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Green Supply Chain Management and Environmental Performance in Small, Medium and Large-Sized Italian Manufacturing Companies

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ABSTRACT

With the world moving towards global warming, a growing population, and the reduction of non-renewable resources, Green Supply Chain Management (GSCM) has recently received increased attention. While green practices are essential in developing a more sustainable performance, the effectiveness of those practices may vary from company to company. The purpose of this study is to showcase various green practices adopted and implemented by companies of different sizes to achieve varying levels of environmental performance. Moreover, to ensure higher sustainability, a company could adopt strategies with the adoption of green practices. The present study is quantitative in nature. The study uses a survey of 100 randomly selected small, medium, and large manufacturing Italian companies listed in the "Bureau van Dijk Electronic Publishing" database about their green practices and environmental performance. The results were analyzed using SPSS. It aimed to analyze whether any relationship existed between different green practices and their impact on environmental performance. This research contributes positively to the literature on the association between GSCM practices and environmental performance. It establishes that company size significantly affects the number and types of green practices implemented and how these can be effectively executed to improve environmental outcomes. The study's findings tested the hypothesis that different-sized companies integrate different Environmental Management practices and GSCM practices. The study revealed that large companies are more likely to implement green practices than small ones. The findings provide practical insights to managers, particularly those in the manufacturing and logistics sectors, about the GSCM practices likely to yield the best performance benefits. The research offers a nuanced approach to implementing various environmental management practices and to adopting GSCM strategies for a sustainable environment.

INTRODUCTION

According to recent World Health Organization (WHO) data, air pollution causes 4.2 million deaths annually. Additionally, 91% of the world's population resides in areas where air quality is higher than what is recommended by WHO (World, 2019). On the other hand, globalization has brought prosperity at the cost of environmental degradation in terms of climate change and loss of biodiversity (Song *et al.*, 2020). The public is becoming more and more aware of the dangers and therefore puts pressure on firms to take measures in their operations in regard to environmental and social sustainability. Green Supply Chain Management (GSCM) has emerged as a channel to integrate environmental management with supply chain processes, spanning a product's life cycle from design to disposal (Longoni *et al.*, 2018). The stakeholder pressure from the outside and the strategic goals from the inside are the main motivating factors for a firm to adopt GSCM practices. Besides, GSCM will enhance corporate image, efficiency, and innovation (Aslam *et al.*, 2019). However, it presents risks associated with innovation management, performance sharing, short-term cost issues, and long-term benefits (Gawusu *et al.*, 2022). Although the literature supports the financial benefits stemming from GSCM, more studies are required on its performance implications, particularly in the areas of environmental collaboration and monitoring. This paper focuses on how GSCM practices impact the performance of firms in the Italian industry.

Sustainability

Sustainability is the capability of continuing a defined behavior indefinitely. Integration of sustainability into the supply chain itself has been one step ahead, including all processes from the processing of raw materials to delivery to the customer (Taghikhah *et al.*, 2019). However, sustainability goes further beyond the core of supply chain management to product design, by-products of manufacturing, extension of life or recovery at end-of-life, and so on (Linton *et al.*, 2007). The definition of sustainability that the Brundtland Commission uses is a development that answers current human needs without undermining the possibility of future generations meeting their own needs (Borowy, 2013). The three dimensions of sustainability and refers to organizational sustainability as 'a balanced situation among three dimensions of economic development, environmental stewardship, and social responsibility (Purvis *et al.*, 2019).

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Supply Chain Management

Supply chain management is an important competitive strategy in an era where globalization has been pushing competition on the networks of companies. Definitions of SCM differ, but most of them usually include all the stages involved in satisfying a customer demand, starting from production and inventory to location and transportation coordination (Vidrova, 2020). SCM embraces all efforts starting from the final product or service production and ending in delivering it, including supply and demand management, sourced raw materials, manufacturing, warehousing, order management, distribution, and finally, delivery. Every organization forms part of at least one supply chain or divergent supply chain (Tien *et al.*, 2019). Most often, the supply chains are divergent in nature where raw materials get transformed into a host of end products adding value along the chain. Figure 1 shows the process of the supply chain from start to end.

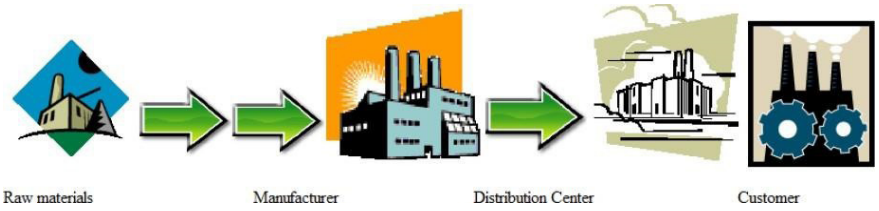

Figure 1: Supply chain

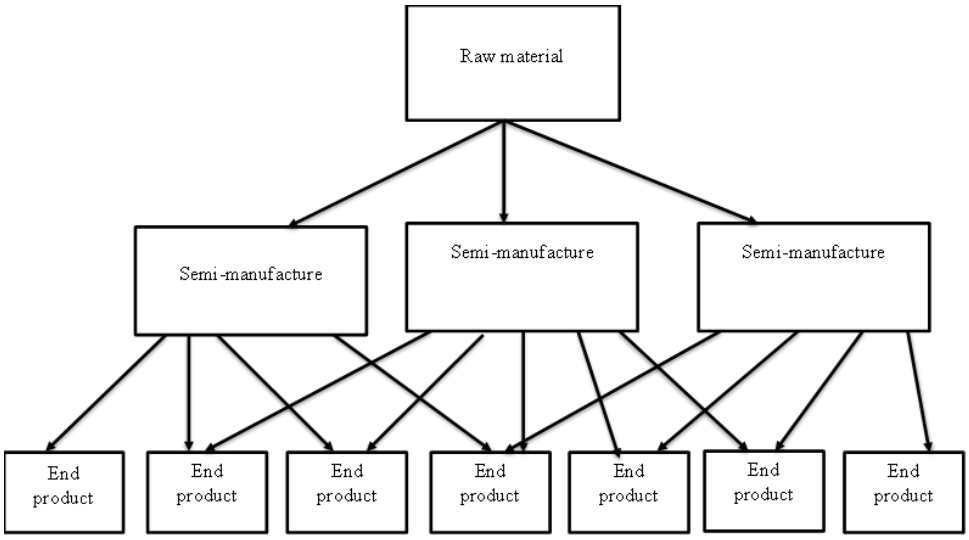

Figure 2: Shows the divergent supply chain

As vertical integration facilitates the ability of units within the supply chain to communicate effectively and share information, it enables effective supply chain operation. If manufacturers take access to the retailers' sales information, they can get better forecasts of demand, reduce lead times, control variability in a supply chain, reduce inventory levels, and smooth production (Lalou *et al.*, 2020). On the other hand, horizontal cooperation in the form of price fixing or sharing of markets is illegal, since it clearly violates the various competition laws (Levenstein & Suslow, 2020). Figure 3 shows the supply chain integration.

