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Understanding Nike's “Considered Index” Green Initiative Using the Technology-Organization-Environment Framework

Rebecca Angeles
Faculty of Business Administration, University of New Brunswick Fredericton, Canada, rangeles@unb.ca

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Rebecca Angeles
Faculty of Business Administration, University of New Brunswick Fredericton, Canada
rangeles@unb.ca

Abstract
This study explains the implementation of an environmental management information system that supports the sustainability goals of Nike using the technology-organization-environment (TOE) framework of Tornatzky and Fleischer. Literature review is applied to a single firm in using the TOE framework, with particular emphasis on the technological context of the framework. The use of Nike’s firm level decision support systems is highlighted in this study. Suggestions are made about improving Nike's Material Sustainability Index (MSI), its key sustainability tool, which is at the heart of the firm's group decision support system tool.

Keywords

Sustainability; environmental management information systems; technology-organization-environment framework; decision support systems; environmental issues

1. Introduction
This paper looks at how Nike, a premier sports shoe and apparel firm, implemented its environmental management information system (EMIS) in the form of a decision support system to enable its “Considered Index” environmental sustainability initiative and as a component of its environmental management system (EMS). An EMIS is an “…organizational-technical system for systematically obtaining, processing, and making available relevant environmental information available in companies….” (El-Gayar & Fritz 2006, p. 2). An EMS is set of management policies, business processes, and metrics for improving a firm’s environmental performance (Pun et al. 2002). The theoretical framework used for understanding how Nike unfolded its EMIS is Tornatzky and Fleischer’s (1990) technology-organization-environment framework.

2. Research question
This study seeks to answer this research question: “How can we explain the implementation of an EMIS, specifically, a decision support system (DSS) focused on supporting environmental and sustainability goals of Nike using the TOE framework?”

3. Literature review on the technology-organization-environment (TOE) framework

This study will use the technology-organization-environment (TOE) framework introduced by Tornatzky and Fleischer (1990) that uses three elements that influence technological adoption --- the environmental context, the organization context, and the technological context.

3.1 Environmental Context

The environmental context is the arena surrounding a firm, consisting of multiple stakeholders such as industry members, competitors, suppliers, customers, the government, the community, etc. They can influence how a firm interprets the need for innovation, its ability to acquire the resources for pursuing innovation, and its capability for actually deploying it. These stakeholders could either support or block technological innovation.

Changing market and competitive conditions prod firms to use various forms of innovation. Government regulation is also another powerful tool for constraining a firm's operational activities, increasing costs of production, and instigating an investigation of technologies that must meet specified criteria. Finally, dominant customer firms could exert their power to shift their suppliers' production activities to comply with its requirements.

3.2 Organizational Context

A range of descriptive measures characterize the "organizational context": firm size; the centralization, formalization, and complexity of its managerial structure; the quality of its human resources; the amount of slack resources available internally; formal and informal linkages within and outside the firm; decision making and internal communication methods; and boundary spanning mechanisms to communicate with the external environment. "Organic" and "mechanistic" organizational systems are also relevant here (Burns & Stalker 1961). Frequent lateral communication, decentralization of leadership and control, and active networking both within and outside the firm are hallmarks of the "organic" system. Building interorganizational collaboration mechanisms is fundamental in meeting the needs of electronic coordination linkages enabling supply chain partnerships.

Top executives can energize major organizational changes by (Tushman & Nadler 1986): (1) communicating a clear image of the firm's strategy, core values, and role of technology in meeting this strategy; (2) sending consistent signals within and outside the firm about the value of the innovation; and (3) creating a team responsible for crafting a vision relevant to the innovation.

3.3 Technological Context

Tornatzky and Fleischer (1990) presented their "systems design perspective," which is a synthesis of the following approaches: technocentric, sociocentric, conflic/bargaining, systems life cycle, and socio-technical systems.

(1) Understand the characteristics of the innovation

The technocentric approach espouses the notion that technological factors dominate the implementation experience, thus, leading to the following consequences: (a) there should be a detailed technical plan for implementation; (b) methods engineering should help in the redesign of business processes and jobs; (c) the innovation should be able to be integrated with the existing technical system; and (d) technical criteria should be used in measuring implementation effectiveness (Rousseau 1988). The “systems design perspective” also calls for a technology-organization match. The technology innovation also influences how different parts of a firm need to coordinate. Implementation of information systems supporting environmental goals extends the level of coordination needed from internal integration to interorganizational integration within the supply chain context.

