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# THE IDENTIFICATION OF KEY SUCCESS FACTORS IN SUSTAINABLE COLD CHAIN MANAGEMENT: INSIGHTS FROM THE INDIAN FOOD INDUSTRY

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**ABSTRACT:** Supply chain sustainability has emerged as an indispensable research agenda for governments, industriesand non-governmental organizations. Due to the country's status as a developing nation, cold supply chain management in India is still in its infancy.Today, due to health consciousness and a greater focus on sustainability, customers are demandingfresh, toxic free, highly eco-friendly food products. However, sustainable cold chains have not yet received sufficientattention throughout the world. Therefore, this paper seeks to address cold chain sustainability issues. After an extensive review of the literature and after discussions with cold chain practitioners, we have formulated ten sustainable cold chain constructs. We have then taken this proposed framework and validated it with an empirical study of the Indian food industry. This study includes several alarming findings. Specifically in India: i) environmental issues and social responsibility are not as important as other supplier selection criteria; ii)social responsibility ranks 18$^{th}$ among 19 food supplier selection criteria; iii) low carbon emissionsareviewed as a less important value added trait in comparison with other traits (this means that in India buyers focus more on individual and immediate benefits rather than longer lasting advantages); iv) life cycle analyses, renewable energy sources and passive cold chains are the least often implemented cold chain practices; v) the government usually encouragescompanies to adopt and implement sustainability in their operations, but in actual practice, training programs that provide guidance in terms of sustainability are less rigorous in comparison to the actual requirements; but on the bright side; vi) business sustainability builds trust between companies and all of their stakeholders and thus contributes to strong chain relationships.

***KEYWORDS:*** Food industry,cold supply chain, sustainability, production, supply chain practices.

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## 1. INTRODUCTION

Over the past few years, the practical implementation and study of sustainable supply chain management (SSCM) has been growing rapidly to include ecological, social and financial benefits (Ageron, Gunasekaran, & Spalanzani, 2012; Zailani, Jeyaraman, Vengadasan, & Premkumar, 2012; Bourlakis, Maglaras, Aktas, & Gallear, 2014). Today, sustainability in supply chains (SC) has become an unavoidable subject (Porter & Kramer, 2006) and plays a critical role in efficient SC execution. It enables companies to achieve a high level of efficiency through optimal resource planning (Rao & Hotl, 2005; Beske, Land, & Seuring, 2014). Globally, however, research on sustainability in cold chain (CC) management has not received enough attention. Indeed, sustainable cold chain management (SCCM) is a strategic tool for achieving social, ecological and economic goals in managing SC activities that deal with perishable products like medicine, blood, dairy, meat, food, vegetable, mushroom, flower and fruit products, etc., which must be processed, kept, stored and distributed under special time and environmental conditions.

One of the important branches of CC deals with the food supply. The food industry is subject to regular changes in customer demand patterns (Aramyan, Kooten, Vorst, &Oude Lansink, 2007; Beske et al., 2014; Bourlakis et al., 2014). However, food CC can be divided into "fresh agricultural products" (e.g. vegetables and fruits) and "processed food products" (e.g. convenience food and soft drinks). Generally, SCCM demands practices like environmental friendly packaging, the use of passive CC (using ice and water to maintain the temperature of perishable products), temperature-controlled production, cold logistics systems, the use of recyclable packaging, and the systematic handling of returned orders and proper waste disposal, etc. As a consequence, CC requires huge amounts of power to maintain the temperature of perishable foodstuffs during warehousing, transportation and the retail end, which leads to CC producing one percent of all world carbon emissions (Bozorgi, Zabinski, Pazour, &Nazzal, 2015). In addition to this, in many developed and developing nations, firms do not accurately dispose of large quantities of these wastes (Nandy et al., 2015).

Food production in India was 264.80 million tons in 2013-14, and this figure declined 3% to 257.07 million tons in 2014-15. Here it is interesting to note that 30-40% of farm products are spoiled due to a lack of cold storage facilities in India. Moreover,India is currently facing high inflation in terms of food prices (Devi, 2014). Thus, declining production, increasing waste, environmental issues, new health problems and a growing population indicate that unfavorable conditions will continue in the near future. Thus, focusing on SCCM will help to cope with the problems we have discussed above. The main focus of this article will be on studying the following research questions:

- What are the reasons behind the adoption of sustainable CC practices?
- What are the food supplier selection criteria?
- What are current sustainability environmental issues?
- How does SCCM add value for firms and customers?
- What are the categories of sustainable CC?
- What are effective CC practices and the dynamic capabilities needed to attain sustainability?
- What are the most effective indicators for measuring sustainable CC performance?
- What are the major hurdles to,and possible paybacks from sustainable CC?

To the best of the authors' knowledge, this is the first study to focus on CC sustainability in order to assist companies in identifying the key success factors, so that all the economic, environmental and social goals can be satisfied simultaneously. This paper has several distinctive features:

- For the first time all factors that are likely to influence the performance of SCCM have been identified.
- The most important implemented industrial sustainable practices and their benefits for enterprises as well as for society are discussed.
- A number of promising performance indicators for evaluating SCCM have been identified through cooperation with Indian food industry firms.
- This paper will provide firms as well as their stakeholders with a clear understanding of what is important to them and what they need to do. Thus, it will surely improve their competitiveness in meeting sustainability expectations.

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The ensuing sections discuss the state of the art literature in the relevant fields, proposed approach, and results after implementing it in the context of analyzing SCCM. There are 7 main sections. Section 2 is a review of the literature related to SSCM. Section 3 presents our conceptual model of SCCM. We discuss our research methodology and empirical analysis in Sections 4 and 5. Finally, Sections 6 and 7 consist of a discussion of the results and our concluding remarks.

