



SCOPE OF GREEN SUPPLY CHAIN MANAGEMENT IN NORTH INDIAN CONSTRUCTION INDUSTRIES

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Abstract: *The subject of green supply chain management has acknowledged responsiveness in modern years between manufacturing practice and research. With important environmental effects, the north Indian construction industry desires environmental management tools to report these problems. This research was based on a literature review of the environmental effect of north Indian construction industries and green supply chain management. A study in the construction industries were lead to find out the general view of green supply chain management in north India. Study was developed to improve the consciousness of green supply chain management. In addition, the problems met in the research were calculated and possible openings for future research are proposed.*

Keywords: *green supply chain management, north Indian construction industry, Green purchasing, Sustainable development and sustainable construction.*

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INTRODUCTION

As one of the greatest vital issues to business, environmental management is becoming a key planned issue for organizational performance [1]. With the introduction of Environmental Management System (EMS) into the business, a consistent rise in the use of environmental management tools have emerged [2]. Besides of 'in-house' environmental development, there is a tendency that organizations are lengthening the parameters of the EMS's outside the factory and into their supply chain networks. Environmental impacts happen across all phases of a product's life cycle, from the raw material abstraction, to manufacturing, use and reuse, final cycling, or removal, namely from cradle to grave [1]. Green supply chain management (GSCM), as well as other linked ideologies, has become an important policy for companies to achieve profit and market rewards by reducing the environmental risks and improving the efficiency.

The construction industry is one of the greatest vital areas for the human development by improving society's physical environment: its output is used for production, business and accommodation, and for providing vital utilities [3]. However, construction typically has an important and permanent impact on the environment. Impacts including huge use of natural resources, pollution of environment, and high energy depletion are among the whole supply chain from production of construction materials to the end user. With the growing of environmental consciousness, the term of 'sustainable construction' is becoming popular. The sustainable construction should include 'cradle to grave' appraisal, not only the serviceability of a building during its generation, but also the reprocessing of resources to cut waste stream related with destruction should be concerned. The material purchasing in construction industry is the vital process of supply chain management [4]. The increasing environmental consciousness and promise of businesses, governments, and individuals has encouraged the growth of procurement and purchasing strategies combined with environmental necessities. A set of green purchasing strategy has been developed with four principle attributes. At the same time, corporation's have create that implementing green supply chain management results in not only environmental profits, but can also enhance quality of product, raise productivity, and reduce of risk of supply chain break or damage to status.



With the contextual information, the primary objective of this study is to find out the condition of green supply chain management in the north Indian construction industry for the possible improvement of sustainable development. The specific objectives are as follows:

- Measure the environmental implication of construction materials in construction industry.
- Examine the response to green supply chain management of the north Indian construction industries and find out the similar and different characters.
- Using the 'green purchasing strategy' to evaluate the situation of green supply management implementation in the construction industries from the north India.
- Propose initiatives for the green purchasing and possible outlets for future study.

OVERVIEW OF NORTH INDIAN CONSTRUCTION INDUSTRY

The construction industry can be realized as just on-site construction activity or, broadly, as covering the extraction of materials, sales and manufacture of construction products [5].

The size of the north Indian construction industry is illustrated by the following statistics:

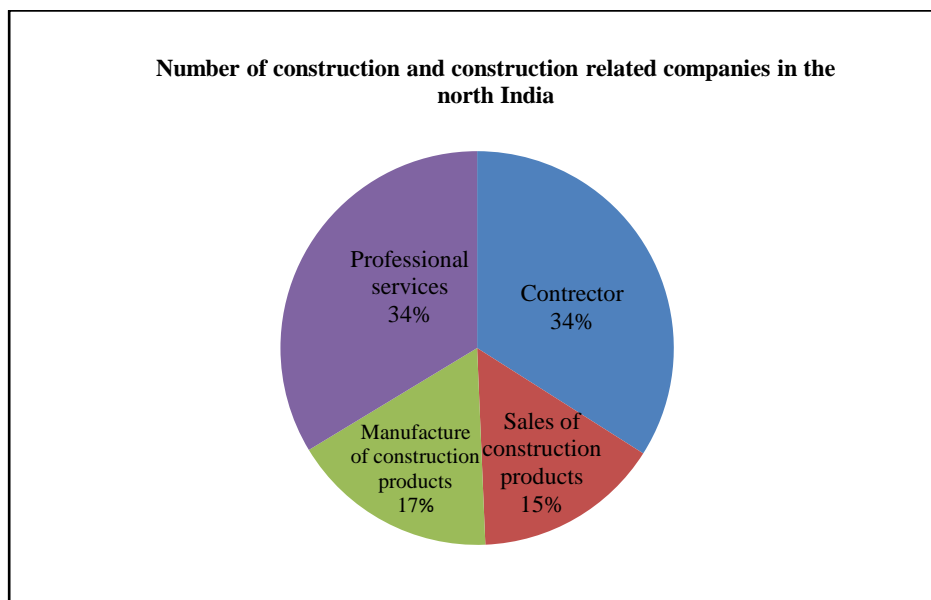


Figure 1 Number of construction and construction-related companies in the North India