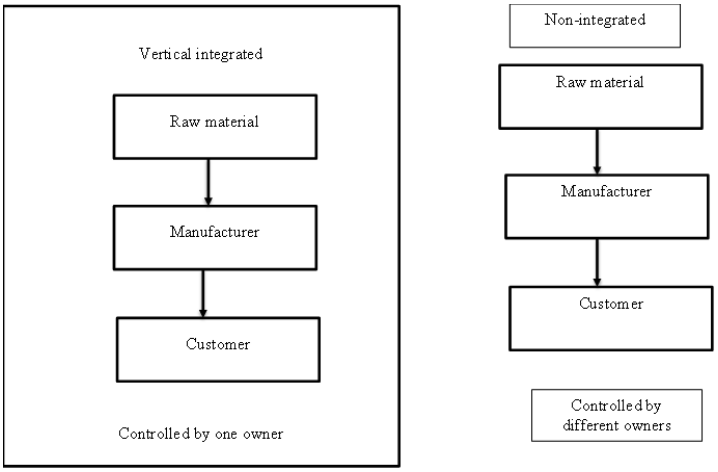

Figure 3: Supply chain integration

Sustainable Supply Chain Management (SSCM)

SSCM is management in the flow of raw materials, information, and capital, together with company cooperation up and down the supply chain to integrate economic, environmental, and social goals derived from customer and stakeholder requirements (Zimon *et al.*, 2019). The attainment of environmental and social criteria is expected across all departments, but organizations are expected to achieve the economic criteria through competitiveness and by ensuring that the needs of the customers are met as required. Environmental supply chain management incorporates aspects such as reduction, recycling, reusing, and substitution of materials (Okogwu *et al.*, 2023). The success matrix of a supply chain is tied to customer expectations, globalization, information technology, government regulations, competition, and the environment. The concept of SSCM has been developed to achieve a balance among the three dimensions of sustainability so that sustainable performance can be achieved; in case two dimensions overlap, organizations may completely lose survival, social costs, or environmental costs (Aliakbari Nouri *et al.*, 2019). Environmental issues are emphasized as they impact the people's welfare and the economic system's output as well.

Green Supply Chain Management

GSCM comprises traditional supply chain management practices that are complemented by additional environmental criteria, such as minimizing waste, conserving energy, and avoiding dangerous materials and their diffusion (Kalpande & Toke, 2021). GSCM involves supply chain stages from product design to end-of-life management and further to green procurement, supplier evaluation, recovery, recycling, and green production (Wibowo *et al.*, 2018). Companies operate to comply with government regulations, customers' demands for environment-friendly products, and differentiation from competitors by means of GSCM. GSCM is a subset of SSCM that looks at broader economic, social, and environmental sustainability issues (Agrawal *et al.*, 2023).

Traditional Supply Chain Management and GSCM

Environmental issues have, over time, led to surpassing the traditional SCM. Traditional SCM, with the main focus on economic objectives, cannot thrive in a highly competitive market due to legislative pressures exerted by consumers' environmentally friendly concerns (Taghikhah *et al.*, 2019). Green Supply Chain Management (GSCM) is unlike any of the traditional SCM, which often disregards environmental impacts; it combines ecological optimization with economic objectives (Ali *et al.*, 2020). Traditional SCM tends to track and manage the finished product and does not take into consideration the environmental impact while producing and distributing, while GSCM focuses on minimizing such adverse impacts. Table 1 shows the difference between traditional SCM and GSCM

Table 1: Differences between the GSCM and Traditional SCM (Source: Luthra et.al, 2011, p.235)

	Characteristics	**GSCM**	**Traditional-SCM**
1	Objectives	Economic & Environmentally Friendly	Economic
2	Environmental impacts	Low environmental impacts	High environmental impacts
3	Cost	High	Low
4	Flexibility	Low	High
5	Speed	Low	High
6	Supplier selection criteria	Environmental friendly – long term relationship	Price- short term relationship

Motivation for Adopting GSCM

Firms have become more integrated with their stakeholders; the trend changed from stand-alone firms to integrated supply chains and further developed into what is called GSCM. Engaging in Sustainable Supply Chain Management is viewed as a must-be rather than a may-be type of discretionary behavior (Mentzer *et al.*, 2001). Researchers have focused on the following subjects while researching GSCM.

1. Pressure/Drivers to adopt green practices
2. Practices implemented
3. Performance gained

Figure 4: Path from pressure/drivers to performance through practice implementation

The implementation of GSCM practices is driven by pressures or drivers that begin the adoption of green practices. In the process of adopting green practices, companies may face barriers at certain times, which may prevent practices from being implemented and thereafter the performance of these practices evaluated, but after the barriers are overcome, practices can be implemented and the performance of these practices evaluated (El-Garaihy *et al.*, 2022). The present study hypothesizes that after successfully adopting green practices and overcoming barriers, environmental performance can be achieved.