## 2. LITERATURE REVIEW

In this section, we review the SC sustainability literature on in order to identify existing gaps. SC sustainability has remained at the top of the research agenda over the past few decades in industry as well as academia. The negative impact of industrial growth and high resource consumption during the 1970s and 1980s has led to an increased general awareness of SSCM (Barber, 2007). Shashi and Singh (2015) address cold logistics management as an important exercise in food SC, focusing on as it focuses on strategic, transparent integrated cooperation and the attaining of company ecological, social and financial goals through inter-organizational trade processes.Moreover, Gimenez, Sierra, and Rodon (2012) address CC sustainability as a triple bottom line for stakeholder satisfaction.

Sustainability in food CC deals with how organizations may be depleting their resources (Bourlakis et al., 2014). Like other products SC, food chain processing also generates industrial effluents and other wastes (NCCD, 2012). These wastes are also one of the most pervasive concerns in terms of sustainability. CC by itself may account for 1% of world carbon emissions (Bozorgi et al., 2015). Thus, there is a strong need to decrease this carbon emission rateby using macroscopic CC methods (Guo & Shao, 2012). Basically, transportation and distribution cost show the level of competency of a company's CC logistics operations. It thus indicates the sustainable capacity of companies to reduce their fuel consumption, costs and wastes. Meanwhile, exact route planning can reduce lead times, food spoilage, fuel costs and carbon emissions (Carter & Dresner, 2001; Bogataj, Bogataj, & Vodopivec, 2005). This implies that CC logistics management can not only help attain environmental sustainability, it can minimize costs.

Generally, factors such asthe cross-modal links, infrastructure networks, the amount and nature of investments, rules, coordination and company visions affect CC sustainability (Subin, 2011). Indeed, appropriate stockroom location, temperature monitoring and the adequate disposal of hazardous materials add sustainability to business processes. Ma and Wang (2010) discuss the importance of freezing at production, storage and distribution points. In the same vein, Clark (2007) emphasizes that SSCM requires the implementation of a product-oriented approach and a shift towards more valuable product manufacturing that can meet buyer expectations. In addition, all upstream and downstream partners should apply specific sustainability practices during their stages (Hanson, Melnyk, & Calantone, 2004).

Today, companies demand more from their vendors to help them attain a competitive position. Better buyer-supplier relationships can foster flexibility, customer responsiveness, green purchasing, quality control, added value, reverse logistics and recycling (Vachon & Mao, 2008). Shreay, Chouinard, and McCluskey (2016) address the fact that efforts to improvesustainable practices on the part of suppliers can minimize total costs and maximize consumer satisfaction.This highlights the importance of strategic supplier development programsin gaining competence in sustainability. Hence, appropriate supplier selection and evaluation can enhance organizational social responsibility in terms of the environment and society (Vachon & Mao, 2006; Andersen & Skjoett-Larsen, 2009).

Moreover, national and local governments, the World Health Organization and other NGOs have been working to save the environment and protect consumers from food scandals (Gruber & Panasiak, 2011). In doing so, many governments have also started providing grants to firms to sustain their sustainability programs. This can help firms and their suppliers mitigate the risk of environmental and political uncertainty (Liu, Ke, Wei, Gu, & Chen, 2010). Besides,using recyclable packaging material (Shreay et al., 2016), reducing waste and pollution, and using carbon free energy can improve a company's image (Beske et al., 2014).It is obvious that there is a vast amount of literature available that deals with SSCM. Nevertheless, most of these studies fail to highlight CC sustainability issues. Hence, this study attempts to fill this gap.

## 3. A CONCEPTUAL MODEL FOR SUSTAINABLE COLD SUPPLY CHAIN MANAGEMENT

Based on the literature discussed above, we have developed a conceptual model for SCCM for this

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study based on Ageron et al. (2012). This article uses tenSCCM constructs, namely: (1) reasons behind the adoption of sustainability, (2) food supplier selection criteria, (3) environmental awareness, (4) adding value through sustainable CC, (5) sustainable CC categories, (6) sustainable CC practices, (7) sustainable CC dynamic activities, (8) sustainable CC performance indicators, (9) sustainable CC hurdles, and (10) sustainable CC paybacks.

### *3.1. Reasons/motivations behind the adoption of sustainability*

In business, each and every task has a specific objective. These days, the accelerating rise in world temperature, the depletion of available resources, and large quantities of soil, water and air pollution due to increased industrialization and large amounts of food waste are some key concerns that must be controlled within a specific period of time (Doonan, Lanoie, & Laplante, 2005; Papargyropoulou, Colenbrander, Sudmant, Gouldson, & Tin, 2015). Global competition is another factor that has made sustainability more important in securing competitive benefits (Kaditi, 2013). Moreover, customer expectations, government initiatives, and pressure from related national/international food safety bodies and health organizations, as well as financial institutions and NGOs have obliged companies and their chain partners to adopt sustainability in their business operations. As a consequence, firm managers are taking sustainability seriously in terms of their business visions.

