried to find out the relationship of Data-Driven Supply Chain Practice (DDSCP)

with Sustainable RMG Performance (SRP), Organizational Agility and Eco-Efficiency, Mediating role of Organizational Agility and Eco-Efficiency and the moderating effect of green absorptive capacity.

FIGURE 1: Research Framework

4. Research Methodology



4.1 Research Design

This study used a quantitative, and cross-sectional survey-based design to test relationships based on the DCV and ACT, following a deductive structure since it allows hypotheses derived from theory to be tested against structured empirical data. In addition, the study has allowed the estimation of the direct, mediating, and moderating structural paths linking DDSCP, OA, EE, GAC, and SRP. Finally, the cross-sectional design was deployed collection of data at a single point in time, to evaluate complex multivariate relationships across a representative sample of ready-made garment manufacturers in Bangladesh operating under similar conditions.

4.2 Sampling and Data Collection

A total of 215 responses were collected to analyze the data where all the responses were accurate, valid and reliable without any missing data. Considering the rule of Hair et al., (2019) for determining the sample size using 5*items rule where minimum 190 responses were required for 38 items which are above the threshold to analyze research data. The respondents consist of middle- and senior-level managers, specifically supply chain executives, operations managers, sustainability officers, and factory directors, in the export-oriented RMG sector of Bangladesh's manufacturing industry. These individuals were selected as key informants to gain direct insights into digital supply chain integration, agility, resource management, and sustainability outcomes. Since an updated, comprehensive sampling frame of all managerial staff across the industry was unavailable, and so, convenience sampling approach was implemented. To keep the dataset reliable and relevant, meet three criteria were enforced for the participants: (1) hold a current management role in supply chain, production, or environmental compliance; (2) have at least 3 years of experience in the RMG sector; and (3) serve at an enterprise that uses digital tools, automated tracking, or data platforms in its daily supply chain operations. A prospective power analysis was conducted for Structural Equation Modeling (SEM) to determine statistical accuracy of the required sample for SEM analysis (Faul et al., 2007).

4.3 Measurement Instruments

A multi-item measurement scale was developed to operationalize all the latent constructs in the conceptual model, drawing on well-established and well-designed literature, and slightly reworded to fit the context of the RMG sector in Bangladesh. A standardized five-point Likert scale was used to evaluate all responses, anchored from 1 ("Strongly Disagree") to 5 ("Strongly Agree"), providing sufficient variance to measure managerial perception while maintaining the instrument's reliability.

The independent variable, *Data-Driven Supply Chain Practices (DDSCP)* was measured using 5 items from Fosso Wamba et al. (2015), Chavez et al. (2017), and Yu et al. (2018, 2019), evaluating the extent to which real-time operational tracking, cross-functional data integration, predictive analytics, and end-to-end information sharing are utilized by the firms to support decision-making in the overall supply chain network.

Sustainable RMG Performance (SRP), which is the dependent variable in this paper, was measured as a higher-order construct that included a total of 13 items measuring economic, environmental, and social dimensions based on the concept of the Triple Bottom Line (TBL) framework taken from Zhu et al. (2008), Slaper and Hall (2011), and Islam et al. (2026) assessing factory-level cost reduction, mitigation of waste, compliance with buyers standards, workplace safety and social practices.

Moving on to the two mediating variables, *Organizational Agility (OA)* was measured using a total of 8 items adapted from Sharifi and Zhang (1999), Lu and Ramamurthy (2011), and Tallon and Pinsonneault (2011) to understand the firm's ability to sense rapid changes and make faster decisions that help in reconfiguring operational processes with speed and dexterity. Then, the items used to measure *Eco-Efficiency* totaled 7 and were adapted from Zhang et al. (2008), Koskela and Vehmas (2012), and Carvalho et al. (2017), which focused on resource usage intensity, energy conservation, material efficiency, and operational waste minimization.

Finally, for measuring the moderating variable, *Green Absorptive Capacity (GAC)*, a total of 5 items was adapted from Zahra and George (2002), Chen et al. (2014), and Qu et al. (2022).

4.4 Common Method Bias (CMB)

Since the data were collected for both independent and outcome variables simultaneously using a self-administered survey focused on a single key informant, common method bias (CMB) could be a potential source of systematic measurement error in the findings (Podsakoff et al., 2003, 2012). This risk, therefore, was handled on two fronts: through procedural design choices before distributing the survey, and through statistical checks after the data was received. In addition, psychological separation was built between the predictor, mediating, and outcome constructs by shuffling scale items and randomizing their order. To avoid confusion or biased answer patterns, a structured, standardized set of survey items, developed by industry professionals and academic experts, was implemented to avoid complex terms. Statistically, data validity was verified by running two complementary tests. The test was conducted to address the limitations of Harman's test (Harman, 1976) by using Kock's (2015) full collinearity assessment approach, which generates Variance Inflation Factors (VIFs) for every latent variable in the structural model. Every single VIF was below the 3.3 threshold, confirming common method bias and single-source contamination do not pose a serious problem for this measurement model.

5. Data Analysis and Results

5.1 Demographic Profile

The study included 215 participants, of which 65.6% were male and 57.7% held a master's degree. Most respondents (78.1%) work in large organizations with more than 2,000 employees and have significant professional experience. Furthermore, many of the participants belong to the Supply Chain/Logistics (34.9%) and Production (21.9%) departments.