(2) Develop measures of implementation effectiveness
A wholistic approach to measuring implementation effectiveness would include metrics that are relevant to the technocentric, systems development life cycle, sociocentric, and conflict/bargaining approaches.

(3) Plan and pace implementation
Pacing technology implementation refers to the speed at which changes are unfolded, which could range anywhere from gradual to radical (Roitman et al. 1987).

(4) Design or redesign the organization
The sociocentric approach focuses on making the organization more flexible, humanistic, and open to changes brought about by the innovation (Tornatzky & Fleischer 1990).

(5) Modify human resources policies
Human resource policies involving employee selection, compensation, appraisal, and training --- all of which have important implications for innovation implementation have to be modified to fit the innovation (Ettlie 1988).

(6) Design or redesign jobs
The design and/or redesign of jobs are needed to ensure that the affected workers and the work system required by the innovation are linked (Tornatzky & Fleischer 1990).

(7) Install the innovation and integrate with the existing system
The systems design approach prescribes the following: (a) incorporating end user needs into the requirements definition phase; (b) designing the new system so that it can integrate with the larger IT system that encompasses the firm; and (c) ensuring the provision of resources for reliable system maintenance and providing for both incremental and radical system changes if called for.

EMSs which would need some form of IS to capture, collect, store, and analyze data and distribute information in the form of reports for various stakeholders. Chen et al. (2008, pp. 2-3) define green information system (IS) as ”...the design and implementation of information systems that contribute to sustainable business processes.”

Using automation in establishing information baselines on inputs (energy, water, materials, etc.) and outputs (waste, greenhouse gas (GHG) emissions, etc.), a green IS can strongly support an EMS in monitoring an organization's environmental performance (Melville 2010).

The different elements of a green IS (i.e., hardware, software, procedures, data, networking, people) have a critical contribution to the EMS that oversees the improvement of the natural environment and addressing climate change (Melville 2010). Support for meeting the Global Reporting Initiative (GRI) standard, an internationally recognized sustainability reporting framework used for firms in all industries, would be a good example of the how a green IS application can enable the high report generation requirements of an EMS (Souto, et al. 2012).

The TOE framework has been a helpful tool in understanding how firms adopt technological innovations as indicated by the following studies. Lin (2009) used TOE to explain the factors involved in the adoption of radio frequency identification (RFID) in the logistics industry in Taiwan. Zhu et al. (2006) used TOE in deriving a technology diffusion perspective on e-business adoption in 10 countries. Hackney et al. (2006) used TOE in analyzing the adoption of Web services in five U.K. firms using the case study approach. In 2005, Sharma and Citurs (2005) used some elements of TOE in their model as antecedent conditions to explain the adoption of RFID in 16 firms. In 2001, Kuan and Chau (2001) investigated the factors of electronic data interchange (EDI) adoption among 575 small Hong Kong firms using TOE. In 2000, Ryan et al. (2000) used some TOE elements to explain the adoption of knowledge management technologies using data obtained from the U.S., Mexico, and Japan.

4. Research methodology

This paper uses a single case study approach in aligning the concepts and guidelines prescribed by the TOE framework to Nike. The case study approach is an appropriate methodology in testing the application of a conceptual framework to a real firm. This study used the qualitative research method of content analysis in analyzing secondary sources such as Nike corporate sustainability reports, journal articles, case study materials, trade publication articles, etc. Most of these materials are freely available on the web. The following are accepted definitions of the content analysis method:

> "Content analysis is any research technique for making inferences by systematically and objectively identifying specified characteristics within text." [Stone et al. 1966, p. 5])
> "Content analysis is a research technique for making replicable and valid inferences from data to their context." [Krippendorff 1980, p. 21]).
> "Content analysis is a research method that uses a set of procedures to make valid inferences from text." [Weber 1990, p. 9]).

In this study, the concepts used for conducting content analysis were derived from the TOE framework. This framework forms the "context" of the content analysis method as applied to Nike's sustainability initiative in its supply chain.