### *3.2. Food supplier selection*

Suppliers are known as the engine of business. Organizations expecttheir suppliers to adopt sustainable SC practicesto maximize the firm's integrity. The incorporation of technology on the part of primary suppliers has a significant impact on organizational profitability, and supplier performance also has a profound influence on SC performanceoverall (Ageron et al., 2012; Rezitis & Kalantzi, 2016). According to Fritz and Schiefer (2008) and Chapbell, Mhlanga, and Lesschaeve (2016), consumers demand fresh, safe and value-added food for consumption at reasonable prices, as well as its availability through prompt delivery at locations near them. In this regard, selecting an appropriate food supplier is a major decisionthat involves the consideration of criteria such as product freshness, its commitment to fulfilling orders, cost, quality, prompt delivery, environmental friendly operations, service rates and supplier certifications, etc. Our review of the literature has helped us in this identification of food supplier selection criteria (Losito, Visciano, Genualdo, & Cardone, 2011; Palak, Ekşioğlu, & Geunes, 2014; Grimm, Hofstetter, and Sarkis, 2014).

### *3.3. Environmental awareness*

Environmental awareness issues revolve around all spheres of life. It is essential that all business partners should be more familiar with these issues in order to develop a healthy ecological, economic and social environment. Some of the popular sustainability issues are organic production, reductions in resource utilization and waste, and the proper disposal of waste, green sourcing, lean processing, recyclable packaging and logistics, etc. (Guo, Liang, & Xu, 2008; Gunasekaran & Spalanzani, 2012).

### *3.4. Value adding factors for Sustainable CC*

Today, adding value at each stage of CC is a paramount business objective and is associated with consumer buying behavior. Therefore, the development of sustainable food value chains could help firms and their partners increase their profits (Martinez et al., 2006). Moreover, value chainsrequire close collaboration between various stakeholders, namely: farmers, agribusinesses, governments and civil society who all add value to agricultural products through sorting, grading, processing, green packaging, refining purity and taste, etc. (Shashi & Singh, 2015) In this way, the value added through sustainability can be used as a diagnostic tool to manage operations, investments and buying decisions that affect CC performance.

### *3.5.Sustainable CC categories*

CC categories are frequently implied by the management of equipment and employees. Making decisions relating to partners, learning programs and transportation systems, etc. are critical sustainable CC categories inthe food business. Thus, thecompanyhas to map out the most promising sustainable CC categories to deal with risks and opportunities. These categories can be classified as: partner development, partner selection, joint development, technical integration, cold logistics integration (Guo & Shao, 2012), organizational learning, stakeholder management, and innovation and life cycle assessment (Bai, Sarkis, Wei, & Koh, 2012). However,the selection of sustainability categories dependsvery

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much on a firm's size and the availability of its resources. It can foster strategic planning pertaining to energy, products, transportation and material management,and can also develop a culture of learning and development throughout the chain.

### *3.6. Sustainable CC practices*

Sustainable CC practices are important elements in the food industry. As we discussedabove, SCCM permits organizations to implement practices like green sourcing, green packaging, reprocessing and proper waste dumping (James & James, 2010). It significantly affects sustainable CC performance. Environmental sustainability is not possible without adopting SCCM practices. Moreover, the integration of sustainable practices between upstream and downstream partners can increase the effectiveness of operational performance and resource utilization (Carter & Rogers, 2008).

### *3.7. Sustainable CC dynamic activities*

A firm's dynamic activities help develop, expand or/ and adjust its resources to obtain greater cost-effectiveness than its competitors. These organizational activities can comein the form of knowledge assessment, knowledge acquisition, ability development, partner development, product development, cold logistics integration and CC relationship management. Reflective control over the whole CC process permitsnew resource configurations and makes it possible to adapt to sudden changes. Furthermore, these activities help organizations improve chain traceability and monitoring to satisfy customer expectations.

### *3.8. Sustainable CC performance indicators*

Performance measurements play a vital role in evaluating firm efficiencies and inefficiencies to make the necessary changes in existing structures (Aramyan et al., 2007). Therefore the right selection of performance indicators is of great importance to SCCM. These performance indicators should include reductions in processing costs, inventory costs, waste rates, energy consumption rates, order return rates and an increase in the use of passive CC, etc. (Guo & Shao, 2012). Agricultural products are produced on a seasonal basis; therefore, food safety and control over the food supply during all chain stages is very important for effective performance management (Martinez, Poole, Skinner, Illes, & Lehota, 2006; Fritz & Schiefer, 2008). We have selected these SCCM performance indicators after considering all stages of the food supply, starting with production and ending with retail stores.

### *3.9. Sustainable CC hurdles*

The hurdles that block the implementation of CC sustainability are different compared to general SC. It is essential to identify these hurdles in order to mitigate their impact on a firm's overall performance. Some of the major hurdles that have restricted CC sustainability are inadequate CC infrastructure, uneven installation of CC centers, high energy costs, a lack of CC integration, inefficient processes, a lack of effective environmental measures, a lack of government support and a lack of CC expertise (Subin, 2011; Bozorgi et al., 2015). In this section we will underline the major hurdles to the implementation of CC sustainability in a firm's operations.

### *3.10. Sustainable CC paybacks*

There are a number of paybacks to implementing CC sustainability that occur in different forms. These can be in terms of reducing risks, costs, inventory levels, lead times, waste and adding more value, offering greater flexibility, customer satisfaction, improved quality, brand value, improved working conditions and strong inter-organizational relationships, etc. (Barber, 2007; Pagell, Krause, & Klassen, 2008; Luthra, Kumar, Kumar, & Haleem, 2011). Therefore, it is important for organizations to carefully evaluate CC sustainability paybacks. This will enable organizations to maintain strong positions in relation to their competitors and mitigate the risks associated with political uncertainty.

## 4. RESEARCH METHODOLOGY

At this juncture, after formulating the conceptual model for SCCM, we will shed some light on our research methodology for this study.