- The construction sector in north India contributes to a growth of 4.9% at an estimated value of USD 50 Billion to be attained by 2009.
- There are up to 300 companies involved in construction.
- Contractors alone having a gross annual output of around Rs.500 billion.



- Around 1.5 million people are employed on-site.

The Construction industry plays an important role in shaping society's physical environment: its output is used for production, commerce and shelter, and for providing vital utilities [3].

However, construction usually has a significant and irreversible impact on the environment:

- Use of land in competition with other activities, such as agriculture;
- Use of virgin land such as forests, wetlands and coastal areas, which often implies loss of biodiversity;
- Massive use of natural resources, many of which are non-renewable;
- Pollution of air during the transportation of materials and site activity;
- Consumption of water and pollution of water reserves;
- Generation of waste owing to poor resource management;
- High energy consumption on site and in completed facilities; and
- Generation of noise by site activity.

Buildings significantly influence the environment in the eight major stress categories: use of raw materials (30%), energy (42%), water (25%), land (12%) and pollution emission such as atmospheric emissions (40%), water effluents (20%), production of solid waste (25%) and other releases (13%).

RESOURCES IN CONSTRUCTION

This part involves some information of the use of materials in the construction industry. It relates to the environmental impacts of construction materials to the total human activities. It is calculated that 120 million tons of materials are used in the north Indian construction industry in the India each year, which equates to 1.8 tons per person, it means that the construction sector accounts for over much of the resource use in the north India by weight. Aggregates are mineral materials, such as sand or gravel, which are used in making concrete. Aggregates make up over 50% of construction materials by weight (30 million tones/year) in the north India. There are two reasons for this deforestation, one is logging for timber, and the other one is the clearance for agriculture. Consequently, two critical implications of deforestation have been emerging. One is the loss of biodiversity in the world, the loss of habitats and species forever. The other is a reduction in the earth's capacity to absorb CO₂. This drop of absorption capacity is proving critical at a time of increased CO₂ emissions, leading to global warming and worldwide climatic change [6].



Although timber is theoretically a renewable resource and substitution of wood for other materials in some countries can reduce materials related CO₂ emissions, it can only be considered as such if it comes from sustainable managed woodland. The use of certified sustainable timber is a very positive mechanism for acquiring sustainability of timber usage in the construction industry. Cement is one of the basic construction materials, which consists of alumina, silica, lime and other substances. The preparation of cement includes mining; crushing, and grinding of raw materials (principally limestone and clay; calcinations of the materials in a rotary kiln; cooling the resulting clinker; mixing the clinker with gypsum; and milling, storing and bagging the finished cement. The process of cement production is energy-intensive. Cement production is the third ranking producer of CO₂ in the world after transport and energy generation, it is responsible for 7-10% of the world's total CO₂ emission.

Concrete is a mixture of sand, gravel, crushed rock or other aggregates held together by a hardened paste of cement and water. The process of producing concrete at a ready-mixed batching plant involves accurately weighing the required quantity of each constituent material and mixing them together either in the drum of a mixer truck or in a static pan mixer. During the manufacture of ready-mixed concrete, waste arises from three sources:

- Washing out truck mixer drums at the end of each working day to prevent fresh concrete residue from setting in the drum overnight;
- Washing down the yard and plant;
- Occasionally unwanted fresh concrete is returned to the batching plant from site.

The causes of waste in construction are numerous, and are usually classified under two headings known as direct and indirect waste. The direct waste was generated in transport, delivery, storage, cutting, spillage, theft, vandalism, wrong use, wrong specification, learning-by-doing waste and inefficient plant, and those associated with the characteristics of the material, bespoke dimension make-up, production waste and poor workmanship are called indirect. However, it is clear that this problem requires many different considerations and involves professionals, manufacturers and industrialists.

SUSTAINABLE DEVELOPMENT AND SUSTAINABLE CONSTRUCTION

Sustainable development' is defined as the development which meets the needs of the present without compromising the ability of future generations to meet their needs [6].