TABLE 1 | Demographics

Demography	Category	Frequency	Percent (%)
Gender	Male	141	65.6
	Female	74	34.4
Education	Master's Degree	124	57.7
	Bachelor's Degree	62	28.8
	Postgraduate Diploma	23	10.7
	MPhil / PhD	4	1.9
	Not specified	2	0.9
Years of Experience	7–10 years	71	33.0
	4–6 years	49	22.8
	11–15 years	46	21.4
	1–3 years	24	11.2
	More than 15 years	23	10.7
	Not specified	2	0.9
Company Size (Employees)	More than 5000	89	41.4
	2001–5000	79	36.7
	500–2000	42	19.5
	Less than 500	5	2.3
Department	Supply Chain / Logistics	75	34.9
	Production	47	21.9

Sustainability / Compliance	44	20.5
Other	27	12.6
Management	22	10.2

Note. $N = 215$.

5.2 Measurement Model Assessment

The outer model indicates that the theoretical constructs are reliably and validly measured before evaluating structural pathways. By rigorously testing the indicator reliability, convergent validity, internal consistency, and discriminant validity, this segment confirms that the survey instrument accurately captures the intended operational realities of the surveyed RMG firms.

The constructs used in this study contributed meaningfully through understanding indicator reliability, where the outer loadings of each measurement item were examined. The range of outer loadings was from 0.726 (ECO5) to a maximum of 0.883 (DDSCP5). Because all indicator loadings exceed the minimum requirement of the 0.70 threshold. Thus, a sufficient reliability item is established for every construct within the model.

TABLE 2 | Reliability and Validity.

Variables	Items	Fac. Loa.	CA	CR	AVE
Data-driven supply chain practice	DDSCP_1	0.833	0.894	0.898	0.703
	DDSCP_2	0.841			
	DDSCP_3	0.819			
	DDSCP_4	0.815			
	DDSCP_5	0.883			
Eco-efficiency	ECO_1	0.830	0.896	0.898	0.616
	ECO_2	0.794			
	ECO_3	0.771			
	ECO_4	0.803			
	ECO_5	0.726			
	ECO_6	0.748			
	ECO_7	0.817			

Green absorptive capacity	GAC_1	0.820	0.868	0.880	0.654
	GAC_2	0.808			
	GAC_3	0.784			
	GAC_4	0.791			
	GAC_5	0.839			
Organizational agility	OA_1	0.783	0.913	0.915	0.623
	OA_2	0.855			
	OA_3	0.769			
	OA_4	0.770			
	OA_5	0.754			
	OA_6	0.840			
	OA_7	0.764			
	OA_8	0.772			
Sustainable RMG performance	SRP_1	0.801	0.947	0.947	0.610
	SRP_2	0.768			
	SRP_3	0.745			
	SRP_4	0.760			
	SRP_5	0.790			
	SRP_6	0.745			
	SRP_7	0.808			
	SRP_8	0.788			
	SRP_9	0.767			
	SRP_10	0.849			
	SRP_11	0.764			
	SRP_12	0.805			
	SRP_13	0.758			

To ensure consistent responses, the internal consistency was evaluated using the Cronbach's alpha and composite reliability (CR) to verify that the items measuring a specific construct are built based on the robust outer loading. Based on the data collection, the constructs illustrated acceptable

reliability, with CA values ranging from 0.868 for green absorptive capacity to 0.947 for the SRP. CR values showed that the datasets mirror this strength, ranging from 0.88 (GAC) to 0.947 (SRP). Since all the values tremendously exceed the baseline of the 0.70 benchmark, the model confirms that the items for each construct reliably measure the same inherent phenomenon within the RMG supply chain context.

The convergent validity of this is assessed through the AVE to verify that each construct adequately explains the variance of its respective indicators. The AVE value ranged from 0.610 for SRP to 0.703 for DDSCP. Since all AVE scores surpass 0.50 threshold, the model holds strong convergent validity, proving that the constructs illustrate a sufficient degree of indicator variance to justify the structural equation.

5.2.1 Discriminant Validity

After all the validity has been emphasized, the research finally includes each latent factor where it is empirically different from the others within the proposed framework. To understand this validity, the study used the HTMT ratio of correlations, strictly complying with the conservative threshold of $HTMT < 0.85$. As specified in table 3, the highest observer HTMT ratio was 0.822, found between organizational agility and sustainable RMG performance. All the HTMT values, including the moderation interaction terms, which ranged from 0.066 to 0.258, remained strictly below the baseline of 0.85. In addition, the Fornell-Larcker criterion square root was satisfied, meaning the square root of the AVE for each construct exceeded its highest correlation with any other latent variable in the model. Therefore, the measurement model is fully validated, confirming construct uniqueness and preparing for further analysis, inner model structure assessment.

TABLE 3 & 4 | Discriminant validity result.

HTMT	DDSCP	ECO	GAC	OA	SRP	GAC × DDSCP
DDSCP						
ECO	0.748					
GAC	0.489	0.583				
OA	0.817	0.717	0.521			

SRP	0.779	0.817	0.583	0.822		
GAC × DDSCP	0.086	0.091	0.258	0.066	0.105	
Fornell-Larcker	DDSCP	ECO	GAC	OA	SRP	GAC × DDSCP
DDSCP	0.839					
ECO	0.672	0.785				
GAC	0.435	0.522	0.809			
OA	0.741	0.651	0.470	0.789		
SRP	0.719	0.754	0.539	0.765	0.781	

5.3 Structural Model Assessment

The structural model assessment follows the validations of the measurement model and is prudently constructed to evaluate the predictive capabilities and empirical validities of the structural pathways as proposed in the study. This evaluative stage strictly examines probable correlation issues, specifies the coefficient of the determination (R^2), assesses specific effect size, (f^2), and measures predictive relevance (Q^2 predict) employing the PLS predict procedure.

