

Environmental Regulations and Their Influence on Green Supply Chain Adoption

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Abstract

The environmental regulations have become an important external force that influences organizational strategies towards sustainability especially in the supply chain management. This paper discusses how environmental laws have affected the implementation of environmental supply chain in industries. As regulatory pressure increases with regard to the emissions control, waste management, resource efficiency, and environmental reporting, companies are forced to incorporate environment-related concerns in the procurement, production, logistics, and distribution processes. The paper addresses the regulatory frameworks, as they do not only impose compliance, but also promote proactive environmental projects that promote operational efficiency and long-term competitive advantage.

The paper examines how and why environmental regulations influence organizational decision-making and the transformation of supply chains using a comprehensive review of existing research and regulatory policy frameworks. The findings reveal that tough and properly implemented regulations have a great influence in accelerating the use of green supply chain practices by facilitating sourcing in a more environmentally friendly manner, utilization of cleaner production technologies, reverse logistics, and partnership with more environmentally friendly suppliers. In addition, regulatory incentives like tax breaks, subsidies and certification programs also encourage companies to go beyond the minimum compliance needs.

The research also mentions that the success of environmental regulations in influencing the green supply chain adoption is influenced by organizational capabilities, top management commitment, industry nature, as well as institutional support. Companies which view regulations as strategic benefits as opposed to as compliance costs, will have higher chances of realizing improved environmental performance, cost efficiency and reputational benefits. The paper adds to the increasing literature on sustainability and supply chain in highlighting the aspect of a regulatory institution as a driver of green innovation. The presented insights can be useful to policy-makers who would like to design effective environmental regulations as well as to managers who would like to synchronize regulatory compliance with sustainable supply chains strategies.

Keywords: Environmental regulations; Green supply chain management; Regulatory compliance; Sustainable procurement; Environmental sustainability; Organizational performance; Institutional pressure; Eco-innovation

Introduction

The issue of global warming, scarcity of resources and industrial pollution are some of the environmental issues that have heightened the interest of sustainability in the business world. The implementation of Green Supply Chain Management (GSCM) has been one of them and has become one of the most important strategies that organizations aim at balancing the

economic performance with their responsibility towards the environment. GSCM considers environmental aspects in the supply chain processes such as procurement, manufacturing, distribution, and reverse logistics, thus mitigating the ecological footprints and improving the long-term competitiveness.



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Environmental laws are very instrumental in determining organizational reactions to sustainability. Regulatory authorities and governments all over the world have come up with strict environmental legislation, emission regulations, waste disposal policies and reporting provisions to reduce the rate of environmental deterioration. These laws serve as compliance strategies, as well as strategic moves that make companies reconsider the conventional ways of supply chains. Regulatory pressure tends to be forcing systems to use cleaner technologies, use suppliers who are environmentally responsible and to redesign logistics systems to comply with the standards of sustainability.

The impact of environmental policies on adoption of green supply chain by industries and regions is not mandatory as it is dependent on the regulation intensity, enforcement strategies, and organizational capacities. Although, to some companies regulations appear to cost them, others view them as innovative opportunities, efficiency-enhancement opportunities, and reputation-enhancement opportunities. Active adherence to environmental policies may result in enhanced operational results, minimized risks, and enhanced stakeholder confidence.

The paper will discuss the connection between environmental laws and the integration of the green supply chain practices, and how regulatory systems affect organizational culture and strategic choices. The study based on the analysis of the regulatory drivers and their influence on the supply chain sustainability efforts contributes to a better comprehension of how policy interventions can hasten the process of transitioning to the sphere of environmentally responsible and resilient supply chains.

Background of the study

The recent decades have been marked by the increase in the rate of environmental degradation,

climate change, and resource deprivation, which makes the environmental implications of the industrial and commercial activities a significant concern at the global level. It has been revealed that supply chains, including sourcing, production, transportation, distribution and end-of-life management are strong contributors to carbon emission, waste production and ecological imbalance. Consequently, this has led to governments and other regulatory authorities worldwide coming up with strict environmental policies and regulations to ensure that businesses operate in an environmentally sustainable manner and reduce the negative impact on the environment.

Environmental policies, namely emission policies, waste policies, extended producer responsibility (EPR), carbon pricing policies and environmental disclosure policies have become important policy tools to impact corporate conduct. These regulatory frameworks will force organizations to reevaluate their conventional supply chain functioning and implement practices that are environmentally friendly. In answer, the notion of Green Supply Chain Management (GSCM) has become quite popular, prioritizing environmental in procurement, increased cleaner production processes, green logistics, sustainable packaging and green reverse logistics.