However, several authors note that the practical implications are vague and poorly defined. Besides argue that the two terms 'sustainable' and 'development' are incompatible because development tends to destroy the ability to sustain. A popular recent terminology now employed by The World Bank is 'sustained livelihood', which discuss the dimensions of sustainability. Apparently, for achieving sustainability, the principle of sustainable development should be integrated into national and corporate policies [7]. The term 'sustainable construction' is generally used to describe a process which starts well before construction (in the planning and design stages) and continues after the construction teams have left the site [8]. Sustainable construction should include 'cradle to grave' appraisal, not only the serviceability of a building during its lifetime, but also the recycling of resources to reduce waste streams associated with demolition should be considered. There are four principle attributes which construction sustainability depends on: social, economic, biophysical and technical. Some major green initiatives by contractors and clients the measures of contractors include:

- Having an environmental policy and publishing an environmental statement;
- Incorporation into the annual report of an audit of the company's contribution to green causes; Contribution to training in handling of materials and waste;
- Undertaking environmental audits of their buildings;
- Environmental impact assessment of some activities such as quarrying;
- Placing a main board member in charge of environmental issues.

Also, contractors are paying more attention to corporate environmental strategy, and professional and trade bodies have been preparing 'green' policy papers to guide their members to adopt environmentally responsible practices. With the pressure from statutory control, intensified competition, various stakeholders, social responsibility and corporate image, business enterprises, especially those with environmental have changed their corporate policies and operating practices and procedures. The view of environmental issues should be shifted from "moving from considering environmental issues as peripheral to business to a holistic view of business and sustainable development".

ECOLOGICAL EXECUTIVE SYSTEMS

By understanding the nature and impact of the environmental damage, the construction industry must take practical measures to deal with the problems. The trade-off between



economic growth and the sustainability of the environment can be attained by the corporate environmental management with the company. The satisfaction of customers' requirement for environmentally sound practices, the reduction of costs, and avoidance of infringing environmental legislation can be met by the trade-off. An environmental management system (EMS) is required once the company decides to improve its environmental performance. EMS is a set of management tools, principles and procedures which an organization can use to help protect the environment from the potential impacts of its activities, products, and services. The ISO 14000 series of standards was developed by the International Standardization Organization (ISO) in response to the trend towards sustainable development. The definition of EMS in ISO 14001 is the part of the overall management system which includes the organizational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining a company's environmental policy [8]. The ISO 14001 Standard is organized according to a five-step cycle of continual improvement, using the plan-do-check-review concept. There are many benefits from ISO 14001 which have been covered by literature [10]. These benefits can be summarized as:

- Protection of the environment;
- Reduced operating costs; z Increased access to markets;
- Demonstrated compliance with regulations;
- Improved environmental performance;
- Improved customer trust and satisfaction;
- Enhanced corporate image and credibility;
- Employee involvement and education; and
- Potential impact on world trade to allow competition on an equal basis

SUPPLY CHAIN MANAGEMENT

The term of supply chain can be explained as the life cycle process which supports physical, information, financial, and knowledge flows for moving products and services from suppliers to end-users [11]. Until now, there is no commonly accepted definition of supply chain management. The construction industry is a very fragmented industry. Because of the traditional model of planning, scheduling, controlling and contracting, where each functions



as different islands, the project cost would be increased to unrealistic values [11]. The construction supply chain process includes different stages in the construction process:

- Briefing stage
- Design stage
- Outline proposal
- Scheme design
- Detail design
- Production information
- Project contracts/ tendering stage
- Bills of quantities
- Tender action
- Project planning
- Construction

Construction supply chain (CSC) embodies all construction processes, which starts at the initial demands by the client/owner, to design and construction, maintenance, replacement and eventual demolition of the projects. It also consists of different organizations involved in the construction process, including client/owner, designer, contractor, subcontractor, and suppliers. CSC is both a chain of construction businesses with business-to-business relationships and a network of multiple organizations and relationships. The chain includes the flow of information, materials, services, products, and the flow of funds between owner, designer, contractors, subcontractors, and suppliers [12].

There are three types of CSC:

- The primary supply chain, which delivers the materials that are incorporated into the final construction products;
- The support chain, which provides equipment and materials that facilitate construction;
- The human resource supply chain which involves the supply of labor.

Construction supply chain management can be defined as:

The coordination of inter organizations' decision making in CSC and the integration of key construction business processes and key members involved in CSC, including client/owner, designer, general contractors, subcontractors, suppliers, etc. CSC management focuses on



how firms utilize their suppliers' processes, technology and capability to enhance competitive advantage. It is a management philosophy that extends traditional intra-enterprise activities by bringing partners together with the common goal of optimization and efficiency. CSC management emphasizes on long-term, win/win, and cooperative relationships between stakeholders in systemic perspective. Its ultimate goal is to improve construction performance and adds client value at less cost. Construction supply management focuses on improving total project performance along various metrics including speed, cost, and quality. The integration of the supply chain management should aim at efficiency and effectiveness improvement across all chain members to the construction industry.