5.3.1 Collinearity Assessment (VIF)

Sequentially evaluating the structural path coefficients, first the study evaluates the regression results to verify that the results are not distorted by the lateral collinearity; this emphasizes a scenario where the predictors are highly connected with one another. The Variance Inflation Factor (VIF) is the standard metric used in structural equation modeling in PLS to identify multicollinearity issues. Though the VIF value should comply with the academic standard, the VIF value must rule out the collinearity issue, although in some cases it can be relaxed till 5.0.

The VIF variance analysis confirms that all the indicators encompassing many items satisfy the threshold of 3.0. For example, Data Driven Supply Chain Practice had values ranging from 2.076 to 2.740, while the eco-efficiency (ECO) items were scattered and ranged from 1.680 to 2.404. Green absorptive capacity portrayed exceptionally low correlation issues, with value showing from 1.899 to 1.990. Organizational Agility (OA) items were similarly well positioned, spanning 1.850 to 2.772. A single indicator like SRP10 yielded a VIF of 3.074, though it exceeds the 3.0 benchmark. Since the isolated value is particularly close to 3.0 and falls

far below the relaxed limit of 5.0. So, the research concludes that collinearity does not threaten the structural integrity of this model, ensuring that the predictors remain distinctly independent.

TABLE 5 | Collinearity assessment (variance inflation factor).

Latent Construct	Measurement Items	VIF Range
Data-Driven Supply Chain Practice (DDSCP)	DDSCP1 to DDSCP5	2.076–2.740
Eco-Efficiency (ECO)	ECO1 to ECO7	1.680–2.404
Green Absorptive Capacity (GAC)	GAC1 to GAC5	1.899–1.990
Organizational Agility (OA)	OA1 to OA8	1.850–2.772
Sustainable RMG Performance (SRP)	SRP1 to SRP13	2.066–3.074

Abbreviations: DDSCP, data-driven supply chain practice; ECO, eco-efficiency; GAC, green absorptive capacity; OA, organizational agility; SRP, sustainable RMG performance; VIF, variance inflation factor.

5.3.2 Explanatory Power (R^2) and Effect Size (f^2)

The predictive accuracy of the model is mostly determined by the determination of coefficient. In detail, which quantifies the apportionment of variance in the endogenous variables that are dependent variables with the help of explaining the respective exogenous drivers also known as independent variables. The ideal structural model demonstrated substantial explanatory power; the integrated components as a whole explained a significant portion of 72.1% of the total variance in the SRP ($R^2 = 0.721$, Adjusted $R^2 = 0.714$). Moreover, DDSCP accounted for 54.9% of the variance in the OA ($R^2 = 0.549$) and 45.1% of the variance of eco efficiency ($R^2 = 0.451$).

TABLE 6 | Coefficient of determination (R^2) and explanatory power.

Endogenous Variable	R^2 Value	Adjusted R^2 Value	Explanatory Power
Sustainable RMG Performance (SRP)	0.721	0.714	Substantial

Organizational Agility (OA)	0.549	0.547	Moderate to Substantial
Eco-Efficiency (ECO)	0.451	0.449	Moderate

Abbreviations: ECO, eco-efficiency; OA, organizational agility; SRP, sustainable RMG performance; R^2 , coefficient of determination.

The effect size and explanatory power isolated the incremental and practical contribution of an exogenous variable upon an endogenous construct, particularly while assessing collective explanatory power. Following the guidelines of behavioral science, values such as 0.02, 0.15, and 0.35 representing sequentially small, medium, and large-size effects.

The F-square matrix provides profound realistic significance, particularly on the independent variable. Data-driven supply chain practices exerted the sphere, which shows a massive effect size on both mediators such as eco-efficiency ($f^2 = 1.218$) and organizational agility ($f^2 = 0.823$). Since both are mediating variables, both demonstrated medium incremental impacts on sustainable RMG performance. In contrast, the direct path from the DDSCP to SRP yielded a highly marginal effect size ($f^2 = 0.039$). This reinforces the theoretical necessity of the mediators as a mechanism to sustain performance. Besides, GAC generates a less emphasized effect on the SRP ($f^2 = 0.028$), while its moderating interaction effect (GAC $\times$ DDSCP) produced a statistically negligible impact ($f^2 = 0.001$).

TABLE 7 | Effect Size Analysis (f^2)

Structural Path	f^2 Value	Effect Magnitude
DDSCP $\rightarrow$ Organizational Agility (OA)	1.218	Large
DDSCP $\rightarrow$ Eco-Efficiency (ECO)	0.823	Large
Eco-Efficiency (ECO) $\rightarrow$ SRP	0.195	Medium
Organizational Agility (OA) $\rightarrow$ SRP	0.186	Medium
DDSCP $\rightarrow$ Sustainable RMG Performance (SRP)	0.039	Small
Green Absorptive Capacity (GAC) $\rightarrow$ SRP	0.028	Small
GAC $\times$ DDSCP $\rightarrow$ SRP (Moderation)	0.001	Negligible

5.3.4 Model Fit Assessment

The proposed model is examined by evaluating global model fit indices to find out the overall adequacy of the model. To assess the model fit, metrics such as the SRMR are needed to assess the model fit. The values less than 0.08 are generally considered a good model fit. The estimated model yielded an SRMR value of 0.071, which falls comfortably below the conservative 0.08 threshold. Moreover, the Normed Fit Index (NFI) stood at 0.857. With the empirical data, these results together demonstrate that the structural model possesses an acceptable fit, which validates the structural pathways for further hypothesis testing.