Environmental Management System

An Environmental Management System (EMS) is an integrated approach to environmental management, based on the development, implementation, and maintenance of an environmental policy (Bravi *et al.*, 2020). It is assumed that there exists a positive correlation between environmental management and corporate performance. It is integrated with system capabilities and environmental metrics and goals to achieve waste reduction goals by employees. The EMS evolved from the development of environmental standards and corporate response to the environmental risks (Wagner, 2020). The most common core elements identified in the EMS are: creating an environmental policy, setting objectives and targets, implementing a program to achieve those objectives, monitoring and measuring its effectiveness, correcting problems, and .review the system to improve it and its overall environmental performance

EMS are crucial for businesses to manage, measure, and continually improve their environmental performance, ensuring compliance with regulations and voluntary standards. They can be certified against ISO 14001, providing assurance of pollution prevention and compliance. By number of ISO 1400 Italy is the second country in receiving certifications (Bravi *et al.*, 2020). EMS benefits include enhanced compliance, improved corporate image, profitability, and sustainability (Wang *et al.*, 2022). However, there is limited understanding of EMS's relationship with an organization's supply chain and if adopters practice Green Supply Chain Management (GSCM). EMSs may be driven by reputation reasons and may not involve the supply chain, leading to questions about their impact on environmental improvements beyond the company's boundaries. Despite this, EMS may encourage some organizations to extend environmental considerations toward suppliers and customers.

Relationship between EMS and GSCM

The use of EMS and GSCM plays a crucial role in promoting environmental sustainability in industries (Qader *et al.*, 2022). EMSs can weaken an organization's environmental stance if its supply chain system does not support environmental objectives. Without GSCM practices, environmental sustainability through EMSs is not possible. Implementing EMSs involves lowering costs, promoting employee collaboration, and continuously improving environmental impact. EMSs promote lean production practices, reducing input use and associated environmental impacts (Das *et al.*, 2023). GSCM practices require effective inventory control systems to manage material flows and prevent overuse of inputs. Both EMSs and GSCM systems emphasize the reduction of inputs and wastage to restrict environmental impacts. EMS adopters adopt a holistic approach, develop a culture of internal appraisal, and work on improvement. Organizations with EMS can easily implement GSCM practices due to internal knowledge and commitment towards environmental management (Canhoto & Wei, 2021). Internal department-wise collaboration is also essential for strong GSCM. Implementing GSCM often involves discussing environmental issues throughout product design and using lifecycle analysis to minimize environmental impact.

Pressures and Drivers for Implementing EMS

Pressure and driver are terms used interchangeably to describe the forces that drive organizations towards adopting green practices. Pressure refers to external factors such as European Union (EU) environmental policies, while drivers are internal factors that motivate an enterprise to adopt green practices. Pressures lead to passive adoption, while drivers foster proactive adoption (Dasanayaka *et al.*, 2022). Walker *et al.* (2008) divided drivers into internal factors related to green supply chain management and external factors like regulatory, customer, competition, societal, and supplier influences (Walker *et al.*, 2008). The institutional theory perspective clarifies that business decisions are influenced by external norms, values, and traditions (DiMaggio & Powell, 1983). Three types of institutional pressures are identified: coercive, normative, and mimetic. Zhu and Geng (2013) further categorized these pressures among Chinese manufacturers and distinguished between coercive, normative, and mimetic pressures, highlighting the importance of understanding these factors in green practices adoption (Zhu & Geng, 2013).

Practices of GSCM

Firms are increasingly adopting GSCM practices to meet stakeholder demands for environmentally sustainable products and processes (Kalyar *et al.*, 2020). These practices can be classified into internal practices, which involve a firm's responsibility towards the environment, and external practices, which involve cooperation with stakeholders, including suppliers and customers. The globalization of industries has led to increased environmental impact, prompting many corporations to adopt green practices to achieve sustainable development goals. Green supply chain practices include green design, green purchasing, green manufacturing, materials management, green distribution/marketing, and reverse logistics (Hervani *et al.*, 2005). Figure 6 shows the components of GSCM

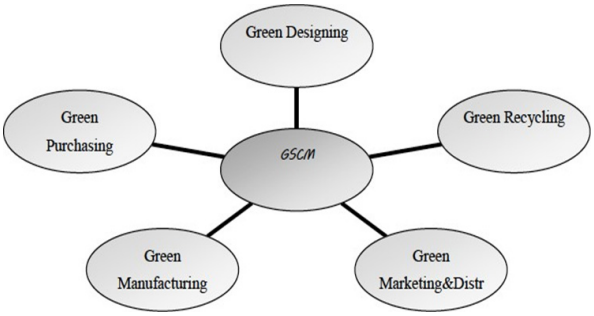

Figure 5: The components of GSCM (modified from Weiwei and Huiyu, 2010 p.13).

Environmental sustainability is a guide for management practices from both operational and strategic dimensions, with researchers analyzing green supply chains in areas such as product design, process design, manufacturing practices, and purchasing (Habib *et al.*, 2021). Integrating the greening phase of the supply chain involves confronting the aftermath and linkages of the supply chain to the natural environment, affecting all parts of the supply chain cycle. Followings are the classic processes and functions in any supply chain, which maintain the complete cycle of material flows. Each of these parts has a deep impact on the environment:

Green Designing

Green design is a crucial industry issue due to government legislation, company image, public impression, consumer demand, and increased waste disposal costs. It focuses on products with minimal environmental impact, reducing, reusing, and recycling ideas. Green design emphasizes energy and resource efficiency. Modular and loop designs are green design tools, allowing for reduced costs and flexibility in product design (Pistikopoulos *et al.*, 2021). Modularity in design provides decrease in cost and makes design flexible (Sonego *et al.*, 2018). Loop design also known as circular design, or design for recycling, focuses on products that can be easily recycled due to rising raw material costs and regulatory pressures (Dumée, 2022).

Green Purchasing

Green purchasing is a crucial aspect of procurement, aiming to reduce waste and promote recycling without compromising performance (Chin *et al.*, 2020). It has evolved from traditional criteria based on price, delivery, and quality to include environmental factors. Green purchasing benefits the environment, brand image, risk reduction, cost minimization, and competitiveness (Wang *et al.*, 2019). In 2017 ISO 20400 was implemented with the aim of increasing green purchasing practices (Teixeira *et al.*, 2018). It can help avoid costly environmental disasters like the BP oil spill (Barrage *et al.*, 2020). Supplier selection is crucial in green purchasing, requiring environmentally aware criteria. There are five steps to supplier selection (1) problem definition, (2) formulation of evaluation criteria, (3) pre-qualification of suitable suppliers, and (4) final choice of the ultimate supplier(s) (De Boer *et al.*, 2001). Constant evaluation can improve supplier performance, and proper relationships with suppliers can lower inventory levels and costs. Table 2 shows the environmental variables for supplier selection and evaluation.