GREEN SUPPLY CHAIN MANAGEMENT

The definition of GSCM is still not clear, because the combination of corporate environmental management and supply chain management is a relatively new area of study and practice [1]. A number of possible definitions of GSCM have been put forth since the 1990's including:

Environmental supply chain management consists of the purchasing function's involvement in activities that include reduction, recycling, reuse and the substitution of materials"[13]. "The practice of monitoring and improving environmental performance in the supply chain"[14]. "The term 'supply chain' describes the network of suppliers, distributors and consumers. It also includes transportation between the supplier and the consumer, as well as the final consumer the environmental effects of the researching developing, manufacturing, storing, transporting, and using a product, as well as disposing of the product waste, must be considered" [15]. GSCM practices range from green purchasing to integrated supply chain flowing from suppliers, to manufactures, to customers and reverse logistics. Five GSCM practices can be used to improve their performance, including internal environmental management, green purchasing, and cooperation with customers, investment recovery, and eco-design practices. These five GSCM practices are integrated into each other and need cross-functional cooperation. Internal environmental management is most significant for the improvement of enterprises' performance. Large customers can impose pressures on their suppliers with requirements of better environmental performance. Therefore, companies and enterprises need to cooperate with



customers for environmental objectives [16]. Green purchasing and eco-design focus on the inbound or early stages of a product's supply chain. Investment recovery is considered as a critical aspect for GSCM practices of United States and European [17]. However, because of the lack of waste management policies and recycling systems, investment recovery in India is not considered to be as important as in developed countries.

ECO PURCHASING

The life-cycle issues of the ultimate disposition of materials must be considered as an integral part of the purchasing and procurement process. Green purchasing has been covered in some literature: green purchasing is an increasingly common practice which is effectively greening the supply chain, and is becoming a key component of SCM. Companies should integrate other members of the supply chain into their environmental management processes. With objective environmental criteria which are developed systematically, the supplier evaluation systems can influence supplier's behavior effectively [18]. Green purchasing consists of "purchasing involvement in activities that include reduction, reuse, and recycling materials" [19]. Also, they find that many firms are developing and implementing "green" strategies to preserve the environment, as well as enhance efficiency and effectiveness.

Recently, green purchasing in construction has been involved the collaborative purchasing by influential groups of buyers, of products with specified performance criteria in the construction areas. It is proved that reduction in resource use of 30-50% has been achieved in a short period According to his theory, some actions should be advocated:

- Development of several principles for formulating requirements and testing, and contract rules including warranties and long-term responsibilities;
- Preparation of international performance standards; and
- Review of international rules for public-sector procurement to enable them to stimulate further innovation in sustainability.

RESEARCH DESIGN AND METHOD

The methodology was designed to generate the most suitable data to achieve the aim and objectives of this research. Two main methods of research were used. A desk study covered the basis of the research and the scope. To acquire the knowledge of construction industry, supply chain management and green procurement, related journals and publications have



been read. A questionnaire survey was conducted to collect the information about the implementation of green supply chain management in construction industry.

Desk study

The desk study had two primary objectives: to examine the environmental impact of the construction industry within the materials area; and to acquire information about sustainable construction, green supply chain management, and the link between them. Based on the broad literature review, the background information was collected to design the questionnaire.

Questionnaire

The research technique employed for the collection of data was a self-completion questionnaire, administered to respondents via email. A period of 3 weeks was allowed for the return of questionnaires. The use of a self-completion questionnaire has several advantages [20]. The cost and weight involved the large sample size is reduced. Compared with mail or personal and telephone interviews, being quick to administer is an advantage. It is acknowledged that there is a tendency for self-completion questionnaire to generate lower response rates than comparable interview surveys. Several techniques were used to make a positive reply possible: A covering letter which explained the purpose and the potential benefits of the research was attached to each questionnaire. It was also assured that all the information provided by respondents will be kept confidential and will not be used for any purposes unrelated to the dissertation. At the same time, to maintain the interest of the reader, the covering letter was limited to less than 100 words. However, because of cultural barrier, minor modification of the covering letter was completed to gain the interest of these respondents. Closed questions might have reduced the spontaneity of their response. In order to increase clarity and ensure that respondents were fully understood, technical and ambiguous terms were avoided. The last part of the questionnaire was set aside for any recommendation from the repliers.

DATA ANALYSIS AND DISCUSSION

Results

The survey shows that most of the responses have been implementing environmental management system. For the north Indian companies, two thirds of the responses have environmental management systems which have been certified by ISO 14001, and 2



companies have not been certified yet. Only one of these companies has no environmental system.