TABLE 8 | Model Fit Results

Metric	Saturated model	Estimated model
SRMR	0.045	0.071
d_ULS	1.516	3.779
d_G	0.705	0.771
Chi-square	803.215	838.245
NFI	0.863	0.857

5.4 Hypothesis Testing

The structural relationship as proposed in the model is evaluated by the bootstrapping procedure in SmartPLS with 5,000 subsamples. The non-parametric approach generates, in contrast, robust errors and t-statistics to determine the statistical significance of the path coefficients. The analysis sequentially assessed the direct effects, specific indirect effects like mediating effects, and the interaction (moderating) effect.

5.4.1 Direct effects (H1 to H5)

The structural model assessment provides strong support for all direct hypotheses from H1 to H5. The results show that DDSCP has a significant positive effect on the SRP ($\beta=0.168$, $t=2.595$, $p=0.009$). Therefore, the H1 is supported by the model output, in addition to DDSCP exerting further positive influence on both mediating variables: OA ($\beta = 0.741$, $t = 24.857$, $p < 0.001$) and ECO ($\beta = 0.672$, $t = 19.268$, $p < 0.001$), confirming and, respectively. This result indicates that both mediating variables significantly drive sustainable outcomes. OA has a strong positive impact on SRP ($\beta = 0.362$, $t = 6.238$, $p < 0.001$), supporting H_4 . Similarly, eco-efficiency positively and significantly influences SRP ($\beta = 0.347$, $t = 6.581$, $p < 0.001$), supporting H_5 .

TABLE 9 | Results of Direct Effects Hypothesis Testing

Hypothesis	Structural Path	Beta (β)	Standard Deviation	T statistics	P-values	Decision
H ₁	DDSCP → SRP	0.168	0.065	2.595	0.009	Supported
H ₂	DDSCP → OA	0.741	0.030	24.857	0.000	Supported
H ₃	DDSCP → ECO	0.672	0.035	19.268	0.000	Supported
H ₄	OA → SRP	0.362	0.058	6.238	0.000	Supported
H ₅	ECO → SRP	0.347	0.053	6.581	0.000	Supported

Note: Data extracted from SmartPLS bootstrapping output.

5.4.2 Specific Indirect Effects (Mediation: H₆ and H₇)

To examine the mediating roles of OA and ECO, the specific indirect effects were analyzed particularly H₆ and H₇. The results ensured that OA successfully mediates the relationship between DDSCP and SRP. The specific indirect path particularly (DDSCP → OA → SRP) is highly significant ($\beta = 0.269$, $t = 6.100$, $p < 0.001$), providing strong support for H₆.