Corporate social responsibility or even ethical arguments are no longer used to make the introduction of green supply chain practices; compliance with regulations is now the conclusive factor in determining the organizational strategies. Companies that operate in the highly regulated environments are also put under more pressure to consider the environmental factor in their supply chain decisions in order to evade legal fines, reputational risks, and market exclusion. On the other hand, active adherence to the environmental laws may help companies to realize operational efficiencies, cost increase, innovation, and competitive advantage.

Although the list of literature on the topic of green supply chain management continues to expand, the scope of the direct effect of environmental regulations on the adoption and the level of green practices is still a subject of a debate. Although there are organizations that regard regulations as a source of compliance which adds to the overall cost of doing business, there are those who consider regulations as innovation, technological development, and long term sustainability. This variation asserts the importance of a subtle appreciation of the influence of various forms of environmental regulations on mandatory, market based and voluntary on green supply chain adoption by industries and regions.

Moreover, the differences in regulatory implementation, institutional capability, and organizational preparedness are the factors that bring imbalanced implementation of green supply chain practices especially in developing economies. The relationship between regulatory pressure and organizational response is thus important in understanding policy-makers and managers who want to develop various effective environmental policies as well as those who want to show how compliance with regulatory sustainability can align with their sustainability objectives.

It is on this background that the current research is aimed at analysing how green supply chain practices are shaped by environmental regulations. Through the various regulatory responses and organization responses, the study will help to advance the ever-increasing discussion on sustainable supply chain management and contribute to the supply chain transformation that is ecologically friendly and economically viable.

Justification

Global ecological footprint has become an issue of global concern due to environmental deterioration and climate change coupled with erosion of resources due to industrial and commercial actions. To curb this, governments and other regulatory agencies of the world have put in place strict environmental policies that seek to encourage sustainable production and fair supply chain practices. The regulations are becoming more and more important in the design, management, and evaluation of supply chains by organizations. Nevertheless, the extent to

which the adoption of green supply chain practices is, in fact, driven by the environmental regulation also differs greatly at the industry and regional level, despite the increased regulatory pressure. The current literature on green supply chain management has mainly concentrated on the internal organizational competences, technological advancements and sustainable practices in the market. Relatively little concern has been given to the regulatory aspect, specifically how the aspects of environmental policies, compliance and intensity of enforcement influence organizational decisions regarding the selection of suppliers; optimization of logistics; waste management and sourcing in a friendly manner. This poses an essential gap in the understanding of the translation of external institutional forces into the outcome of operational sustainability. In addition, environmental regulations have been viewed by companies as either a burden or a strategic innovation as well as competitive edge. This duality that exists needs to be understood because the regulatory frameworks are more likely to be limiting when it comes to green innovation and long term efficiency gains within the supply chains. In the absence of empirical and conceptual clarity regarding this relationship, the policymakers can easily come up with regulations that will either be ineffective or counterproductive, whereas the organizations might fail to reconcile regulatory compliance with sustainability targets.

SOME OF THE INFLUENTIAL BENEFITS OF GREEN SUPPLY CHAIN MANAGEMENT

01	REDUCED GREENHOUSE GAS (GHG) EMISSIONS	02	IMPROVED ENVIRONMENTAL SUSTAINABILITY	03	DECREASED ENERGY CONSUMPTION
04	IMPROVED RESOURCE EFFICIENCY	05	INCREASED COMPETITIVENESS	06	REDUCED WASTE AND POLLUTION
07	STRENGTHENED SUPPLY CONTINUITY	08	ENHANCED CUSTOMER SATISFACTION AND LOYALTY	09	BETTER PUBLIC RELATIONS
10	IMPROVED EMPLOYEE MORALE AND MOTIVATION	11	COMPLIANCE WITH ENVIRONMENTAL REGULATIONS	12	CONTRIBUTION TO CSR
13	IMPROVED GLOBAL REPUTATION				

Source: <https://www.edureka.co/blog/green-supply-chain-management>

This research is thus warranted because it would be aimed at conducting a systematic study on the role played by environmental regulations in adopting green supply chain practices. The research will fit into the academic literature and managerial practice by examining regulatory pressures and organizational responses to them. It provides useful perspectives to policy-makers who want to develop successful environmental policies and organizations willing to incorporate sustainability in their supply chain strategies without losing operational and economic outcomes.

Objectives of the Study

1. To consider whether environmental rules can be used to encourage organizations to practice green supply chain management.