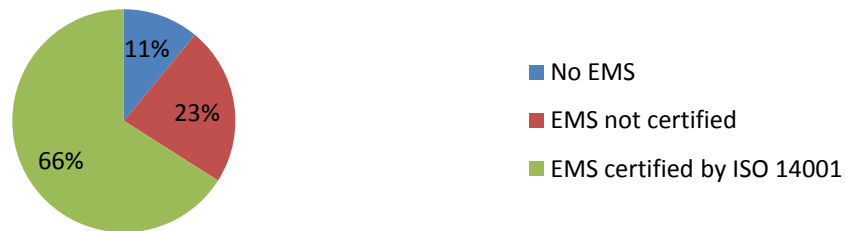


Figure 2 EMS implementation within the North Indian construction companies

The implementation of EMS has several benefits. Apparently, most of the responses from the north India have realized the potential to gain these advantages through implementing an EMS. The data shows that most of the responses from north Indian companies think the implementation of EMSs in the corporation is successful. For the north Indian construction companies, one third of the responses have added environmental issues into their policies and have established proactive operation during the projects. Nearly half of the north Indian construction companies' responses just fulfill the legal requirements. Surprisingly, there are 3 companies think they feel no environmental pressures, one is the company which has no EMS, and the other is seeking for the certification of EMS. The possible reason for this situation is acquiring the ISO 14001 certification increases the access to the market and enhances the image of the companies.

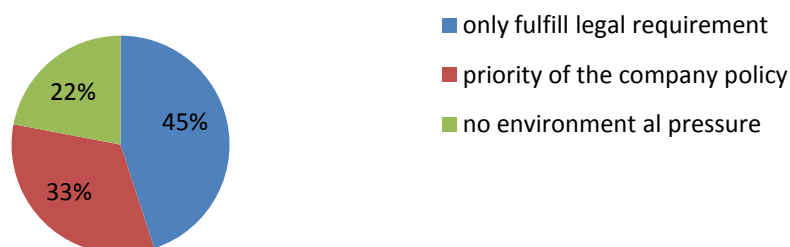


Figure 3 Environmental pressures for North Indian construction companies

The literature review about the environmental pressures have covered five groups of stakeholders: (1) government as regulatory stakeholders; (2) media; (3) local resident as community groups; (4) contractors and clients; and (5) other stakeholders including related organization which can affect the company financially and so on. The data shows that all the



responses from the north Indian construction companies feel the pressures from local residents. Meanwhile, the government, contractors and clients, and other stakeholders are supposed to be the creators of environmental pressures by most of these companies. Less than one third of the responses think the media is creating the pressure.

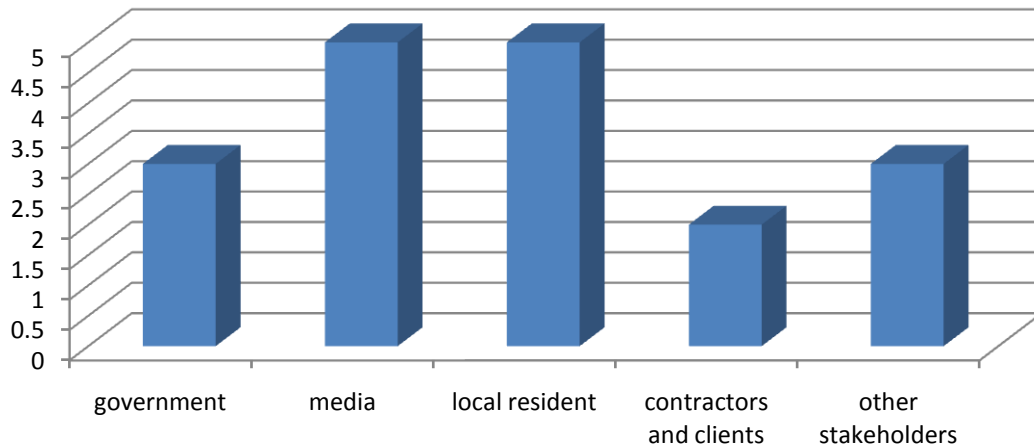


Figure 4 the environmentally stakeholders for the North Indian construction companies