To address this study, we have formulated a semi-structured questionnaire to answer our research questions through primary data. Here we were interested in covering all aspects of SCCM. The whole questionnaire was divided into two parts: organizational characteristics and firm sustainability.Organizational characteristics were associatedwiththe firm profilewhile thethefirm's sustainability was divided into 10 proposed conceptual framework constructs.

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Regarding our questionnaire, we ignored the 5 point Likert scale due to its inability to deal with question sensitiveness (Finstad, 2010). As an alternative, we used two 7-point Likert scales and one rank scale to record feedbacks. The first scale covered the 5 sustainable CC constructs (strongly disagree (1) to strongly agree (7)). The aim of this is to underline the firm's considerations pertaining to the reasons for adopting CC sustainability, environmental awareness, performance measurement indicators, hurdles and paybacks. The second scale covered one construct with 19 variables of supplier selection criteria on the basis of a ranking ((1) most important to (19) least important). The intention behind the measurement of this construct was to identify the top priorities of companies in terms of upstream integration. The third scale covered 4 constructs, namely: adding value through sustainability, CC categories, CC practices and dynamic activities (very low extent (1) to a very high extent (7)). The focus behind this is to identify how companies are working to achieve their sustainability goals.

The content validity of the proposed questionnaire was examined by sending it to 14 food CC experts. At this point, the aim was to ascertain that the content of our investigation was measuring what we proposed to measure. Experts were then asked to give their suggestions, and using them we refined our questionnaire. Afterwards, improved questionnaire was sent to a pilot study to identify any remaining shortcomings. This pilot survey helped us eliminate a few unimportant variables from the questionnaire.

Finally, the full-fledged scale survey was conducted in Indian food industry CC from November 2014 to March 2015. A total of 674 questionnaires were sent through the mail to perishable food product CC practitioners. The list of respondents included CEOs, purchase managers, production managers, quality assurance managers, marketing & sales managers, SC managers, retail managers and others. In total, we received 487 filled out questionnaires in return. We only digitalized 463 out of the 487 returned questionnaires in SPSS because of (missing values and zero standard deviations) with 24 questionnaires. Descriptive statistics (means, standard deviations and rankings) were used to answer the research questions.

The survey findings indicate that the businesses with the greatest representation (32.81%) were from the food processing area. In addition, SC managers accounted for the largest portion of survey respondents, equivalent to 21.02%. Table 1lists the business area and job profile for each of the respondents.

**Table 1: Digitalized survey profile**

| **Business Nature** | **Remarks** | **Respondent Profile** | **Remarks** |
|---|---|---|---|
| Food processing firms | 63 (32.81%) | CEO | 14 (3.02%) |
| Cold logistics service providers | 46 (23.95%) | Purchase manager | 78 (16.84%) |
| Distribution firms | 49 (25.52%) | Production manager | 65 (14.03%) |
| Retail firms | 34 (17.70%) | Quality assurance manager | 58 (12.52%) |
| **Total** | **192 (100%)** | Marketing & sales manager | 63 (13.60%) |
| | | Supply chain manager | 104 (21.09%) |
| | | Retail manager | 52 (11.23%) |
| | | Others | 29 (6.26%) |
| | | **Total** | **463 (100%)** |

## 5. EMPIRICAL ANALYSIS

Sustained practices in CC mostly come from outside India. The country's CC segment is highly fragmented and not developed properly to attract a large number of domestic specialists. It is clear that the rate of energy usage by CC technologies directly affects both the feasibility and finances of sustainability. Unfortunately, due to the use of obsolete equipment and machinery, CC consumes a high rate of energy in India (KPMG, 2009). Thus, authorities in the agriculture, power, education and food segments must work together to encourage the use of advanced CC technology, modern logistics systems, and the development of CC infrastructure networks

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and expertise. In addition, the government must keep on encouraging more private players to invest in Indian CC in order to bring significant competence in sustainability to the food sector.

The results obtained in terms of the reasons and motivations behind applying sustainable practices in Indian CCs are displayed in Table 2. Our findings show government rules and regulations are the main reasons that companies have adopted sustainability in both their own operations and in their supplier's operations. This indicates that government regulatory requirements are playing a leading role in protecting the environment and society. Moreover, sustainability is a strategic concern, and without top-management support it is difficult to achieve. Our findings indicate that the vision of top management frequently incorporates financial, societal and ecological responsibilities in their organizational actions and strategic plans.

Sustainability refers to social, economic and ecological concerns which advocate a better care of customer expectations. Green packaging, lower prices, higher quality, lower carbon emissions and prompt delivery, etc. are the key drivers of sustainability. In today's marketplace, firms that ignore sustainability will be ignored by customers when they make their purchases. Moreover, our analysis emphasizes that both customer expectations and market competitiveness have significantly encouraged sustainable CC practices. Government ecological initiatives have also had a significant impact on the understanding of sustainability issues. In our list of reasons behind the adoption of sustainability, the role of NGOs received the lowest ranking, while in many studies, pressure on firms to adopt sustainability is said to be significant.

**Table 2: Reasons for the adoption of sustainability**

| Reasons for the adoption of sustainability | Rank | Mean scores | Std. deviation |
|---|---|---|---|
| Government regulatory requirements | 1 | 6.04 | 1.312 |
| Top management vision | 2 | 5.83 | 1.826 |
| Customer expectations | 3 | 5.55 | 1.041 |
| Market competition | 4 | 5.47 | 1.405 |
| Government ecological initiatives | 5 | 4.79 | 1.578 |
| NGOs | 6 | 4.32 | 1.733 |

In terms of food supplier selection, accuracy (2.24), quality (2.68), product freshness (3.26), cold warehouses and vehicles (3.59) and price (4.02) are the most promising variables considered. Likewise the supplier order fulfillment capacity (4.42), quantity and cash discounts (4.84) and service rates (5.10) also significantly affect supplier selection. In addition, these firms also give preference to those suppliers who are nearest in terms of geographical location (5.56). This is surely to cut inbound costs, leadtimes and reduce food spoilage during transportation.