> "A context is always someone's construction, the conceptual environment of a text, the situation in which it plays a role. In a content analysis, the context explains what the analyst

> does with the texts; it could be considered the analyst's best hypothesis for how the texts came to be, what they mean, what they can tell or do. In the course of a content analysis, the context embraces all the knowledge that the analyst applies to given texts, whether in the form of scientific theories, plausibly argued propositions, empirical evidence, grounded intuitions, or knowledge of reading habits…. The context specifies the world in which texts can be related to the analyst's research questions." [Krippendorff 2004, p. 33]).

TOE concepts were used in analyzing the secondary materials within the context provided by the different theoretical frameworks or "prior theory." "Analytical constructs operationalize what the content analyst knows about the context, specifically the network of correlations that are assumed to explain how available text are connected to the possible answers to the analyst's questions and the conditions under which these correlations could change….analytical constructs ensure that an analysis of given texts models the texts' context of use…" [Krippendorff 2004, p. 34]).

The following key conceptual elements of the content analysis method as stipulated by Krippendorf (2004) were used in this study: (1) body of text selected for the analysis; (2) research question that needed to be addressed; (3) a context of analysis within which interpretations will be made; (4) analytical constructs that operationalize what the analyst knows about the context; and (5) inferences that will be arrived at to address the research question.

5. Research findings

5.1 Environmental Context

Nike dealt with a number of public relations issues in the mid-nineties as protests were mounted against the firm on account of substandard working conditions in the Asian factories where Nike outsourced the manufacturing of its shoes (Harish 2010). Then, in 1992, Nike was widely criticized for the use of sulfur hexafluoride (SF_6), a powerful greenhouse gas, in its Nike Air shoe. In response, Nike launched a firm-wide training program in 2000 focused on product sustainability and gathering of sustainability metrics (Henderson et al. 2009). These incidents accelerated Nike's subsequent corporate social responsibility exercises and scenario planning sessions (Henderson et al. 2009). Nike acknowledged its reliance on oil-based raw materials for its production needs and, thus, was exposed to rising oil prices and inevitable carbon emission restrictions embodied in government regulations.

Nike publicly declared its shift towards more collaborative participation in the global environmental sustainability conversation. In July 2000, Nike expressed support for the United Nation's Global Compact, an initiative that enlists corporate support in reporting firm compliance in the factories they use with core labor standards relevant to sustainability (Doorey 2011). Nike also introduced its "Transparency 101" initiative made public through a website that posted results of its overseas factory audits. Nike also joined CERES, an environmental sustainability non-government organization that enjoins corporations to sponsor sustainability efforts and report these using the Global Reporting Initiative standards. Nike is also being proactive as its industry competitors launch similar sustainability initiatives in the sports apparel industry.

5.2 Organizational Context

The organizational changes Nike put in motion are characteristic of features of an "organic" organizational system. In 1998, Nike created the Corporate Responsibility and Compliance Division (CRD) which encompassed a number of departments, and a Corporate Responsibility Committee as part of the board of directors committee structure to oversee Nike's social responsibility performance in the areas of labor, the environment, and charitable contributions (Nike 2010-2011). These moves clearly demonstrated top management support. After joining CERES in 2000, Nike fully endorsed CERES environmental sustainability principles and immediately implemented policies reflecting these principles (IISD 2012).

Nike clearly spelled out environmental sustainability as a strategic key driver for the firm's growth (Nike 2010-2011). Nike is using environmental sustainability through the use of initiatives such as its "Considered Index." Four key pillars support the sustainability strategy: materials (i.e., creating a portfolio of environmentally sustainable raw materials); sourcing and manufacturing (i.e., prototyping and scaling sustainable production models); market transformation (i.e., motivating sustainable consumption among customers); and digital services (i.e., deriving revenues from sources other than scarce natural resources) (Nike 2010-2011).

Nike uses formal linking structures to promote "lateral relations" supporting sustainability internally. In 2006, Nike created a management framework that assumes a firm-wide integrating role to ensure accountability in the execution of corporate responsibility programs. The Vice President for Sustainable Business & Innovation (SB&I) reports directly to the CEO and oversees concerns related to development and review of environmental sustainability policies, approval of relevant investments, and evaluation of initiatives involving cross-functional teams that have recruited business and functional executives. Nike has created a permanent SB&I cross-functional team that requires direct contact among managers to ensure the provision of sustainability domain and content expertise companywide in all affected business operations; collaborates with sustainability specialists in other parts of Nike; drives sustainability integration especially through the supply chain; mitigates risks and ensures compliance with sustainability regulations; engages affected stakeholders; and conducts regular reporting of sustainability performance (Nike 2010-2011). Nike uses interorganizational collaboration mechanisms in ensuring supplier compliance with a number of its indices --- "Considered Index," Manufacturing Sustainability Index (MSI), Sourcing and Manufacturing Sustainability Index, Country Risk Index, and Innovation Index (Nike 2010-2011).