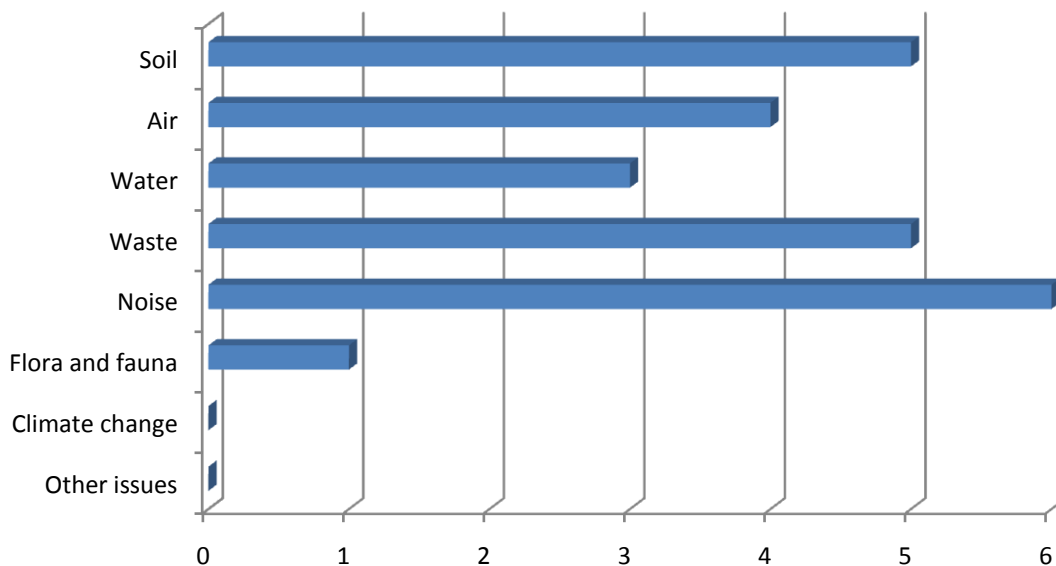


Figure 5 The priorities of environmental performance issues in the North Indian construction

According to the data, the situation in north Indian construction companies is a the environmental issue of noise pollution ranks the first place as two thirds of the companies think the noise is one of their environmental priorities. More than half of the responses think waste management is one of their priorities, followed by the issues of air, soil, water,



flora and fauna. It is notable that none of these responses puts issue of climate change and any other issues into their priorities for the environmental performance.

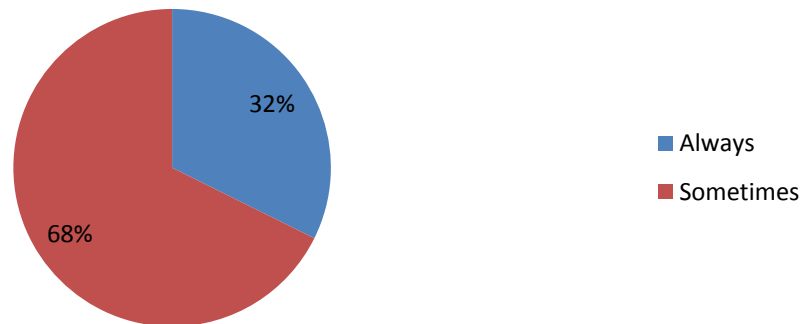


Figure 6 Green construction material purchasing in the North Indian companies

The survey shows that most of the responses from north Indian construction companies have committed to purchase construction materials with environmentally friendly attributes, such as recycled materials, and those with non-toxic ingredients 6 (67%) companies from north Indian construction industry always buy green construction materials leaving the remaining of 3 (33%) companies who buy green construction materials sometimes. As the awareness of environmental protection, customers have been focusing on the total quality of the construction products including the environmental performance of the construction throughout the whole life cycle. Another reason is the increased requirement of regulation. Materials with toxic ingredients are forbidden to use and recycled materials have been encouraged into the material market.

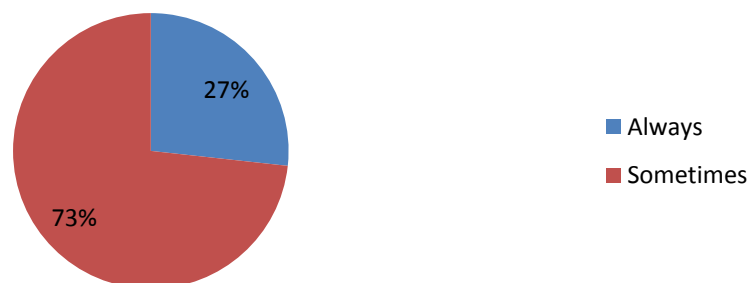


Figure 7 Requirement for suppliers to disclose environmental practices information in the North Indian companies



The requirements for information disclosing, auditing, EMSs implementation and EMSs certification are described as the behavior standards. For the information disclosing, responses from the two countries show different approaches. Nearly three quarters of the north Indian responses always require their suppliers to disclose information about their environmental practices, pollution discharges, and so on. The other 3 companies (27%) say they have this requirement for the suppliers sometimes.