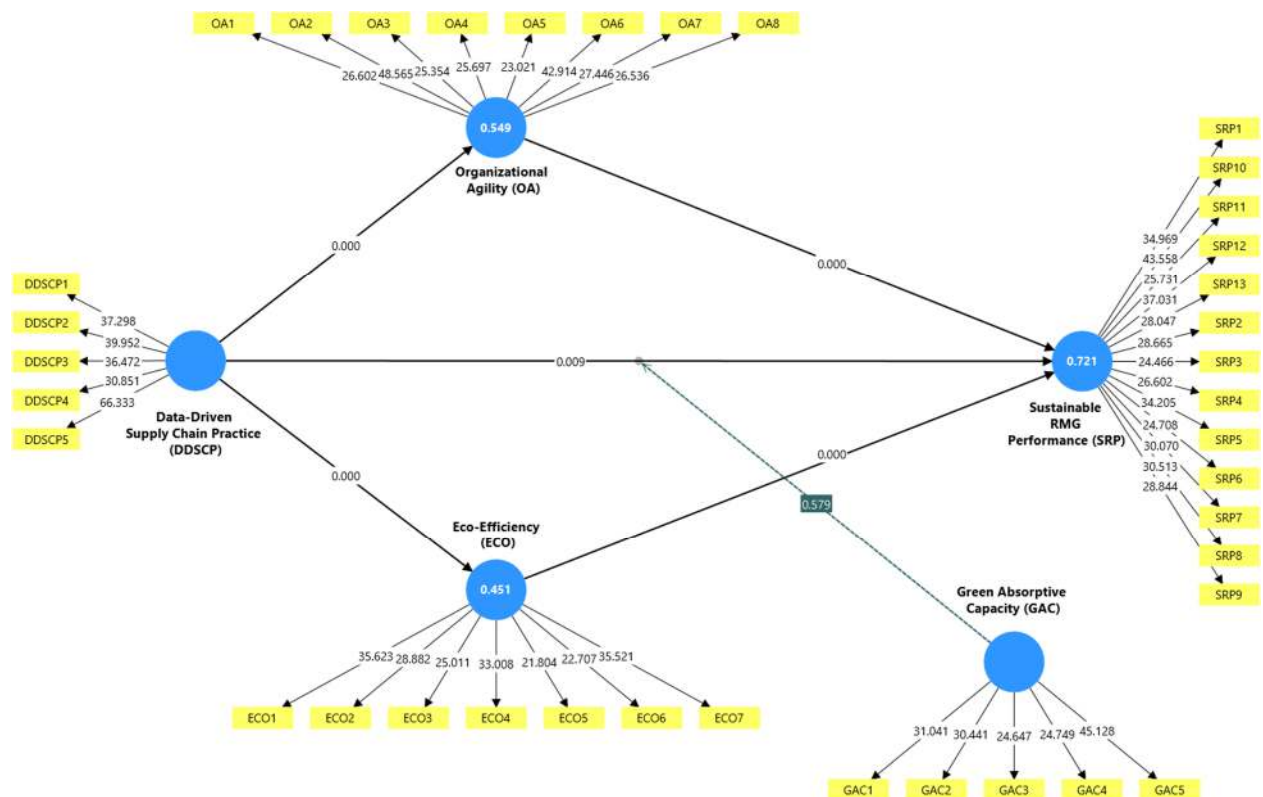


FIGURE 2: Structural model.

As the same goes, ECO serves as a significant mediating mechanism between DDSCP and SRP. The indirect path (DDSCP → ECO → SRP) is statistically significant ($\beta = 0.233$, $t = 6.113$, $p < 0.001$), which supports H_7 . Because the direct path from DDSCP to SRP remains significant ($p = 0.009$). Besides these significant indirect paths, both Organizational Agility and Eco-Efficiency represent complementary partial mediators within the model.

TABLE 10 | Results of Indirect Effects Hypothesis Testing

H	Specific Indirect Path	(β)	T	2.50%	97.50%	P-Values	Decision
H ₆	DDSCP → OA → SRP	0.269	6.1	0.186	0.359	0	Supported
H ₇	DDSCP → ECO → SRP	0.233	6.113	0.160	0.309	0	Supported

Note: Data extracted from SmartPLS bootstrapping output.

5.4.3 Moderating Effect (H_8)

Hypothesis 8 proposed that GAC moderates the relationship between DDSCP and SRP, theorizing that the positive relationship strengthens when GAC is high. An interaction term ($GAC \times DDSCP$) was included in the structural model to test this. The bootstrapping results indicate that the interaction effect on SRP is notably small and statistically insignificant ($\beta = 0.019$, $t = 0.554$, $p = 0.579$).

Hence, H_8 is not supported. This result suggests that while DDSCP and GAC individually contribute to sustainable performance, the internal capacity for assimilating green knowledge does not have a statistically significant effect on or enhance the direct effectiveness of data-driven supply chain activities on performance outcomes.

TABLE 11 | Results of Moderating Effect Hypothesis Testing

Hypothesis	Interaction Path	Beta (β)	Standard Deviation	T-Statistics	P-Values	Decision
H ₈	$GAC \times DDSCP \rightarrow SRP$	0.019	0.035	0.554	0.579	Not Supported

Note: Data extracted from SmartPLS bootstrapping output.

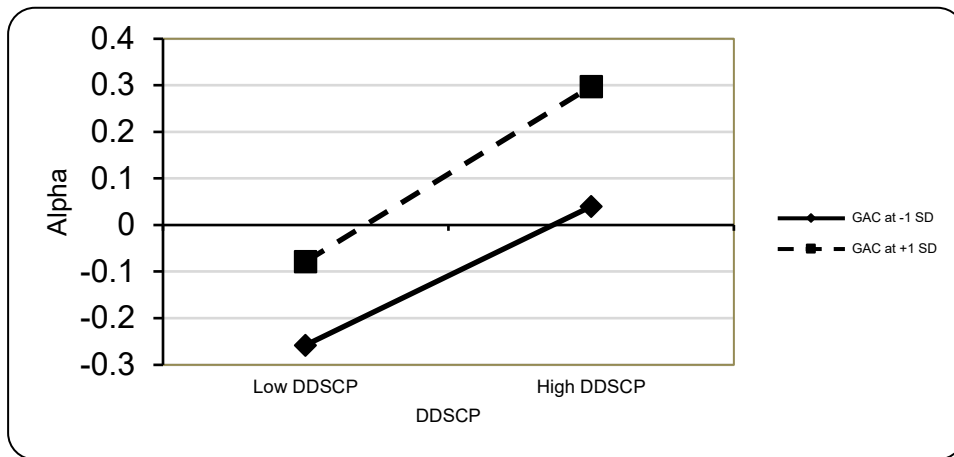


FIGURE 3. Moderating effect of DDSCP on the relationship between GAC and Alpha

6. Discussion

The main theme of this study was to demystify the complex structural setting that establishes how data-driven supply chain practices (DDSCP) conduct sustainable RMG performance (SRP) in an emerging market. This study contributes to the literature on DCV and Absorptive Capacity Theory, both of which rely on a simplistic premise in which technological incorporation is automatically sustainable. It offers an empirically substantiated and nuanced framework that illustrates the sequential operationalization of digital capabilities via intermediate organizational routines (organizational agility and eco-efficiency) to create impactful economic, environmental, and social value.