5.3 Technological Context

Only selected steps in the technological context framework will be discussed using the Nike data. Data was available only for the steps discussed below.

1)Understand characteristics of the innovation (understand technical characteristics of innovation and social/technical context of subsystems)

Nike took a number of steps prior to finalizing the "Considered Index." In 1998, Nike consulted with The Natural Step, a non-profit organization specializing in environmental sustainability, and used its framework grounded in the natural sciences as the basis of its Considered Index initiative (Stoner 2006). Also in 1998, Nike consulted with McDonough Braungart Design

Chemistry (MBDC), a global sustainability consulting and product certification firm, to ascertain the chemical composition of its products and use the findings for transforming its sourcing and manufacturing business processes (Stoner 2006).

Founded on the principles of systems thinking, Nike's "Considered Design" initiative encompasses the domains of product design, manufacturing, and the product life cycle (Nike 2007-2008-2009). The initiative's goal is for Nike to design products across product categories using the fewest materials and enabling easy disassembly to facilitate recycling of products that have reached their end of life into new products or the safe return of the remnants to nature.

Raw materials used for Nike products are a major concern when thinking about the sustainability. Nike uses more than 16,000 different raw materials such as natural fibers like cotton and wool to technical synthetic materials like polyester, nylon, rubber, synthetic leather, and ethylene vinyl acetate (EVA) in an average year for its entire product line (Nike 2010-2011). This wide range of choice for raw material use makes the product design and development processes considerably complex.

2)Develop measures of implementation effectiveness (technical measures, social system measures, and organizational measures)

Nike uses a suite of sustainability indices to assess implementation effectiveness (Nike 2010-2011). The following are the most important indices Nike uses. The Nike "Considered Index" enables the evaluation of specific footwear and apparel products against environmental impacts of water consumption, energy use, waste generation, and toxin generation. The Material Sustainability Index (MSI) is an integral part of the "Considered Index" designed the measure the environmental impacts of raw material used. The "Manufacturing Index" measures the performance of contracted product manufacturers in terms of costing, delivery, quality, and sustainability using a balanced scorecard. The "Sourcing and Manufacturing Sustainability Index" is part of the Manufacturing Index and measures factory progression in seeking improvements in sustainable manufacturing behaviors and processes. The "Sustainability Integration Index" evaluates if sustainability is embedded in the strategy, structure, people, and operations of Nike. "The Innovation Index" measures how sustainability is integrated in Nike's innovative product portfolios to drive business growth.

3)Plan and set pace of implementation (create technical plan; pace implementation; take social, organizational, and technical issues into account)

Nike implemented its "Considered Index incrementally. First, all its products (e.g., footwear, apparel, equipment, accessories) will be required to meet the baseline Considered design standards with targeted dates for each product category (Nike 2007-2008-2009). Nike sought to share the index with senior leadership and roll it out to all product categories and footwear manufacturing base within the period 2007-2009. In 2009, Nike went live with the full-featured online Considered Index tool intended for its product design teams and liaison offices. The first apparel product line developed using the online tool was rolled out in 2010. Once the suite of index tools are fully developed, Nike will share these with the public via the GreenExchange, the Nike-sponsored creative and open digital commons for sharing environmental sustainability innovations with other companies.

4)Install and integrate with the existing technical system (will include integration of social and technical considerations and involvement of affected stakeholders)

Nike introduced the "Considered Index," an online tool that embodies a set of metrics that are a product of Nike's research efforts addressing raw material selection, solid waste, fabric treatments, and solvent use, to be used by Nike's product design teams (Nike 2007-2008-2009). Based on product life cycle thinking concepts, this online systems-integrated tool evaluates the environmental footprint of Nike's product line, drawing product information from Nike's database. For more than 10 years, Nike has been collecting data on solid waste and solvent use of its footwear product line and data on the waste footprint of its both its footwear and apparel items across all sports categories, involving a range of some 80,000 possible raw materials Nike could use (Nike 2007-2008-2009; Nike 2010-2011). After conducting the evaluation process, the tool generates a "Considered Index" score using the Index framework based on Nike's known environmental footprint in the key impact areas of solvent, materials, and energy use and waste generation. Products that earn the "Considered" designation are those whose "Considered Index" score exceeds the corporate average.