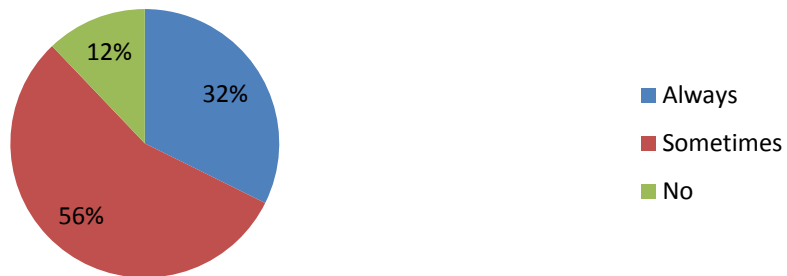


Figure 8 Auditing suppliers to evaluate their environmental performance in the North Indian companies

The situation for the auditing of suppliers environmental performance north Indian companies is more than half respondents audit suppliers to evaluate their environmental performance sometimes. Only (33%) and (12%) companies from north Indian always have this behavior standard for their suppliers.

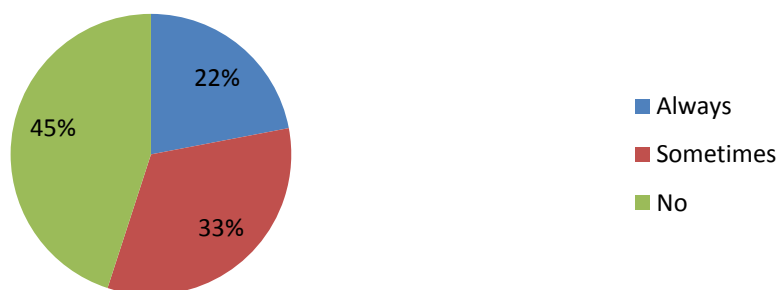


Figure 9 Requirement for the suppliers to implement and maintain EMSs in the North Indian companies

For the requirement of EMSs implementation and maintenance, the data shows different approaches of the responses from the north Indian construction companies. Nearly half of responses from north Indian construction companies have no requirement for its suppliers



to achieve this standard and (33%) companies from north Indian construction companies require their suppliers of this standard sometimes. 22% which always has this requirement for their suppliers.



Figure 10 Requirement for suppliers to obtain certificated EMSs in the North Indian companies

Besides the implementation of EMSs, according to the strategies of green purchasing, the certification of ISO 14001 is important for the quality of the system operation. A little more than half of the responses from north Indian construction companies also have no such requirement. Companies always need certificated EMSs for their suppliers are also the companies who always require EMS implementation. Totally, half of the responses have no requirement for their suppliers to acquire a certificated EMS.



Figure 11 Co-operation with suppliers to reduce environmental impacts through changes in product design and materials use in the North Indian companies

The co-operation in the north Indian companies is weak. One third of these companies never co-operate with their suppliers to deal with this kind of issue. Only 2 companies (16%) always co-operates with its suppliers to reduce their environmental impacts.

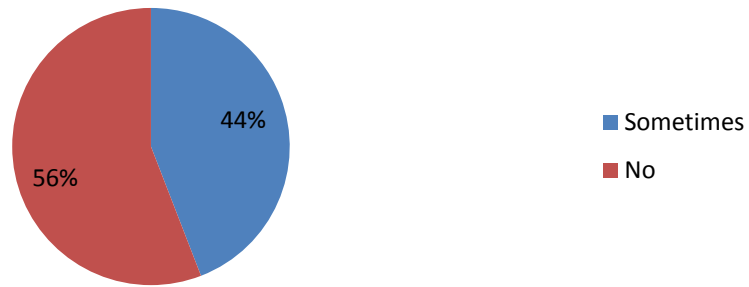
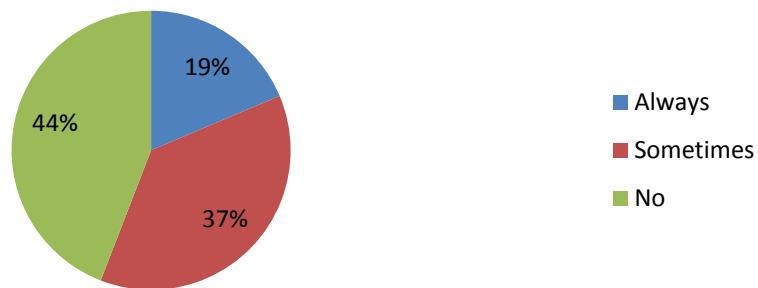


Figure 12 Institute training programmes for suppliers to increase their knowledge of environmental implications in the China companies

All the responses in north India, 5 companies (56%) have no training programmers for their suppliers. The remaining 4 companies do it sometimes. It is clear that the development for the green purchasing in the north Indian companies is weak.



eFigure 13 Informing suppliers of technological developments relating to their operations in the North Indian companies

The situation for informing suppliers of technological developments relating to this operation in the north India Nearly half of the responses from the north India do not inform their suppliers this kind of information. Only 2 companies (19%) inform their suppliers the information.