Table 2: Environmental variables for supplier selection and evaluation (Source: Bai and Sarkis 2010, cited in Vanelle et.al, 2011, p. 340)

Category	Factors	Sub-factors
Environmental practices	Pollution control	Remediation
		End of process controls
	Pollution prevention	Product adaptation
		Process adaptation
	Environmental management system	Establishment of environmental policy and commitment
		Identification of environmental aspects
		Environmental objective planning
		Environmental responsibility assignment
		Evaluation of environmental activities
Environmental performance	Resource consumption	Energy consumption
		Raw material consumption
		Water consumption
	Pollutant reduction	Pollutant agent production
		Toxic product production
		Waste production

Green Manufacturing

Green manufacturing is the process of designing a product to have less waste and fewer emissions throughout its production (Seth *et al.*, 2018). It integrates environmental issues in all of the manufacturing stages. It reduces energy use and wasteful by-products (Pang & Zhang, 2019). Some of the important practices are recycling materials, reusing materials, detecting solid waste, and sourcing products from green suppliers. Three green manufacturing strategies are designing products for reuse, creating interchangeable products, and product upgrades rather than new product formation (Rehman *et al.*, 2016).

Green Marketing and Distribution

Green marketing goes beyond just promoting the green product, but it includes all activities that involve modification in designing, manufacturing, distribution, packaging, and advertising, in a way to reduce environmental impact. There is an emerging trend for green products on the

part of consumers; however, customers prefer products based on product specification and cost, hence hampering widespread adoption (Wahab, 2018).

Green distribution is working to reduce the environmental impact of delivering products to consumers. It is achieved through the use of green vehicles and route optimization options (Thakkar, 2021). Recyclable or reusable materials are used in transport and product packaging. Distribution management and eco-friendly transport methods are the two most effective means for reducing carbon emissions and other environmental impacts associated with logistics operations (Patra, 2018).

Green Recycling or Reverse Logistics

Green recycling or reverse logistics is the process of reusing products and materials in an environment-friendly manner (Govindan & Bouzon, 2018). According to the American Reverse Logistics Executive Council, reverse logistics is the process of "planning, coordinating, and controlling products and resources after the sale and delivery to the customer. This includes returns for repair and credit" (Rogers & Tibben-Lembke, 1999). Reverse logistics is more than reusing containers and recycling packaging as it entails reducing materials in packaging, minimizing transportation energy, and reducing pollution (Kuo *et al.*, 2019).

Technological advances have increased the complexity of products and reduced their respective lifecycle, which increases the industrial waste correspondingly as well. This becomes considerably large in immensely resource-intensive automobile industries. For instance, the major automobile companies in Europe and the US made collaborate to develop the recycling infrastructure for end-of-life vehicles (Saidani *et al.*, 2019).

Malindzakova *et al.* (2022) researched the usage of recycling and reverse logistics in disposable beverage packaging. Their research details the use of a Deposit Refund System (DRS) and reverse logistics to be implemented in practice (Malindzakova *et al.*, 2022). Moreover, Waqas et al (2018) identified the challenges and barriers to implementing reverse logistics. The research identified that lack of management, law and regulation, infrastructure, and knowledge are the key factors in employing reverse logistics in a company (Waqas *et al.*, 2018).

Performance of GSCM

Previous research examined the relationships of GSCM practices with performance in terms of environmental, economic, and operational dimensions. Zhu *et al.* (2005) keynote performance areas include environmental performance, which entails air emissions, wastewater, solid wastes, hazardous material consumption, environmental accidents, and general improvement of the enterprise's environmental situation. Reduced costs of material purchasing, energy consumption, waste treatment, waste discharge, and fines for environmental accidents are all examples of positive economic performance. On the other hand, increased investment, operational cost, costs for environmentally friendly materials, and training costs are considered as negative economic performance. Improvements in operational performance are noticed in on-time delivery, reduced inventory, lowered scrap rates, improved product quality, product lines expansion, and improved capacity utilization (Zhu *et al.*, 2005).

Performance needs to be measured for any business. Firstly, a firm would be concerned about its economic performance as continuous cash outflows may challenge its survival in the long term. From a more macro perspective, environmental performance is more important for the future, and related objectives cannot be restricted only to the survival of a single firm. There are two primary purposes for measuring performance: motivating people and organizations to stick to current and future objectives (Gagné, 2018).

One of the biggest challenges in performance evaluation is to decide what should be measured and how it should be measured, more so in this emerging GSCM, monitoring environmental impacts along the life cycles and the supply chain. There are a number of available models of environmental Key Performance Indicators (KPIs); among them, the Global Reporting Initiative (GRI) is the most comprehensive and probably the most used. GRI addresses issues that range from materials and energy use to water and biodiversity, as well as emissions, effluents, waste, products, and services (Neri *et al.*, 2021). Further, it investigates topics related to compliance, transport, and business integration. On the contrary, the development of various standards with each claiming to be the best is perceived to lead to fragmentation. It basically justifies the reason why a single consolidated standard, accepted globally in the corporate world, is felt to create overall value for all stakeholders.

While the central issue of research normally stays focused on environmental, operational, and economic performance, more recent studies place more emphasis on social performance, like company and product image, employee satisfaction, and customer loyalty. The relationships that pressures, practices, and performance share need to be understood in order to give relevant contributions to GSCM knowledge (Balon, 2020).

In other words, GSCM performance is measured as an interaction of various practices and their corresponding impacts on the environment, economy, operation, and society (Ahmed *et al.*, 2018). A harmonized, globally recognized standard of evaluation is the keystone to creating total value for both companies and the environment.

Hypotheses

Based on the literature from different research articles following hypotheses were formed

H1

Italian companies of different sizes apply different typologies and quantities of GSCM practices.

H2
Companies of different sizes applying GSCM practices can lead to different environmental performance.