We also can observe here that credit-based sales (8.22) attract firms to buying material in bulk quantity from suppliers. One astonishing result of our findings reveals that despite the remarkable global attention paid to the subject of sustainability (i.e. the simultaneous concentration on social, environmental and economic goals), in India, environmental issues (10.13) and social responsibility (11.77) are not as important as other economic supplier selection criteria. In spite of this, environmental issues are fortunately more important for firms at the time of supplier selection compared to long-term SC relationships (10.36) and personal relationships (12.49). In Table 3, we display the food supplier selection criteria.

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**Table 3: Food supplier selection criteria**

| Criteria | Rank | Mean scores | Std. deviation |
|---|---|---|---|
| Accuracy | 1 | 2.22 | 1.072 |
| Quality | 2 | 2.68 | 1.207 |
| Product freshness | 3 | 3.26 | 1.495 |
| Cold warehouses and vehicles | 4 | 3.59 | 1.363 |
| Prices | 5 | 4.02 | 1.850 |
| Order fulfillment capacity | 6 | 4.42 | 1.329 |
| Quantity and cash discounts | 7 | 5.10 | 2.152 |
| Service rates | 8 | 5.12 | 2.848 |
| Geographical proximity | 9 | 5.56 | 3.939 |
| Variety | 10 | 6.63 | 3.683 |
| Delivery style | 11 | 6.87 | 4.027 |
| Certification | 12 | 7.21 | 5.514 |
| Credit based sales | 13 | 8.22 | 5.430 |
| Information sharing ability | 14 | 8.43 | 5.793 |
| Goodwill | 15 | 9.43 | 5.461 |
| Environmental issues | 16 | 10.13 | 5.126 |
| Long-term SC relationships | 17 | 10.36 | 7.960 |
| Social responsibility | 18 | 11.77 | 7.633 |
| Personal relationships | 19 | 12.49 | 6.485 |

Aspects related to the environmental awareness of sustainability are reported in Table 4. This is very important because it shows how environmental awareness helps business by lowering overhead costs, offsetting power usage, reducing the cost of waste removal, as well as boosting, easing and reducing the costs of paperless processes, etc. A company may have the most ambitious environmental policy, but unless it makes all of its stockholders environmentally aware so that they understand the philosophy behind their policy, the goals that the company is aiming for will not be achieved. Our findings indicate that the use of green transportation channels, solar energy and passive CC has not yet received serious attention as expected. This may be happening because less CC expertise is available and the complex designing solar energy projects in India. Indeed, stricter ecological policies and regulation, reverse logistics and product lifecycle management have started to receive attention. It is also interesting that Indian firms consider getting ISO 14001 certification and reducing both waste and energy consumption to be promising solutions for achieving environmental awareness for sustainable CC.

**Table 4: Major aspects of environmental awareness in sustainability**

| Aspects | Rank | Mean scores | Std. deviation |
|---|---|---|---|
| Waste reduction | 1 | 6.19 | 1.124 |
| ISO 14001 Certification | 2 | 6.12 | 1.314 |
| Reduction of energy consumption | 3 | 5.93 | 1.381 |
| Lean management | 4 | 5.83 | 1.279 |
| Proper waste disposal | 5 | 5.72 | 1.296 |

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| | | | |
|---|---|---|---|
| Recyclable packaging | 6 | 5.43 | 1.574 |
| Safety and agile health | 7 | 5.30 | 1.514 |
| Lower levels of greenhouse emissions | 8 | 5.29 | 1.207 |
| Resource management efficiency | 9 | 5.12 | 1.337 |
| Adoption of latest technology | 10 | 4.98 | 1.672 |
| Reverse logistics | 11 | 4.64 | 1.450 |
| Product life cycle management | 12 | 4.31 | 1.625 |
| Solar energy utilization | 13 | 3.98 | 1.067 |
| Use of passive CC | 14 | 3.85 | 1.463 |
| Green transportation channels | 15 | 3.63 | 1.853 |

Moreover, prompt delivery, taste, freshness and proper food labeling are important concerns in terms of VA food traits due to their short shelf life. An unpleasant taste for processed farm products has a detrimental effect on their consumption. A large quantity of perishable products gets spoiled during shipping; hence, packaging and expiration dates can help suppliers handle these products within an appropriate timeframe. Furthermore, this helps make buyers aware of this product attribute in terms of consumption and controlling food hazards. In addition, having farm products available during the entire year will provide significant added value for customers. Table 5 lists the results for the value added by sustainable CC construct.

Our survey results show that low carbon emissions are viewed as providing less added value than other traits. This emphasizes that in India, buyers focus more on their individual and immediate benefits such as money savings, quality, taste, labeling, availability and less lead time rather than long lasting benefits such as a healthy environment. We can see that effectively adding value is good for a firm's business and that of its partners. Not surprisingly, lower prices are the most important VA factor.