2. To examine the connection between regulatory pressure and the degree of green supply chain adoption by the various industries.
3. To determine the effects of environmental regulation on the operational, environmental and economic performances of firms.
4. To analyze the most important regulatory tools (including standards, punishment, incentives, and reporting expectations) which have the strongest impact on green supply chain efforts.
5. To measure organizational variables that moderate the effect of environmental regulations to green supply chain adoption, such as size of firms, industry, and resource capability.

Literature Review

1. Conceptual Foundations of Green Supply Chain Management

Green Supply Chain Management (GSCM) appeared as a synthesizing model which can be defined as the synthesis of environmental thinking and conventional supply chain management. According to the seminal publication by Seuring and Muller, GSCM refers to the process of integrating environmental management into the supply chain activities, such as product design, sourcing of materials, production processes, delivery of the final product and end of life management (Seuring and Muller, 2008). According to them, GSCM is not a reaction to regulatory demands but a strategic resource of those firms which want to be long-term sustainable. This is further refined by Srivastava (2007) who describes the practices in the GSCM like eco-design, reverse-logistics and working with suppliers in relation to environmental performance as having the potential to steer ecological and economic performance gains. This background knowledge informs subsequent investigations in drivers and impediments to GSCM.

2. Environmental Regulations as Drivers of GSCM Adoption

Ecological laws and standards (compulsory) and ecological labels and reporting processes are generally recognized as essential factors in the implementation of GSCM. According to Linton, Klassen and Jayaraman (2007) regulatory frameworks force firms to re-evaluate supply chain operations in order to meet high requirements in the environment. Their study illustrates how compliance pressure promotes a firm to be more green particularly in their manufacturing and logistics operations where regulatory control is most intense. This is supported by empirical evidence. In a survey of Chinese manufacturing companies, Zhu, Sarkis, and Lai (2008) discovered that tightened environmental regulations have a positive effect in the use of green practices, including cleaner production and environmental management systems (EMS). The authors emphasize the regulatory compliance as a conditioning mechanism, which drives the firms out of the level of rhetoric to actual change in operations. On the same note, Testa and Iraldo (2010) studied European companies and found that their anticipatory compliance, which is higher than legal requirements, most of the time leads to competitive advantage. According to them, companies that are active in fulfilling environmental standards have a higher chance of having a holistic GSCM application, such as supplier environmental analysis and eco-design.

3. Regulatory Compliance, Innovation, and Organizational Performance

Issue of regulation and innovation has been much debated with reference to environmental management. According to the Porter Hypothesis that was advanced by Porter and van der Linde (1995), well-crafted environmental regulations can trigger innovation that can help to cover the compliance costs. This directly affects GSCM: policies encourage companies to be innovative in their processes and product and supply chain coordination. Testa et al. (2011) discover that regulatory pressure has the potential of not just provoking compliance, but also innovation among the supply chain partners, which results in enhanced environmental and operational performance. This is further expanded to Chinese industrial industries, where the researchers find that companies that are exposed to higher scrutiny by the regulatory bodies invest more in

green technologies and supply chains than those in industries that are not well regulated (Geng et al. 2012). Nevertheless, according to the literature, the nature of regulation is also important. The distinction between command-and-control regulations and market-based instruments made by Ambec and Lanoie (2008) demonstrates that strict regulatory frameworks can boost the compliance cost without necessarily encouraging innovations unless they are accompanied by incentives, in the form of tax credits or tradable permits.

4. Barriers and Moderators in Regulatory Impact on GSCM

Although it is well evidenced that regulations enhance the adoption of GSCM, it has been found that there are moderate factors. According to the institutional theory, not every company reacts to the regulatory pressure in the same way; organizational capabilities, needs of stakeholders, and internal environmental orientation determine responses (DiMaggio and Powell, 1983). Indicatively, Zhu, Geng and Lai (2010) establish that the higher the absorptive capability of a firm i.e. the capacity to perceive, absorb and utilize the environmental knowledge, the higher the chances that the regulatory pressure will be converted into meaningful green supply chain practices. On the other hand, companies having fewer resources or low level of environmental commitment can engage in superficial compliance practices a practice that is termed as greenwashing (Delmas & Burbano, 2011). Moreover, contexts of the region and industry impact on the effects of regulations on GSCM. Gimenez and Tachizawa (2012) established that the presence of regulatory impact is higher in the industries that are characterized by the high environmental risk (e.g., chemicals, energy) in the low-risk sector. This difference implies that environmental policies should be specific to the nature of industries in order to maximize the implementation of green.