Research Objectives
1. To explore the level of adoption of GSCM practices.
2. To find out which degree GSCM practices can lead to environmental performance.
3. To understand the relationships between GSCM practices and environmental performance.

MATERIALS AND METHODS

Research Design
The present study used a cross-sectional survey research project. The study aimed to focus on how GSCM practices influence environmental performance within Italian manufacturing companies of different sizes.

Population and Sampling
A total of 1800 Italian companies were randomly selected from an online database "Bureau van Dijik Electronic Publishing". The database contained information on more than 700,000 financial, and commercial Italian companies. A structured questionnaire was e-mailed to the randomly selected companies. From the selected companies, 986 acknowledged the e-mail's reception, and 82 valid responses were received. Another batch of e-mails resulted in 12 more responses with a total of 100 responses collected.

Data Collection
Primary data was collected for the research. A structured questionnaire adapted from the works of Joseph Sarkis and others was used that contained 111 questions, divided into four sections: business information, GSCM pressure/drivers, GSCM practices, and GSCM performance (Hervani *et al.*, 2005; Zhu & Sarkis, 2004, 2006). 23 items emphasizing GSCM and 6 items on environmental performance were extracted from the questionnaire based on their relevance to the study (See Appendix 1). 5-point Likert scale was used to gather the responses. The questionnaire was e-mailed to the targeted companies. To have a wide and complete perspective on the Italian situation, companies belonging to fourteen different manufacturing sectors have been included in the sample. The respondents were chosen from different industrial sectors (e.g. textile & apparel, food processing, wood & furniture, metal & mechanical industry, chemical, petroleum, electrical & electronic). The responses were collected within a period of three months, with an additional e-mailing batch in order to maximize the responses.
Table 3 shows the reliability of the data sets.

Table 3: Survey; section of Green Practices

Operational	1	Providing design specification to suppliers that include environmental requirements for purchased items
	2	Cooperation with suppliers for environmental objectives
	3	Environmental audit for suppliers' inner management
	4	Cooperation with customer for eco-design
	5	Cooperation with customers for cleaner production
	6	Cooperation with customers for green packaging
	7	Cooperation with customers for using less energy during product transportation
	8	Design of products for reduced consumption of material/energy
	9	Design of products for reuse, recycle, recovery of material, component parts
	10	Design of products to avoid or reduce use of hazardous products
Managerial	11	Suppliers' ISO14000 certification
	12	Second-tier supplier environmentally friendly practice evaluation
	13	Cross-functional cooperation for environmental improvements
	14	total quality environmental management
	15	Environmental compliance and auditing programs
	16	ISO 14000 certification
	17	Environmental Management Systems exist
	18	Measurement and monitoring of environmental performance
Management commitment	19	Commitment of GSCM from senior managers
	20	Support for GSCM from mid-level managers
Investment recovery	21	Investment recovery (sale) of excess inventories/materials
	22	Sale of scrap and used materials
	23	Sale of excess capital equipment

Table 4: Survey; Section of Performance "environmental"

Environmental	1	Reduction of air emission
	2	Reduction of liquid wastes
	3	Reduction of solid wastes
	4	Decreaseof consumption for hazardous/harmful/toxic materials
	5	Decrease of frequency for environmental accidents
	6	Improve a company's environmental situation

Table 5: Reliability of the data sets

Data sets	Reliability
Small companies	0.371
Medium companies	0.792
Medium-large sized companies	0.689
Large companies	0.871

RESULTS AND DISCUSSION

Results

The GSCM practices and the environmental performance of 100 Italian companies that responded to the survey were analyzed. Figure 6 shows the framework of the analysis that links research objectives and research hypotheses

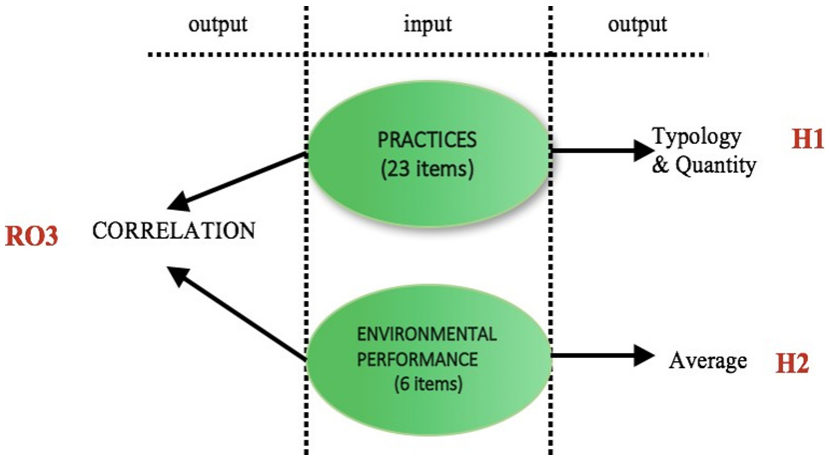

Figure 6: Framework of the analysis

Hypotheses 1

Hypothesis 1 was tested by highlighting the partially or fully implemented practices adopted by companies in each cluster. Table 6 shows the different practices implemented by different companies

Table 6: Practices implemented based on company's Dimension

		Small company (N=41)		Medium company (N=20)		Medium- large company (N=20)		Large company (N=19)	
Practice implemented		**#4-5**	**%4-5**	**#4-5**	**%4-5**	**#4-5**	**%4-5**	**#4-5**	**%4-5**
1	Providing design specification to suppliers that include environmental requirements for purchased items	12	29	9	45	10	50	15	79
2	Cooperation with suppliers for environmental objectives	9	22	5	25	10	50	10	53
3	Environmental audit for suppliers' inner management	8	20	3	15	5	25	9	47
4	Cooperation with customer for eco design	12	29	7	35	10	50	11	58
5	Cooperation with customers for cleaner production	14	34	11	55	13	65	13	68