**Table 5: Value adding factors for Sustainable CC**

| Value Adding Factors for Sustainable CC | Rank | Mean scores | Std. deviation |
|---|---|---|---|
| Lower price | 1 | 6.18 | 1.323 |
| Purity | 2 | 6.17 | 1.204 |
| Quality | 3 | 6.08 | 1.135 |
| Organic food | 4 | 5.93 | 1.436 |
| Fresh food | 5 | 5.86 | 1.310 |
| Taste | 6 | 5.83 | 1.438 |
| Prompt delivery | 7 | 5.72 | 1.183 |
| Less supplier lead time | 8 | 5.69 | 1.203 |
| Environmentally friendly packaging | 9 | 5.60 | 1.317 |
| Availability | 10 | 5.59 | 1.562 |
| Proper Labeling | 11 | 5.56 | 1.336 |
| Less manufacturer lead time | 12 | 5.24 | 1.478 |
| Reverse logistics | 13 | 5.13 | 1.372 |
| Grading | 14 | 4.94 | 2.583 |
| Sorting | 15 | 4.76 | 1.610 |
| Low carbon emissions | 16 | 4.41 | 1.939 |
| Variety | 17 | 4.35 | 1.717 |

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Now we turn to the part of this study that deals with sustainable CC categories. Our results emphasize that risk management and CC integration are almost equally important sustainability categories. Firms have adopted technical integration to gain mutual benefits through combining available technologies. Meanwhile, organizations are giving greater preference to learning from the internal as well as the external business environment to maintain their business competitiveness. Stakeholder management is essential for tackling business uncertainty. Here the innovation category (4.00) is neglected to some extent. Strategic orientationin trade related areas is important in the effective management of the entire SC. Table 6 lists sustainable CC categories in order of their importance.

**Table 6: Sustainable CC categories**

| Sustainable CC categories | Rank | Mean scores | Std. deviation |
|---|---|---|---|
| Risk management | 1 | 5.32 | 1.287 |
| Cold logistics integration | 2 | 5.25 | 1.463 |
| Technical integration | 3 | 4.99 | 1.316 |
| Learning | 4 | 4.81 | 1.614 |
| Stakeholder management | 5 | 4.65 | 1.692 |
| Strategic orientation | 6 | 4.47 | 1.535 |
| Supply chain continuity | 7 | 4.40 | 1.684 |
| Innovation | 8 | 4.00 | 1.892 |

Developing sustainable CC practices is not only critical to business growth, but is also beneficial to future generations. Globalization, climatic change and changes in consumption patterns and increased middle class purchasing power have simultaneously raised the need for improved sustainable CC practices. In this regard, improving ecological standards is viewed as the most important sustainable CC practice. Reducing energy consumption and waste are also receiving attention from firms. Similarly, reducing hazardous/toxic materials in food products is also viewed as important. We have listed sustainable CC practices in the order of their importance in Table 7:

**Table 7: Sustainable CC practices**

| Practice | Rank | Mean scores | Std. deviation |
|---|---|---|---|
| Significant improvement in fulfillment of ecological standards | 1 | 5.93 | 1.196 |
| Significant reduction in hazardous/toxic materials | 2 | 5.79 | 1.298 |
| Achieving waste reduction goals | 3 | 5.78 | 1.009 |
| Strong relationships with the community | 4 | 5.56 | 1.211 |
| Use of clean production technology | 5 | 5.47 | 1.224 |
| Reduction in operational costs | 6 | 5.46 | 1.467 |
| Physical layout designed to optimize materials and energy | 7 | 5.32 | 1.365 |
| Reverse logistics | 8 | 5.26 | 1.972 |
| Recycling | 9 | 5.14 | 1.643 |
| Purchase of packaging that is of lighter weight | 10 | 5.10 | 2.115 |
| Purchase of recyclable packaging material | 11 | 5.06 | 1.631 |

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| | | | |
|---|---|---|---|
| Use of life cycle analysis | 12 | 4.63 | 1.572 |
| Use of renewable energy sources | 13 | 4.26 | 1.565 |
| Use of passive CC | 14 | 4.01 | 1.390 |

Firms are using regular meetings and large amounts of knowledge sharing as the most implemented dynamic activities. Similarly, knowledge acquisition and evaluation, licensing and partner based synergies are other important major activities that firms have adopted in their organization to promote sustainability. At this point, the joint development of products is viewed as the least important dynamic activity. Thus we can conclude that there is a focus on the part of of businesses on their own core competencies.

Our analysis reveals that the rest of the sustainable dynamic activity variables are implemented to a great extent by the firm to develop and maintain sustainability. We can also see that the quality of shared knowledge is more crucial than the transparency of the actions taken. Here in Table 8, then, we list the sustainable CC dynamic activities that assist firms in implementation.

**Table 8: Sustainable CC dynamic activities**

| **Dynamic activity** | **Rank** | **Mean scores** | **Std. deviation** |
|---|---|---|---|
| Regular meetings | 1 | 6.23 | 1.177 |
| Knowledge sharing | 2 | 6.15 | 1.249 |
| Knowledge acquisition and evaluation | 3 | 5.93 | 1.392 |
| Licensing | 4 | 5.90 | 1.285 |
| Partner-based synergies | 5 | 5.87 | 1.363 |
| Transparency | 6 | 5.76 | 1.668 |
| Partner development programs | 7 | 5.64 | 1.403 |
| Common IT System | 8 | 5.41 | 1.574 |
| Partner training | 9 | 5.28 | 1.780 |
| Joint development of products | 10 | 4.82 | 1.813 |

When sustainability is implemented, it needs to be measured in order to make changes in existing patterns to accomplish predefined sustainability objectives. Hence, CC performance measurement is the most important step towards successful and effective SCCM.