In conjunction with the "Considered Index" tool, Nike uses its Materials Sustainability Index (MSI) to identify what it calls "environmentally preferred materials" (EPM) (Nike 2007-2008-2009). EPMs are defined as those raw materials that have low environmental impact in terms of chemistry, energy and water use, and waste generation. The MSI tool evaluates raw materials according to these four criteria: (1) chemistry: risks to human health are determined using a number of toxicology indicators such as presence of carcinogens, acute hazards, chronic hazards, and endocrine disruptors/teratogens; (2) energy intensity: amount of energy consumed per unit of raw material processed; (3) physical waste generated: recycled inputs used, manufacturing waste generated, and product end-of-life disposition; and (4) water intensity: amount of water required to process raw material.

The Nike MSI tool assigns a numeric value to the raw materials used, which is, then, translated into the final sustainability score for the finished product. The Nike MSI is also an online tool that uses red-yellow-green color coding to indicate the environmental impacts of specific raw materials evaluated throughout their life cycle phases. The green color means that the raw materials have a low environmental impact, whereas, red means that an opportunity for significant improvement and perhaps, even, further research is recommended.

The upgraded MSI tool includes a rating system for raw material vendors in order to incentivize them to become environmentally sustainable using the following criteria (Nike 2010-2011): (1) whether or not they are complying with the Restricted Substance List (RSL) testing requirements and the Nike Water Program requirements; (2) if they are participating in the materials certification processes such as the Global Recycle Standard; and (3) if they have the ISO 14001 certification or conduct their production operations in "green" buildings.

6. Discussion of findings

Nike primarily used some form of DSS tool in designing a selected number of indices to help its decision makers address sustainability related issues: Considered Index; Materials Sustainability Index (MSI); Manufacturing Index; Sourcing and Manufacturing Sustainability Index; and

Country Risk Index. Turban et al. (2005) refer to a DSS as "…a computer-based information system that combines models and data in an attempt to solve semi-structured and some unstructured problems with extensive user involvement."

The MSI score reflects points earned by a specific raw material in three areas --- a base material score, material environmental attributes, and supplier practices (Nike 2012). Raw materials can earn a maximum of 100 points; the higher the MSI score earned, the more sustainable the raw material is. The MSI score also includes the four environmental impact areas taken into consideration by Nike: energy; greenhouse gas (GHG) intensity; water and land use intensity; and physical waste. Evaluation of the environmental impacts of raw materials depends on "life cycle analysis," (LCA) which tracks the environmental impacts of the product from the raw material stage through to manufacturing, distribution, and consumption.

6.1 Base Material Score

Life cycle information (LCI) is used to compute the Base Material Score. LCI is derived using a method that tracks the "cradle-to-gate life cycle" environmental impact of the raw material, which spans the origin of the raw materials, processing and pre-manufacturing activities, material manufacturing, and post-manufacturing processing (Nike 2012). The MSI framework uses a mathematical function to transform energy and GHG intensity, water and land use intensity, and physical waste data into a percentile score for each indicator. Nike evaluates both naturally sourced and synthetic raw materials.

6.1.1 Data issues with base material scores

The MSI framework uses multiple data sources when converting information into functional units: (1) for generic materials, Nike uses literature reviews covering peer-reviewed and publicly available publications, and (2) when LCI data in unavailable, Nike uses published studies where the data may be converted into the functional unit Nike uses. Nike uses primary data sources such as government and/or utilities data assembled by the World Resources Institute for the GHG protocol, and for ancillary data concerning electricity grids such as GHG intensity factors. When LCI data is not available, Nike uses estimates based on the firm's professional experience and judgment. Nike also uses supplier data provided through completed questionnaires for some raw materials. This data, however, is limited to certain segments of the cradle-to-gate life cycle.

6.1.2 Modeling issues with base material scores

Worksheets used to calculate Base Material Scores are also process flow charts which track the origin of the raw materials and continues through about 11 more processes (Nike 2012). LCI conventions are followed for calculating energy, GHG, and water intensity (Nike 2012).