6	Cooperation with customers for green packaging	6	15	5	25	7	35	9	47
7	Cooperation with customers for using less energy during product transportation	15	37	11	55	9	45	9	47
8	Design of products for reduced consumption of material/energy	28	68	15	57	15	75	16	84
9	Design of products for reuse, recycle, recovery of material, component parts	20	49	9	45	13	65	14	74
10	Design of products to avoid or reduce use of hazardous products	27	66	9	45	13	65	14	74
11	Suppliers' ISO14000 certification	16	39	11	55	6	30	9	47
12	Second-tier supplier environmentally friendly practice evaluation	12	29	4	20	3	15	9	47
13	Cross-functional cooperation for environmental improvements	15	37	9	45	5	25	10	53
14	Total quality environmental management	15	37	10	50	12	60	12	63
15	Environmental compliance and auditing programs	16	39	8	40	11	56	12	63
16	ISO 14000 certification	17	41	10	50	12	60	15	79
17	Environmental Management Systems exist	23	56	11	55	15	75	15	79
18	Measurement and monitoring of environmental performance	20	49	12	60	12	60	15	79
19	Commitment of GSCM from senior managers	15	37	6	30	9	45	10	53
20	Support for GSCM from mid- level managers	27	66	13	65	4	20	10	53
21	Investment recovery (sale) of excess inventories/materials	7	17	11	55	6	30	7	37
22	Sale of scrap and used materials	12	29	12	60	6	30	9	47
23	Sale of excess capital equipment	15	37	12	60	4	20	6	32
Average			**38**		**46**		**46**		**59**

In all clusters, the most implemented practice is the "design of products for reduced consumption of material/energy," with large firms having the highest adoption at 84%.

The design practices in the top five for small and medium-large firms are also "design of products for reuse, recycle, recovery of material, parts" and "design of products to avoid or reduce the use of hazardous products".

Medium-sized firms are more biased towards the combination of investment recovery and managerial practices; some of the most common are "sales of scrap and used materials," "sales of excess capital equipment," "measurement and monitoring of environmental performance," and "support for GSCM from mid-level managers."

Large firms, however, tend to focus more on managerial practices such as "ISO 14000 certification," "environmental management systems," and "measurement and monitoring of environmental performance," and the operational practice of "providing design specifications to suppliers that include environmental requirements for purchased items."

In general, the number of practices in place increases with firm size. While the small firms reported 38%, the medium and medium-large did so for 46%, and the large ones for 59%. There is therefore a clear gap between the small and large firms in the sense that the bigger the firms, the more the green practices implemented. Hence the hypothesis was tested positive.

Hypothesis 2

Hypothesis 2 was tested by considering the average of all environmental performances collected through the 5-point Likert scale method. Table 7 shows the environmental performance based on company dimensions.

Table 7: Environmental performance based on Company Dimension

Environmental performance	**Small company (N=41)**		**Medium company (N=20)**		**Medium-large company (N=20)**		**Large company (N=19)**	
	Average	**Std Dev.**	**Average**	**Std Dev.**	**Average**	**Std Dev.**	**Average**	**Std Dev.**
Reduction of air emission	3.32	1.29	3.00	1.12	3.20	1.06	3.79	1.19

Reduction of liquid wastes	2.95	1.22	3.15	1.23	3.15	0.81	3.68	0.82
Reduction of solid wastes	3.02	1.12	3.10	0.97	3.20	0.95	3.58	1.12
Decrease of consumption of hazardous/harmful/ toxic materials	3.30	1.20	3.10	1.29	3.35	0.99	3.58	1.02
Decrease of frequency of environmental accidents	2.27	1.37	2.40	1.47	2.00	0.97	2.74	1.24
Improve company's environmental situation	3.25	1.22	3.40	1.23	3.70	0.98	3.84	0.83
Average of Environmental performance	**3.02**	**1.00**	**3.03**	**1,07**	**3.10**	**0.59**	**3.54**	**0.77**

The results of the analysis specify that large firms have an average environmental performance that is considerably higher at 3.54 compared to small and medium enterprise categories, all within the range of 3.02 to 3.10, thus confirming H2.

Table 7 shows that small companies have the lowest rate of GSCM practices adoption and worst environmental performance. It is manifested in Figure 7 and 8; the bigger the size of the company, the more practices are adopted, and the better the average environmental performance.