First, the results confirm that DDSCP directly affects sustainable performance, but that this effect is theoretically insufficient to lead towards holistic transformation. Digital technologies, such as statistical forecasting, real-time tracking, and blockchain, are widely recognized for sustainability challenges in the modern supply chain literature. However, we argue that big data and digital integration mainly offer infrastructural visibility and informational value (Yu et al., 2018). Data on carbon footprints, fabric waste, or labor conditions alone do not fix system inefficiencies in the context of the highly labor-intensive and heavily monitored RMG industry of Bangladesh. Therefore, DDSCP should be conceptualized not as a direct problem-solver, but as a foundational catalyst that requires complementary organizational mechanisms to translate static digital insights into dynamic sustainable actions.

The most fundamental theoretical contribution of this study is based on this realization, which is the need for the indispensable mediating role of organizational agility. The findings provide strong evidence that the basic essence of DDSCP is to increase an organization's agility, thereby contributing to sustainable performance. Building on Teece (2007), the capability to “sense” opportunities in the environment based on information is only useful provided that the firm has the capability to “seize” and “reconfigure” its operating resources to make the opportunity work. The business landscape for RMG manufacturers is very dynamic, with frequent changes in buyer compliance worldwide, fluctuation in demand, and disruption in the supply chain. These companies have the informational dexterity needed to make agile decisions necessary for business based on data (Felipe et al., 2019). Therefore, organizational agility is the strategic connection, and it is the organizational reflex that enables a company to switch production lines overnight, change sourcing, or adopt new safety measures without the cost or production delay, and thus forge the bridge to digital sensing and sustainable execution.

Meanwhile, research considers eco-efficiency as the essential operational mechanism to connect DDSCPs and SRPs. Agility is the strategic speed and flexibility of an enterprise, and eco-efficiency is the physical resource optimization of an enterprise in a rigorous manner. Data-driven practices allow for a fine-grained and real-time evaluation of the production lifecycle, thus identifying exactly where energy is being wasted or raw materials are not being used. Carvalho et al. (2017) expressed that eco-efficiency brings together the concepts of economic viability and ecological responsibility. The operational expression of digital intelligence in the RMG sector is the transformation of data analytics into eco-efficient actions, such as maximizing fabric utilization in the cutting room, recycling wastewater, and saving energy. This dual mediation implies that data must support two aspects of sustainability, strategic flexibility (agility) and physical resource optimization (eco-efficiency).

One of the more interesting and unexpected findings from the moderation analysis is related to the concept of GAC. The study shows that the direct impact of GAC on sustainable performance is confirmed, but the moderating role between DDSCP and SRP is not significant. This is contrary to the traditional perceptions of absorptive capacity as a synergistic multiplier of technological capabilities (Zahra & George, 2002). The institutional conditions of the developing economic context can provide a theoretical explanation for this seeming paradox. The level of green knowledge assimilation in the Bangladeshi RMG sector is mainly based on the mandatory pressure of international buyers instead of advanced integration of digital technologies. Consequently, GAC is a stand-alone, fundamental operating need. Moreover, the absence of moderation implies that the current digital infrastructure in these companies may be too immature to successfully blend the complex knowledge from the external environment with the algorithmic data within the companies.

Therefore, GAC is one thing that companies use, directly, to fulfil sustainability requirements, and more or less parallel to their data-based supply chain activities (Aboelmaged & Hashem, 2019).

Finally, this study enriches the discussion on sustainable supply chain management by demonstrating that the journey towards sustainable management is a process that includes digital transformation as an intermediate stage. In such volatile and export-oriented manufacturing businesses, sustainability does not happen on its own because of technology, but is deliberately built and architected, with data-based insights being aggressively pursued through agile organizational culture and eco-efficient routines.

7. Implications, Limitations, and Conclusion

7.1 Theoretical Contributions

This study critically offers multiple noteworthy theoretical contributions and progresses the literature at the congruence of supply chain digitalization, corporate sustainability, and dynamic capabilities, which first of all, contextualized the DCV within a well-established manufacturing sector, that is, the RMG sector, and explicates the intermediate mechanisms via which multi-dimensional Sustainable RMG Performance (SRP) are derived, converting Data-Driven Supply Chain Practices. The empirical findings are seen to break the deterministic assumptions regarding digital transformation by showcasing the remarkably small direct effect of DDSCP on SRP. Although it statistically it is seen to have a significant direct effect, the actual influence is channeled through Eco-Efficiency (ECO) and Organizational Agility (OA) as complementary partial mediators, confirming that digital tools like predictive analytics, RFID tracking, and information integration do not bring sustainability outcomes automatically unless they are transformed into organizational sensing and routines on operational resource optimization (Teece, 2007; Yu et al., 2018). Secondly, this study embellishes the Absorptive Capacity Theory in the green domain (Zahra & George, 2002). Despite the existence of direct relationship within GAC (Zahra & George, 2002) and sustainability outcomes, the proposed moderating role of linked DDSCP-SRP became statistically non-significant. It is suggested by several empirical studies that, for digital execution in resource limited developing countries, external environmental knowledge absorption works as an independent baseline ability instead of acting as a boundary-enabling condition. Overall, the study agrees that, with the validation of an integrated structural model accounting for almost 72.1% of the variance in sustainable garment performance, this paper establishes a granular framework that explains the mechanisms of achieving economic, social, and environmental equilibrium by RMG manufacturers amidst the turbulent demands of institutions.