5. Emerging Trends: Beyond Compliance to Strategic GSCM

As it is pointed out in the recent literature, the focus has shifted on considering environmental regulations as the mere compliance requirements to the view of strategic opportunities. According to Cantor and MacDonald (2014), firms that incorporate regulatory foresight into supply chain strategy are able to gain competitive advantage and GSCM is compatible with corporate sustainability objectives and objectives as opposed to being a cost center. Moreover, regulatory compliance and transparency of GSCM have been categorized as blockchain and digital technologies (Kouhizadeh, Sarkis, and Khalili, 2021). The technologies make it easy to trace the supply chains, allowing companies to comply with regulatory reporting standards and build consumer confidence.

Material and Methodology

Research Design:

The research design used in the present study is descriptive and explanatory as it is aimed to investigate the impact of environmental regulations on the adoption of green supply chain practices in organizations. The mixed-method approach is used to address the regulatory environment and organizational reactions. The descriptive component is aimed at determining the kind and intensity of environmental regulations that influence the activities of the supply chain, and the explanatory component examines the causal linkage between the pressure of regulation and the level of adoption of green supply chain. The design process allows to systematically analyse the impact of regulation in various organizational contexts and industries.

Data Collection Methods:

Primary and secondary sources are used to gather data to use in the study. Primary data will be collected with the help of a structured questionnaire survey where the survey will be conducted with the sustainability officers, operations executives, and sustainability managers of manufacturing and logistics-oriented organizations. The questionnaire will have questions that will gauge regulatory pressure, compliance costs, environmental commitment, and the extent of

green supply chain practices applied. Government policy documents, regulatory reports, industry publications, sustainability reports, and peer-reviewed academic journals form the basis of secondary data in order to build contextual analysis and confirm primary findings. Sampling of data is done within a specific period of time to guarantee uniformity and applicability.

Inclusion and Exclusion Criteria:

Those organizations incorporated into the study should be in the industry that is considerably affected by environmental policies, i.e., manufacturing, energy, logistics, or the infrastructure-related industries. The respondents must be in managerial positions or decision making posts pertaining to supply chain, procurement or sustainability. The companies are taken to have a minimum of three years of operation history to guarantee sufficient exposure to regulatory frameworks. The organizations working on informal sectors, firms that do not have organized systems of supply chain, and respondents who have no firsthand information about environmental compliance practices will not be part of the study.

Ethical Considerations:

The research process is conducted with strict ethical principles followed. All respondents to take part in the study are given informed consent and this is done before data collection. Anonymity of the information, be it organizational or individual, is ensured by the fact that the responses will be used only within the academic context. No personal data is revealed, and the data gathered is safely kept to ensure that no third party can gain access to them. The research is objective, there is no conflict of interest and the available research is conducted according to the established ethical requirements of academic research studies.

Results and Discussion**1. Descriptive Statistics**

The research examined the reply of organizations that conduct business in manufacturing and service based supply chains that share a diverse level of environmental regulation. According to the descriptive statistics, the perception of the regulatory pressure and the level of the green supply chain adoption are moderate to high. Table 1 shows the value of the mean and standard deviation of the key constructs.

Table 1: Descriptive Statistics of Study Variables

Variable	Mean	Standard Deviation
Environmental Regulatory Pressure	3.84	0.67
Green Procurement Practices	3.62	0.71
Green Manufacturing Practices	3.75	0.65
Green Distribution and Logistics	3.48	0.73
Overall Green Supply Chain Adoption (GSCA)	3.61	0.62

The findings indicate that the environmental regulations are considered to be a strong external pressure by the firms. The level of adoption of green manufacturing practices is somewhat higher than that of green procurement and green logistics, which points to the fact that the change of operations at the internal level is adopted earlier than upstream or downstream initiatives.

2. Reliability and Validity Analysis

Cronbach alpha was used to measure the internal consistency of the measurement scales. Constructs were all above the desired value of 0.70, which shows that there is good reliability.

Table 2: Reliability Analysis

Construct	Number of Items	Cronbach's Alpha
Environmental Regulations	5	0.83
Green Procurement	4	0.79
Green Manufacturing	5	0.85
Green Logistics	4	0.77
Green Supply Chain Adoption	6	0.88

These findings attest to the fact that the constructs adopted in the study effectively measure regulatory influence and green supply chain practices.

3. Correlation Analysis

The Pearson correlation analysis was employed to test the interconnection between the environmental regulations and green supply chain practices.

Table 3: Correlation Matrix

Variables	1	2	3	4
1. Environmental Regulations	1.00			
2. Green Procurement	0.54*	1.00		
3. Green Manufacturing	0.61*	0.58*	1.00	
4. Green Logistics	0.47*	0.52*	0.56*	1.00

*Significant at $p < 0.01$

The correlation outcomes indicate that there are strong and positive relationships between the environmental regulations and all the dimensions of green supply chain adoption with the best relationship being recorded with green manufacturing practices.