6.2 Material Environmental Attributes

Nike positively scores a finished material for incorporating elements of green chemistry, recycled and organic content, and water conservation (Nike 2012). Point reductions occur when blending or compositing two or more raw materials takes place as more resources are needed for the manufacture and recycling of the resulting products at the end of their lives.

6.2.1 Nike green chemistry program

The Nike Green Chemistry Program seeks to reduce the use of toxic chemicals in the raw materials and production processes used. A systematic method assesses the presence of toxins in both the raw materials and production processes used.

6.2.2 Water conservation

Reuse and recycling of wet processing water in textile manufacturing are rewarded here. Points are awarded for the use of water-efficient or waterless processes for textiles and wet processing methods to color and/or finish the textiles, and for encouraging water reuse and recycling.

6.2.3 Recycled and organic content

Use of recycled and organic content in the raw materials is rewarded since these materials have low chemistry, energy and GHG intensity, and water and land use intensity requirements.

6.2.4 Blends and composites

Raw materials are penalized for the use of blends of composites --- the combination of two or more raw materials into a finished material--- due to its higher resource impacts in terms of chemistry, energy and GHG intensity, and water and land use intensity.

6.3 Supplier Practices

Suppliers that comply with a number of Nike's programs are rewarded: Nike's Restricted Substances List (RSL) Program, Water Program, Energy and Carbon Program, and other non-Nike sustainability certifications and programs that can improve a supplier's sustainable practices.

6.4 MSI Output and User Interface Issues

The user interface for the MSI framework is governed by the three tiers used in reporting data (Nike 2012). The Tier 1 end user view shows enough details to help the end user understand the scoring framework behind the Base Material Scores. The report view in Tier 1 shows an alphabetical listing of the high-level summary impacts of Chemistry, Energy and GHG Intensity, and Water and Land Use Intensity. The Tier 2 end user view was designed to give the materials and life cycle practitioner enough data to understand the MSI framework. The Tier 3 end user view accentuates the sources of data used for calculating the MSI score, algorithms employed, and assumptions used in order to present the reports or views shown in Tiers 1 and 2.

7. Conclusion and future research direction

Research results demonstrate that the data based on Nike's experience supports key elements of the TOE framework, which proves to be helpful in understanding why and how firms pursue their sustainability initiatives. Today's DSSs could support group-based collaborative decision making initiatives, which are appropriate to environmental DSSs such as the one used by Nike (Shim et al. 2001). Features of group support systems linked by Internet-enabled connections using portals or extranets could be used in synchronous and asynchronous decision making scenarios of virtual teams involving experts in the different scientific disciplines covered by life sciences (e.g., chemistry, biology, industrial ecology, etc.). Also, electronic connections with regulatory agencies and sources of ever changing government regulations will be essential. Constantly updating and displaying supplier performance on the relevant Nike indices using digital dashboards with electronic scorecards could hasten supplier responsiveness to Nike sustainability requirements.

Data management aspects of environmental DSSs could be made more powerful by the use of datawarehouses linked to enterprisewide systems that collect data with direct environmental implications. Overwhelming data volume could be managed using intelligent agents that screen and filter usable data from multiple organizational data sources. Java-based components could be designed to search for specific data sources that meet user-defined search profiles (Shim et al. 2002). The modeling component of the environmental DSS could be improved through the use of current solution software embodying techniques of metaheuristics to solve combinatorial problems. Techniques that could be used include genetic algorithms, neutral networks, and other artificial intelligence-based tools. More advanced mathematical programming behind the models could also be integrated with widely used tools like Microsoft Excel (Shim et al. 2002). User interface features could incorporate those supported by mobile device technologies, mobile e-services, and wireless protocols such as Wireless Application Protocol, Wireless Markup Language (WML), and iMode to encourage ubiquitous and rapid real-time communication and information exchange among decision makers (Shim et al., 2002).

Once a critical mass of firms across industries is found to be demonstrating corporate social responsibility through environmental sustainability, it would be feasible to conduct empirical research on the concepts embodied in the TOE framework. Relationships between appropriately operationalized TOE concepts and dependent variables like the firm's economic performance, costs of supporting its green supply chain, customer satisfaction and loyalty, among others, could be tested.

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