As we can see from Table 9, reducing the rate of waste is the most appreciated sustainable CC performance indicator in terms of helping firms quantify their cash and material savings. Reduced levels of carbon emissions and customer complaints and improved customer satisfaction rates are also considered in evaluating CC operations. Since CC requires a large amount of energy sources, the evaluation of reduced energy consumption is also a key indicator to ensuring CC sustainability. Overall, firms consider sustainable CC performance indicators to be important,since the score of the least important indicator (i.e. reduced maintenance costs) is 5.32.

**Table 9: Sustainable CC performance indicators**

| **Sustainable CC performance indicators** | **Rank** | **Mean scores** | **Std. deviation** |
|---|---|---|---|
| Reduction in waste rate | 1 | 6.04 | 1.132 |
| Reduction in customer complaint rate | 2 | 5.98 | 1.211 |
| Reduction in carbon emission rate | 3 | 5.97 | 1.186 |

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| | | | |
|---|---|---|---|
| Customer satisfaction rate | 4 | 5.94 | 1.185 |
| Reduction in overall energy use | 5 | 5.86 | 1.716 |
| Reduced transportation costs | 6 | 5.79 | 1.481 |
| Shipping accuracy rate | 7 | 5.76 | 1.379 |
| Reduction in lead time | 8 | 5.72 | 1.652 |
| Improved product quality rate | 9 | 5.71 | 1.307 |
| Increased profits | 10 | 5.69 | 1.373 |
| Reduction in cooling costs | 11 | 5.64 | 1.439 |
| Reduced inventory costs | 12 | 5.62 | 1.377 |
| Staff retention | 13 | 5.62 | 1.247 |
| Order returns | 14 | 5.56 | 1.624 |
| Reduced processing costs | 15 | 5.54 | 1.407 |
| Recycling rate | 16 | 5.40 | 1.438 |
| Reduced warehousing costs | 17 | 5.35 | 1.512 |
| Reduced maintenance costs | 18 | 5.32 | 1.420 |

A list of hurdles that have stifled sustainability is shown in Table 10. These obstacles to implementing sustainable cold chains in India have been hot topics in discussions about why India has yet to become the "Food Basket of the World." In India, inadequate CC infrastructure, high investment costs, a lack of CC expertise, high energy costs and the complexity of designing ways to reduce the consumption of resources and energy are considered to be the biggest obstacles which have impeded the adoption of CC sustainability. One interesting finding here is that a lack of government support received a value of 4.38, while a lack of training courses is ranked 15th.This means that the government usually has backed firms in the adoption and implementation of sustainability in their operations, but that training courses to guide this process have not been made a requirement.

Moreover, available CC has been installed unevenly which shows up in the unavailability of multi-commodity based CC capacity. A report published by the Emerson Group emphasizes that most of the available CC technologies in the country are outdated. Hence, the existing structure requires more CC coordination, ideal arrangements, consistent processes, specific environmental goals and the latest CC technology.

**Table 10: Sustainable CC hurdles**

| **Sustainable CC hurdles** | **Rank** | **Mean scores** | **Std. deviation** |
|---|---|---|---|
| Inadequate CC infrastructure | 1 | 6.32 | 1.134 |
| High investment costs | 2 | 6.30 | 1.136 |
| Lack of CC expertise | 3 | 6.18 | 1.092 |
| High energy costs | 4 | 6.14 | 1.120 |
| Complexity of designing ways to reduce resource/energy consumption | 5 | 6.01 | 1.078 |
| High costs of hazardous waste disposal | 6 | 5.98 | 1.236 |
| Lack of CC integration | 7 | 5.97 | 1.203 |
| Costs of environment friendly packaging | 8 | 5.96 | 1.404 |
| Lack of specific environmental goals | 9 | 5.95 | 2.270 |

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| | | | |
|---|---|---|---|
| Unavailability of CC performance measurements | 10 | 5.89 | 1.117 |
| Uneven installation of CC centers | 11 | 5.86 | 1.280 |
| Lack of technology | 12 | 5.81 | 1.538 |
| Complexity of designing ways to recycle used products | 13 | 5.78 | 1.248 |
| Inefficient processes | 14 | 5.73 | 2.437 |
| Lack of training courses | 15 | 5.62 | 1.381 |
| Lack of awareness about adopting reverse logistics | 16 | 5.42 | 1.363 |
| Lack of government support | 17 | 4.38 | 1.136 |

According to the figures reported in Table 11, the major paybacks of sustainable CC are goodwill, higher customer satisfaction and less lead time. It also leads to significantly more added value, better quality and reduction in waste. As companies have implemented their sustainability plans, working and living conditions have definitely improved. Thus, we can observe that business sustainability builds trust between the government, suppliers, firms and all of the stakeholders involved in building strong CC relationships.

**Table 11: Paybacks of sustainable CC**

| Paybacks of sustainable CC | Rank | Mean scores | Std. deviation |
|---|---|---|---|
| Goodwill | 1 | 6.18 | 1.200 |
| Customer satisfaction | 2 | 6.17 | 1.199 |
| Less lead time | 3 | 6.08 | 1.386 |
| Large amount of added value | 4 | 5.93 | 1.357 |
| Reductions in waste | 5 | 5.88 | 1.148 |
| Improved quality | 6 | 5.87 | 1.240 |
| Improved working conditions | 7 | 5.80 | 1.235 |
| Reductions in stocks | 8 | 5.73 | 1.356 |
| Flexibility | 9 | 5.63 | 2.049 |
| Reductions in energy costs | 10 | 5.54 | 1.121 |
| Strong CC relationships | 11 | 5.54 | 1.883 |
| Development of trust | 12 | 5.53 | 1.943 |

## 6. DISCUSSION

Ten sustainable CC constructs have been used to develop the theoretical model framework for this study. In this study, we have specifically conducted an analysis of the Indian food industry in terms of CC sustainability practices. To test and validate this model framework we have developed a semi-structured questionnaire.