7.2 Practical Contributions

This study is also seen to address managerial and policy-based implications through providing actionable roadmaps for the factory owners, supply chain directors, and individual policy makers of the RMG sector of Bangladesh to enable them to navigate volatile global markets and comply with different legal frameworks that will strengthen stakeholder trust. It is to be well noted by the RMG owners and the senior executives is that capital expenditures on advanced supply chain software like cloud ERP, blockchain traceability platforms and IoT sensor suites will produce if used in an isolated manner will produce negligible sustainability dividends, therefore along with investing on acquiring software, organizational capability building must be prioritized by the leadership and to be very precise, cross functional teams must be trained to convert real-time data into faster decision making (organizational agility) and reduction in shop-floor wastes, water and energy (eco-efficiency). In addition, it is a mandatory responsibility of the supply chain managers to leverage data visibility that will help to establish collaborative, flexible workflows aiding organizations to quickly adapt to sudden buyer specification changes and regulatory updates without raising operating costs or producing excessive chemical and fabric wastes. Furthermore, the findings highlight the significance of moving beyond traditional physical infrastructure subsidies for industry associations like the BGMEA and governmental policy makers and working on policy initiatives that must incentivize digital-green capability building. This can be facilitated by the targeted technical training programs, subsidized digital infrastructure upgrades for small and medium size enterprises and through standardizing open-data circular economy frameworks that help supplier factories capture eco-efficient operational practices and monetize systematically. This finally drives the organizational profit as well as enhances the brand image of the company and makes it look attractive to the investors, partners and helps the company to stay competitive in the long run.

7.3 Limitations and Future Research Directions

Notwithstanding the paper's theoretical and practical implications, it still holds a list of many methodological limitations that present fruitful areas to be reached in the future. First, the research depends on a single point of time collected cross-sectional data restricting the ability of establishing definitive longitudinal causality between data-driven implementations and long-run sustainability performance dimensions. In the future, scholars need to deploy longitudinal approach of research designs for tracking the maturation of data-driven capabilities and how triple-bottom-line performance is influenced over extended investment lifecycles. Secondly, the data set was gathered on the basis of convenience sampling of managerial key informants having strong knowledge on the supply chain operations within readymade garments (RMG) sector of

Bangladesh, opening a possibility for subjective reporting bias despite conducting rigorous procedural and statistical common method bias checks. Investigations that will be conducted in future can adopt dyadic or multi-respondent research designs that will connect both the Bangladeshi operational managers and international buyer procurement leads. Furthermore, the study continues to leave a room for further research on policy analysis and implementation of broader strategies after Bangladesh graduates from Least Developed Country to still sustain in the global competitive landscape. In other words, although Bangladesh currently represents a globally crucial apparel hub, it is needed to make a cross-national comparative analysis encompassing other major textile-exporting countries including India, China, Vietnam and Cambodia to test the strength of the proposed structural relations and the contextual boundary across differing institutional and regulatory conditions.

7.4 Conclusion

The whole research could be concluded through showcasing that in an era characterized by extensive and increasing technology development, climate vulnerabilities, regulatory pressure and excessive buyer scrutiny, the garment sector in Bangladesh faces immense push towards synchronizing digital transformation with sustainable development. This is why the study investigated the structural mechanisms via which Ready Made Garments (RMG) sector's performance can be made highly enhanced and sustainable by Data-Driven Supply Chain Practices (DDSCP) along with explicitly explaining the mediating effects of OA and Eco-Efficiency (ECO) alongside the moderating role of GAC within the RMG industry. It is revealed by empirical findings that data-driven practices play a powerful catalytic role in enhancing sustainability. It is done primarily by building and reinforcing shop-floor eco-efficiency routines and organizational agility collectively explaining almost 72.1% of the variance in triple-bottom-line performance. Conversely, green knowledge assimilation does not act as an interactive accelerator of digital tools but instead as direct driver. The ultimate takeaway of this research is unambiguous because digital technology in manufacturing supply chains is not the end itself rather true sustainable performance can be made to emerge only when agile operational structures and eco-efficient organizational routines can embed analytical data streams that will ultimately boost the capability of responding dynamically to stakeholder expectations.

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Ethics declarations

Ethical Approval and Informed Consent

This article does not contain any studies with human participants performed by any of the authors.

Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. The authors declare that they have no conflict of interest.

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Appendix

RESEARCH QUESTIONNAIRE

Data-Driven Supply Chain Practice and Sustainable RMG Performance: The Mediating Roles of Organizational Agility and Eco-Efficiency Moderated by Green Absorptive Capacity

Dear Respondent,

This questionnaire is part of an academic research study examining how data-driven supply chain practices influence sustainable performance in the Ready-Made Garment (RMG) sector, through the mediating roles of organizational agility and eco-efficiency, and the moderating role of green absorptive capacity. Your responses will be used strictly for academic purposes and will be kept confidential. Please answer every item based on your honest perception of your organization.

Thank you for your time and valuable contribution.

Part I: Respondent & Organizational Profile

1. Name of Organization (optional): _____
2. Designation / Job Title: _____
3. Years of Experience in the RMG Industry: _____
4. Gender: ☐ Male ☐ Female ☐ Prefer not to say
5. Company Size (No. of Employees): ☐ < 500 ☐ 500–2000 ☐ 2001–5000 ☐ > 5000

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6. Department: ☐ Supply Chain / Logistics ☐ Production ☐ Sustainability / Compliance ☐ Management
☐ Other

Part II: Construct Items

Instructions: Please indicate the degree to which you agree with the following statements relating to your company/organization, using the scale below.