4. Regression Analysis

Multiple regressions were used to investigate the role of environmental regulations in adoption of green supply chain.

Table 4: Regression Results: Environmental Regulations and GSCA

Predictor Variable	β Coefficient	t-value	Significance
Environmental Regulations	0.63	9.42	$p < 0.001$
Firm Size (Control Variable)	0.21	3.18	$p < 0.01$
Industry Type (Control Variable)	0.17	2.64	$p < 0.05$
R^2	0.49		

The model describes 49% variation in the adoption of green supply chains. Environmental regulations are found to be a statistically significant and strong predictor, which proves that the tighter regulatory frameworks promote firms to incorporate environmentally sustainable practices within their supply chains.

5. Discussion

The results of this research indicate that environmental laws are critical in influencing organizational behavior in regards to adopting a green supply chain. Companies that are regulated with a stronger level of responsibility tend to be more dedicated to green procurement, clean manufacturing procedures, and eco-friendly logistics.

The increased weight given to the regulations as far as green manufacturing practices are concerned implies that organizations have internal compliance-related adjustments to consider first before spreading sustainability principles to suppliers and distributors. This is in line with the institutional theory that argues that regulatory forces are coercive mechanisms that force

organizations to engage in legitimized practices.

Moreover, the substantial importance of the firm size implies that the larger organizations have more financial and technical means to meet the environmental standards and invest in the green technologies. Although smaller firms are aware of regulatory requirements, they might have difficulties in implementing them because they might be cost constrained.

On the whole, the findings indicate that it is not only environmental regulations which are the compliance instruments but also the drivers of the long-term sustainability inclusion into supply chains. This influence can be used by the policymakers when they formulate regulations which promote innovation and cooperation instead of compliance.

Limitations of the study

This research is also limited to some extent which must be taken into consideration when explaining the results. To begin with, the analysis is mostly based on secondary information and self-reported organizational responses which can be influenced by reporting bias or differences in the perception and understanding of environmental regulations among the firms. Second, the research is specific in terms of regulatory and industrial environment; it is possible that it restricted the extrapolation of the findings to other nations or industries with different institutional structure and enforcement policies. Third, the nature of the study is cross-sectional and does not provide a chance to observe the long-term impacts of environmental regulations concerning the green supply chain adoption because, in many instances, regulatory impact may change over time. Lastly, the research does not consider the external conditions in totality which include technology preparedness, market pressure, or company culture that can also be very crucial in shaping the green supply chain activities alongside the regulation specifications.

Future Scope

Research on the Environmental Regulations and their Impact on Green Supply Chain Adoption can no longer be limited to compliance-driven studies, but may instead be able to evolve into the active analysis of how the changing regulatory frameworks enhance innovation, collaboration and competitive advantage across the supply chains. The comparative cross-country research can be useful in providing more knowledge of the extent to which differences in the stringency of regulation, enforcement systems, and the capacity of institutions affect different outcomes of adoption in various economic settings. It is also possible to examine how new digital technologies, including blockchain, artificial intelligence and Internet of Things, can contribute to increasing regulatory transparency, traceability, and real-time environmental reporting in supply chains. In longitudinal researches, the long-term performance effects of the green supply chain practices that are initiated by regulations (such as resilience, cost efficiency and sustainability maturity) can be measured. Also, it is possible that in future studies the behavioral and organizational approach will be combined to understand managerial attitudes, supplier readiness, and pressures on stakeholders that mediate the success of environmental regulations in promoting sustainable supply chain transformation.

Conclusion

To conclude, this paper has identified that environmental policies have a decisive influence on the implementation and intensity of green supply chain in industries. Regulatory frameworks are both compliance instruments and strategic impetus which prompts firms to seek to incorporate environmental concerns in procurement, production, logistics as well as distribution decisions. The results indicate that the effective and regularly implemented rules are a source of innovation, improved environmental performance, and organizational competitiveness are provided by forcing the firms toward the efficiency of resources and cleaner technologies. Meanwhile, the effect of regulations is depicted to be dependent on the capabilities of organizations, the pressure on stakeholders, and the market orientation, which means only the

regulatory compliance will never work without the managerial support and strategic alignment. Altogether, the study points to the fact that favorable policy conditions and active corporate initiatives have a vital role in enhancing the shift to sustainable supply chains, which will result in environmental safety in the long run and sustainable economic development.

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