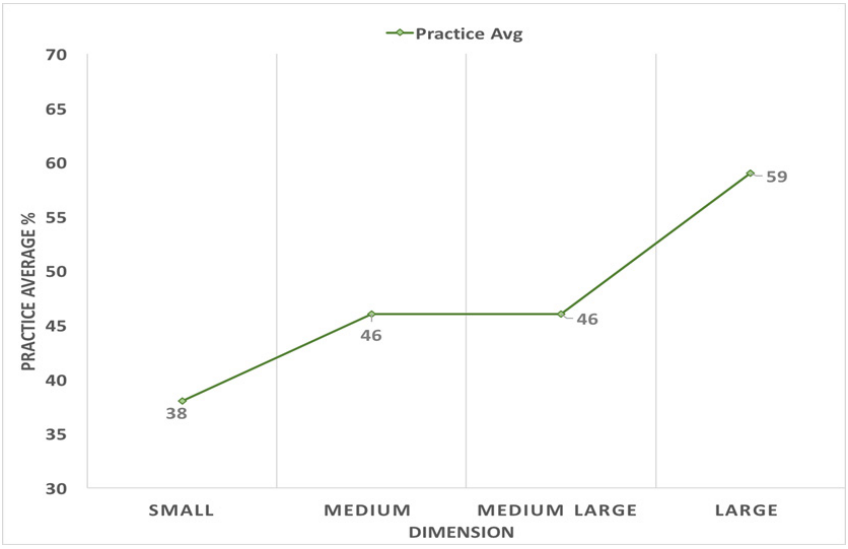

Figure 7: % of Practices averages

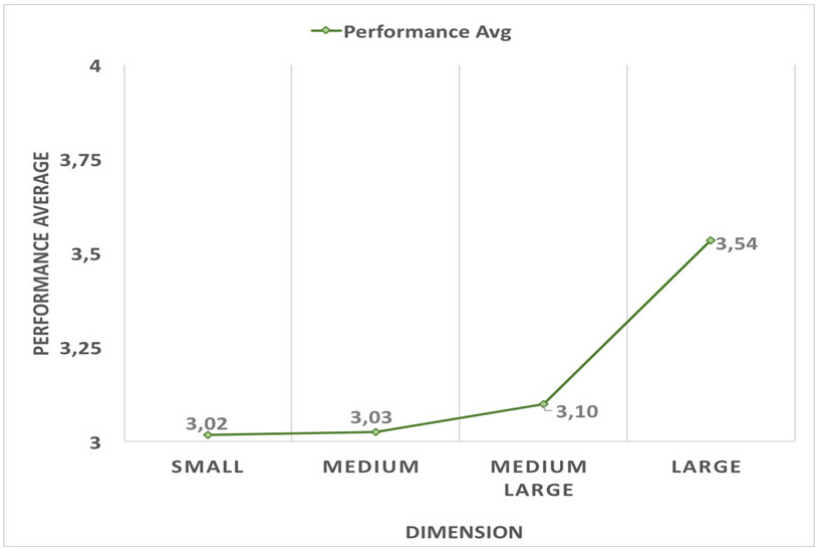

Figure 8: Performances Averages on the 5-point Likert scale

In smaller companies, there is a greater emphasis on design-related practices, whereas in larger companies, there is a domination by managerial practices. This shift may imply that the managerial practices are of more dominant influence and perhaps explain the steep increase in the averages of both practices and performance with company size.

Large companies typically show high benefits from GSCM practices where environmental performance values almost in all cases remain above 3.5 except the "Decrease of frequency of environmental accidents."

Small companies uniquely achieve their best performance in the "Decrease of consumption of hazardous/ harmful/toxic materials" with a value of 3.30, while other companies mostly report that the most positively influenced by GSCM practices is "Improve company's environmental situation".

For the "Decrease of frequency of environmental accidents," in all clusters by company size, the practices do not seem to influence this variable significantly, with values reaching no higher than 2.74.

Correlation

Correlation analysis between the 23 green practices and 6 environmental performance measures has shown a clear gap between the most applied practices and those highly applicable to environmental performance.

A framework was developed to showcase the correlation between different values. Where, $x < -0.4$ shows Negative correlation, $0.600 < x < 0.699$ shows Well correlated items, $0.700 < x < 0.799$ shows High correlation, and $x > 0.800$ signifies a Very high correlation.

Small Companies

Table 8 shows the Correlations based on the Company Dimension of small companies

Table 8: Correlations based on Company Dimension: Small companies (N=41 companies)

Performance Practice	Reduction of air emission	Reduct ion of liquid wastes	Reduct ion of solid wastes	Decrease of consumption of hazardous/ h armful/ toxic materials	Decrease of frequency of environmental accidents	Improve a company's environmental situation
Design of products to avoid or reduce use of hazardous products	0.267	0.312	0.038	0.680	0.425	0.287
Suppliers' ISO14000 certification	0.577	0.624	0.353	0.360	0.447	0.365
Environmental compliance and auditing programs	0.577	0.496	0.467	0.387	0.272	0.608
ISO 14000 certification	0.498	0.694	0.390	0.399	0.176	0.402
Environmental Management Systems exist	0.503	0.612	0.387	0.495	0,208	0.469
Measurement and monitoring of environmental performance	0.562	0.577	0.553	0.515	0.378	0.663

Only 6 practices are positively correlated with any environmental performance for small companies. Among them, only two practices are on the list of the most implemented: "Products are designed based on the reduction of the use of hazardous products" ($r = 0.680$) correlated with "Hazardous/harmful/toxic permanently reduced" and "Environmental Management System exists" ($r = 0.612$) correlated with "Liquid wastes have been reduced".

Medium Companies

Table 9 shows the correlation based on company dimension in medium-sized companies.

Table 9: Correlations based on Company Dimension: Medium companies (N=20 companies)

Performance Practice	Reduction of air emission	Reduct ion of liquid wastes	Reduct ion of solid wastes	Decrease of consumption of hazardous/ h armful/ toxic materials	Decrease of frequency of environmental accidents	Improve a company's environmental situation
Cooperation with suppliers for environmental objectives	0.792	0.622	0.668	0.683	0.672	0.655
Cooperation with customers for green packaging	0.399	0.325	0.445	0.575	0.624	0.415
Design of products to avoid or reduce use of hazardous products	0.520	0.310	0.449	0.723	0.501	0.359

Cross-functional cooperation for environmental improvements	0.520	0.600	0.573	0.391	0.452	0.617
Total quality environmental management	0.724	0.687	0.496	0.528	0.589	0.601
Environmental compliance and auditing programs	0.783	0.754	0.684	0.619	0.670	0.797
ISO 14000 certification	0.604	0.728	0.589	0.441	0.474	0.564
Environmental Management Systems exist	0.523	0.619	0.535	0.429	0.361	0.549
Measurement and monitoring of environmental performance	**0.669**	**0.687**	**0.645**	**0.454**	**0.498**	**0.654**

There are 9 practices in medium-sized firms which are positively correlated with environmental performance. Where, both sets of practices "Cooperation with suppliers for environmental objectives" and "Environmental compliance for auditing programs" are very strongly and very widely correlated with 6 environmental performances but rank only 20th and 17th in terms of implementation, respectively. And lastly, there were 4 environmental performances where "Measurement and monitoring of environmental performance" are very well correlated in terms of implementation within the top 5 implemented practices.

Medium-Large Companies

Table 10 shows the correlation based on company dimensions in medium-large-sized companies.

Table 10: Correlations based on Company Dimension: Medium-large companies (N=20 companies)

Performance Practice	Reduction of air emission	Reduct ion of liquid wastes	Reduct ion of solid wastes	Decrease of consumption of hazardous/ h armful/ toxic materials	Decrease of frequency of environmental accidents	Improve a company's environmental situation
Providing design specification to suppliers that include environmental requirements for purchased items	0.109	0.090	0.561	0.615	0.323	0.118
Design of products for reduced consumption of material/energy	0.378	0.203	0.742	0.338	0,000	-0.024
Design of products to avoid or reduce use of hazardous products	0.009	0.306	-0.522	0.793	0.150	0.010
Suppliers' ISO14000 certification	0.169	0.415	0.658	0.482	0.376	0.183
Second-tier supplier environmentally friendly practice evaluation	0.110	0.237	0.620	0.365	0.379	0.199
Environmental compliance and auditing programs	0.046	0.082	0.691	0.548	0.500	0.112
Investment recovery (sale) of excess inventories/materials	-0.471	-0.125	0.333	0.217	-0.046	0.023
Sale of excess capital equipment	-0.400	-0.173	0.243	0.143	0.103	-0.072

In medium-large-sized companies, 6 practices are positively correlated and 2 are negatively with environmental performance. "Design of products for reduced consumption of material/energy" is highly correlated with "Reduction of solid wastes" (r=0.742) and is most implemented. "Design of products to avoid or reduce use of hazardous products" is fifth in implementation and correlated with "Decrease of consumption for hazardous/harmful/toxic materials" (r=0.793). Two "Investment recovery" practices are negatively correlated but happen to be the least implemented.