1 = Strongly Disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly Agree

Section A: Data-Driven Supply Chain Practice

(Independent Variable)

Item No.	Statement
DDSC1	Our company establishes a flexible and open central data environment.
DDSC2	Our company builds consistent interoperable, cross-functional department databases to enable concurrent engineering, rapid experimentation and simulation, and co-creation.
DDSC3	Our company aggregates customer data and makes them widely available to improve service level, capture cross- and up-selling opportunities, and enable design-to-value.
DDSC4	Our company implements advanced demand forecasting and supply planning across suppliers.
DDSC5	Our company implements lean manufacturing and models production virtually (such as digital factory) to create process transparency, develop dashboards, and visualize bottlenecks.

Source: Fosso Wamba et al. (2015), Chavez et al. (2017), and Yu et al. (2018, 2019)

Section B: Organizational Agility

(Mediator 1)

Item No.	Statement
OA1	We have the ability to rapidly respond to customers' needs.
OA2	We have the ability to rapidly adapt production to demand fluctuations.
OA3	We have the ability to rapidly cope with problems from suppliers.
OA4	We rapidly implement decisions to face market changes.
OA5	We continuously search for forms to reinvent or redesign our organization.
OA6	We see market changes as opportunities for rapid capitalization.
OA7	We adapt resources, processes, and technologies to meet the needs of the changing environment.
OA8	We consider new pricing, marketing, production, and/or alliance actions.

Source: Sharifi and Zhang (1999), Lu and Ramamurthy (2011), and Tallon and Pinsomeault (2011)

Section C: Eco-Efficiency

(Mediator 2)

Item No.	Statement
ECO1	Our environmental efforts have resulted in significant waste reduction in agencies.
ECO2	Our environmental efforts have resulted in improved quality of services.
ECO3	We focus our environmental management on improving the company's reputation.
ECO4	Our environmental efforts have generated improvements in our working environment.
ECO5	The benefit of environmental efforts has reduced the costs related to processes, products, and services.
ECO6	Our environmental efforts have contributed to the adoption of alternative technologies and processes.
ECO7	Our environmental efforts have helped our company develop new products, services, and processes.

Source: from Zhang et al. (2008), Koskela and Vehmas (2012)

Section D: Green Absorptive Capacity

(Moderator)

Item No.	Statement
GACAP1	The organization is able to communicate green knowledge across its divisions.
GACAP2	The organization is able to effectively apply new external green knowledge for commercial purposes.
GACAP3	The organization is able to identify, obtain, and value external green knowledge that is crucial to its operations.
GACAP4	The organization is able to integrate existing green knowledge with newly obtained and incorporated green knowledge.
GACAP5	The organizational structure facilitates the development of the ability to analyze, comprehend, and deduce information regarding green knowledge.

Source: Zahra and George (2002), Chen et al. (2014), and Qu et al. (2022)

Section E: Sustainable RMG Performance

(Dependent Variable)

E.1 Economic Sustainability

Item No.	Statement
ECON1	With digital technologies, costs in different parts of the supply chain are reduced.
ECON2	The use of digital technologies makes it possible to eliminate rework and reduce waste in production processes.
ECON3	With the help of digital technologies, smart contracts can be appropriately managed.
ECON4	By using digital technologies, it is possible to supply raw materials with quality and suitable prices at the right time.

E.2 Environmental Sustainability

Item No.	Statement
ENV1	Digital technologies can help reduce energy consumption and greenhouse gas emissions.
ENV2	New production methods using digital technologies help improve waste management and green production management.
ENV3	The use of digital technologies can reduce the use of natural resources in many processes.
ENV4	Digital technologies can reduce energy consumption in the transportation of workforce and materials by enabling remote operations.

E.3 Social Sustainability

Item No.	Statement
SOC1	Digital technologies can provide new work patterns by changing how work is done and working hours.
SOC2	Digital technologies can help improve employee safety and health.
SOC3	Digital technologies can increase the ability to share information between stakeholders.
SOC4	Digital technologies, with the possibility of <u>information sharing</u> , can increase the rights of consumers and producers at the community level.
SOC5	Using real-time information and digital technologies, the government can better predict and plan the needs and infrastructure of organizations.

Source: Zhu et al. (2008), Slaper and Hall (2011), and Islam et al. (2026)

— End of Questionnaire —

Thank you very much for your participation.

Online Survey form (Along with the no. of Respondents)

Data-Driven Supply Chain Practice and Sustainable RMG Performance

Questions Responses 215 Settings

Data-Driven Supply Chain Practice and Sustainable RMG Performance Survey

This survey explores how digital supply chain practices drive sustainability in the RMG sector. Your responses are confidential.

Section 1 of 6

Data-Driven Supply Chain Practice and Sustainable RMG Performance

This questionnaire is part of an academic research study examining how data-driven supply chain practices influence sustainable performance in the Ready-Made Garment (RMG) sector, through the mediating roles of organizational agility and eco-efficiency, and the moderating role of green absorptive capacity.

Your responses will remain anonymous and confidential, and will be used strictly for academic purposes.

This survey will take approximately 8-10 minutes to complete.

For most sections, you will be asked to rate statements on a 5-point Likert scale, where:
1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree.

Please answer every item based on your honest perception of your organization.