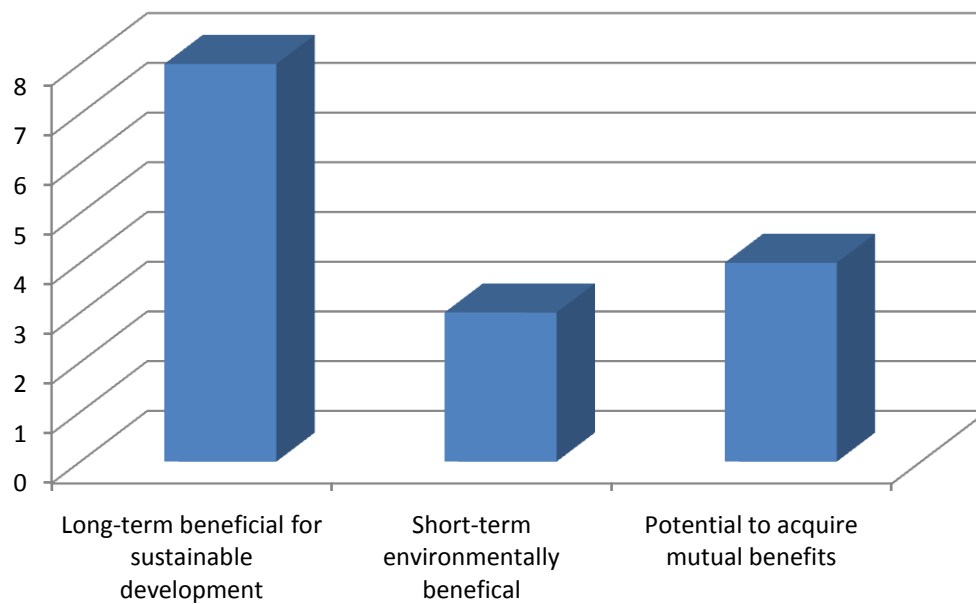


Figure 14 The perception of green supply chain management

As the figures show, maximum of the replies from the north India approve that it is long term advantageous for sustainable development. About half of the north Indian replies reflect it is also conceivable to obtain short term environmental assistances by refining suppliers' action. However 7 companies from the north India think it has possible to gain shared aids for both the company and suppliers. With the idea of possible win situation, the north Indian companies have paid more attention to this area and it is also approved by the analysis of green purchasing activities of north India.

To review, the investigation of the questionnaire data found:

- Most of the chartered companies from north India have appreciated their environmental implication within their actions.
- Replies from the north India reason local inhabitants are a pressure creator for their environmental enactment; however, the media is also one of the main pressure creators.
- Waste management is the most important environmental issue for the north India the most concerned issue is noise;
- It is believed that green supply chain management is beneficial for the sustainable development in the construction industry.



It is significant for the construction industry to growth the awareness of green procurement, particularly for the north Indian construction industry. Some initiatives would be helpful [8]:

- Emerging skill in SCM within industry.
- Exercise purchasing officers in key features of green procurement with presentation evaluation and monitoring.
- The administration should deliver direct support through its procurement policies and actions.
- Contribution motivations to support clean production processes and practices.
- Helping environmental accountability among all construction agencies, enterprises and experts.
- Refining the best practices in green procurement;
- Instituting an annual competition in enterprises to recognize excellence in green procurement.

CONCLUSION

This investigation aims to investigate the fact of green supply chain management in the north Indian construction industry. Previous to this, many investigators have enclosed the green supply chain management and the creativities and pressures for the implementation. Through a desk study about the environmental implementation of construction industry and green supply chain management, the basis of this research is accomplished. Giving to the literature review, green supply chain management can find sustainable development in the construction industry for the goal of “sustainable construction”. A review which focuses on the construction materials movement from the suppliers to the builders is lead the north Indian construction companies. The examination finds that most of the replies from the north India have awareness about the environmental inference of their activities. Established on the green purchasing events, one questionnaire is used to examine the condition of the replies from the north India. Companies from north India have been implementing GSCM, and co-operation with their suppliers. Also, the awareness of GSCM, the maker of pressures for GSCM is different for the companies from the north India.

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