Large Companies

Table 11 shows correlation based on company dimension of large companies.

Large companies display only 4 practices that are positively correlated: "Design of products for reduced consumption of material/energy" and "Providing design specification to suppliers that include environmental requirements for purchased items" are ranked top 2 practices and highly correlated with "Reduction of solid wastes" with r=0.728 and r=0.775, respectively.

Table 11: Correlations based on Company Dimension: Large companies (N=19 companies)

Performance Practice	Reduction of air emission	Reduct ion of liquid wastes	Reduct ion of solid wastes	Decrease of consumption of hazardous/ h armful/ toxic materials	Decrease of frequency of environmental accidents	Improve a company's environmental situation
Providing design specification to suppliers that include environmental requirements for purchased items	0.319	0.440	0.775	0.226	0.242	-0.565
Cooperation with suppliers for environmental objectives	0.408	0.374	0.685	0.226	-0.195	0.331
Design of products for reduced consumption of material/energy	0.261	0.402	0.728	0.279	-0.011	0.597
Sign of products for reuse, recycle, recovery of material, component parts	0.376	0.614	0.676	0.295	0.120	0.459
Investment recovery (sale) of excess inventories/materials	0.016	-0.402	-0.285	-0.271	-0.017	-0.412
Sale of excess capital equipment	-0.024	-.0.434	-0.352	-0.245	0.021	-0.387

Generally, larger companies apply more of the practices, and a shift from operational to managerial leads to better environmental performance. Very high Environmental Performance (EP) improvement is significantly related to well-correlated practices rather than to large numbers of practices implemented. Hence, the analysis contradicts the literature that more practices always lead to better performance and stresses the correct allocation of practices to achieve desired performance outcomes.

Discussion

The present study aimed to assess the relationship of different environmental management practices and their relationship to different environmental performance indicators within companies of different sizes. The results show how such practices are effective, but also point out which among the most applied ones are significantly related to good environmental performance.

In the case of small-sized companies, only six practices were positively correlated with at least one environmental performance indicator. This suggests that whereas some practices are both diffused and highly influential, others that may improve performance are less applied (Dey *et al.*, 2018). Nine practices were positively correlated to environmental performance in medium-sized companies. Only two showed a positive correlation with all six indicators of environmental performance. Both practices ranked rather low in terms of actual implementation (20th and 17th, respectively), thus there is a gap here between potential and actual practice.

Medium-large companies had six practices with positive correlations and two with negative correlations. The first one, "Design of products for reduced consumption of material/energy," was the most implemented practice. The negative correlations involved "Investment recovery" practices, which were among those less implemented, thus explaining how the limited implementation of these practices would alleviate their negative impact on environmental performance. Large companies had only four practices that were positively correlated. The two most applied practices, "Design of products for reduced consumption of material/energy" and "Providing design specifications to suppliers that include environmental requirements for purchased items," were highly correlated with "Reduction of solid wastes", denoting the trend that larger companies apply more practices, and these shift from operational to managerial ones, leading to better environmental performance (Rehman *et al.*, 2021).

Trends and Implications in Different Sized Firms

Indeed, this analysis confirms both hypotheses: H1 and H2. Evidence was found that large firms tend to have considerably better environmental performance compared to small ones (Vives, 2022). This may be a function of the higher material, human, and financial resources that large firms can deploy for environmental purposes. The top practices among the large firms that turn out as highly correlated with good environmental performance underline the crucial impact of firm size and the number of practices on the general environmental outcome. This study reveals that no minimum number of practices assures improved outcomes. Rather, it is the strategic allocation and implementation of practices that correlate to better performance (Singh & Hong, 2020).

Role of Environmental Management Systems and Green Supply Chain Management

Organizations that can successfully integrate EMS with GSCM practices can strive for holistic environmental sustainability (Ociepa-Kubicka *et al.*, 2021). This would mean that the set environmental goals can be shared throughout the supply chain network so that there is

an added advantage to the performance of each player, thereby reducing environmental hazards.

In other words, a firm should have a strategic conformance about environmental management practices and integrate EMS with GSCM for better environmental performance. Larger companies have larger resources and higher adoption of effective practices, which lead to superior outcomes (Das *et al.*, 2023).

CONCLUSION

Under a strategic inclusion of sustainable practices up and down the supply chain, companies in Italy would be better placed to make positive contributions toward the environment, reduce their ecological footprint, use resources more efficiently, and foster a more sustainable economy. The analysis indicates that with the adoption of GSCM practices, improved environmental performance indicators can be observed. In particular, companies that have invested in eco-friendly procurement, waste reduction, energy efficiency, and closed-loop systems witnessed a great reduction in greenhouse gas emissions, water consumption, and generation of waste. This outcome is important to emphasize since it attests that GSCM may be an influential tool in fostering environmental sustainability.

While large sized companies make huge progress, ample scope still exists for smaller companies and traditional industries to catch up with the inequalities. These require multiple strategies and efforts through government support, industry collaboration, and capacity-building initiatives.

Limitations and Future Recommendations

The research was limited to the Italian industries and does not account for the GSCM practices in other countries. The research also gathered data from the companies registered on the Italian website and therefore presents a gap for the companies that were not listed on the website. The research was quantitative in nature and only presented statistical data. Further research should be conducted in other countries. A qualitative approach should be used to support the quantitative results Future studies should explore the specific challenges faced by small and medium-sized companies in implementing environmental management practices.

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