Perhaps government regulatory requirements create fear among firms in terms of fulfilling the sustainability prerequisites. The evasion of these prerequisites creates regulatory problems for profit-oriented organizations that can lead to the cancelling of licenses and cash fines. Nonetheless, there is a strong need to evaluate the regulatory compliance rate in small scale industries. The findings of this study indicate that CC infrastructure is a prime area for improvement. Therefore the government should promote private investment in the CC sector, which would be beneficial for sustainable development. Similarly, government efforts in the domain of emission control technology, awareness and expertise could significantly contribute to attaining sustainability.

In addition to this, companies need to set their yearly sustainability goals, and to accomplish these goals

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companies they need to be fully integrated with their upstream and downstream partners and also be concerned with their own performance. More emphasis should be placed on waste reduction because it also affects waste disposal costs. Likewise, employee retention and training may enable firms to wield better control over emissions during the production process. Usually authorities do not put much emphasison evaluating the workflow of these business units. Managers frequently are not very dedicated towards their entrepreneurial and social responsibility responsibilities, which leads to apathy on the part of middle and lower level workers. Thusapathy of this kind can foretell greater carbon emissions, raw material waste, energy waste and internal conflicts in the future. We deem this to be another interesting finding as no previous work has confirmed the impact of management commitment upon the performance of their subordinates.

Indeed, firms are giving more preference to delivering pure, quality products to consumers to make them healthier, but not to reduce carbon emissions. Though product purity and quality have only the positive effects on the firm's consumers, company negligence towards lowering the rate of carbon emissions has a toxic effect on the health of the entire world. In terms of this serious issue, high customer expectations and social pressures are two important aspects of green consciousness. Normally, a lack of awareness on the part of customers and society tends to diminish voluntary contributions from NGOs, governments and corporate houses. Hence, regular pressure from society and customers is needed to maintain company progress in terms of sustainability.

The partners of any organization are commonly known as the backbone of a business. If the suppliers supply low quality raw materials, then it will directly affect the quality of the finished product and the quality of these finished products will negatively affect the company's brand name in the market. Similarly, the quality of other supplier services also affecta company's brand name. Thus, CC suppliers and sub-suppliers need to pay more attention to improving the accuracy of product orders, quality, freshness, cold warehouse standards, vehicle sustainability and product pricing. Before selecting suppliers, organizations should be more aware of previous sustainability efforts in order to increase their enterprise's efficiency in protecting the environment. The use of the latest technology and trained manpower can be a game changer in terms of waste reduction. The reduction of waste maximizes the rate of product processing, energy conservation and savings in terms of other necessary inputs. Furthermore, these inputs can be used in the next production batch, which will satisfy sustainability expectations (lowering pollution rates, carbon emissions, production lead times and fuel usage, etc.)

Partner based synergies and information transparency clarify business objectives and facilitate sustainable practices among a firm's partners. Mutual synergies help firms tackle internal and external business hurdles. Since dissatisfied customers are quick to switch to other brands in today's marketplace, reducing customer complaints and optimal problem solving should be considered prime business imperatives. Our discussions with those involved in CC have revealed that CC lead timesare important and noticeable, because as CC lead times increase, the chances of food spoiling also increase along with fuel consumption and monetary losses. Indian companies do not have specific environmental goals and frequently firms resist implementing sustainable practices. Thus, the absence of specific environment management goals, neglect and an unwillingness to tackle this issue are major hurdles that have hindered firms from reaping the benefits of CC sustainability.

Previous studies of sustainability have measured safety and agile health issues. We have included this in our investigation, and our findings indicate decisively that this is important in terms of sustainability. This fact should encourage companies to place a higher priority on the safety and health of their employees, society and other living things. Retaining reliable, experienced and knowledgeable staff reduces customer dissatisfaction and helps builda healthy working environment. In addition to this, a successful partner development program enriches firm competenceand helps solvefinancial difficulties.

## 7. CONCLUDING REMARKS

In this study, we have developed and analyzed ten SCCM constructs within the context of CC. For each of these constructs, we have in turn identified the major reasons for adopting sustainability, supplier selection criteria, environmental awareness, sustainability practices, value adding factors, as well as sustainable CC performance measures, hurdles and possible paybacks. We have discussed the most important implemented industrial sustainable

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practices and their benefits for enterprises. This article also highlights the gap between required CC capacity and existing CC capacity in India. This study covers almost every aspect of CC sustainability. This study's results argue that sustainability could have a profound impact on CC performance. However, consumers are also not very aware of the benefits of low carbon emission levels. Thus, this is hurting the efforts of various levels of government and other environment management authorities. Due to high initial costs, developing renewable energy source infrastructure and passive CC systems are less preferable choices for the food industry. Moreover, as the survey points out, there is a strong need for close integration to compensate for the absence of resources. The government and NGOs will have to work in a unified manner to promote training programs to achieve their sustainability objects. These programs could also increase the efficiency of operational staff, cut waste and make the economy less dependent on carbon.

### *7.1 Study limitations and future avenues for research*

One limitation of this study is that CEOs represented only 3.02% of the responses in our survey. Thus, a greater involvement on the part of the industrial elite would be more helpful and would make future survey findings more interesting. Another possible avenue for future research would be applying the proposed model framework to the pharmaceutical industry to measure its approaches to sustainability. Structural equation modeling (SEM) could be used to test the relationships between the sustainability constructs we have developed.

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