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An empirical investigation of critical success factors and performance measures for green manufacturing in cement industry

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Abstract

Purpose – The purpose of this paper is to aim for the development and analysis of green manufacturing (GM)-based framework on the identified critical success factors (CSFs) and performance measures (PMs) in the context of the Indian cement industry.

Design/methodology/approach – The research follows survey method for data collection. For framework development, it uses factor analysis on the identified CSFs and regression along with the appropriate measures for checking statistical consistency and validity.

Findings – This is the first research towards GM framework for the Indian cement industry. Till date, no framework is available which could guide researchers and practitioners of this environment unfriendly industry. Study exposes lack of connectivity between CSFs and PMs for a GM framework and highlights weaknesses of cement industry in this regard. It offers a generalised GM framework linking PMs with top management, human resource management, organisational culture, green practices, process management and supply chain management.

Practical implications – The framework is expected to help both researchers and practitioners from cement, construction and other industries who are serious towards GM implementation and are looking for appropriate mechanism. This framework if implemented properly will result in enhanced productivity.

Originality/value – This work is one of the few and pioneering efforts to investigate GM linking CSFs and PMs in Indian manufacturing sectors and the first in cement industry. Not many studies are available in the context of cement industry, which is the lifeblood of infrastructure and construction sectors. The importance of the work increases as it is conducted in the Indian context, which is undeniably an important economy of the world.

Keywords Process management, Critical success factors, Green manufacturing

Paper type Research paper

1. Introduction

Green manufacturing (GM) is no more a buzz word, which used to be heard in boardrooms and corporate meetings, rather has become a challenging reality. Today, it is being discussed as a philosophy, a framework and an integrated manufacturing management approach which covers much more than minimising resources consumption, energy, wastes, emissions and pollution. GM embraces the use of eco-friendly design, raw materials, packaging, distribution and even reuse/retreatment

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after the useful life of a product. It is a term used for describing practices that do not harm the environment during any part of the manufacturing and includes recycling, conservation, waste reduction management, environmental protection, regulatory compliance, pollution control and allied issues (Jabbour *et al.,* 2015; Jeyaraman and Kee Teo, 2010; Drohomeretski *et al.,* 2014; Rehman *et al.*, 2016).

GM is also known as clean manufacturing, environmentally conscious manufacturing and sustainable manufacturing. Irrespective of the name, the goal remains the same, i.e., designing, making and delivering products that minimise negative effects on the environment through their production, use and disposal (Ball, 2015; Chuang and Yang, 2014; Bartlett and Trifilova, 2010). Typically, it becomes challenging when one deals with cement industry, known for its environment unfriendliness. Therefore, a research like ours, which links GM intricacies, CSFs and PMs of cement industry, becomes important for researchers and practitioners.

This research identifies CSFs and PMs through literature review and feedback from industry professionals and subsequently leads towards the development of GM framework for Indian cement industry. This research endeavour directly supports the vision of the UN Climate Change Conference (COP21/CMP-11), which encourages techno-managerial initiatives and aims at legally binding agreement including manufacturing, services and trade practices. The significance of this study increases many times, as it is being reported for an important developing economy of the world, i.e., India, which is the world's second largest cement producing country after China and is a major contributor of greenhouse gas emissions (www.statista.com).

The research offers useful guidance to cement industry professionals, civil engineering and construction communities about CSFs, PMs, GM and sustainability practices, which influence cement manufacturing and should be considered while making strategic decisions regarding GM. Scholars like Sarkis (2001), Antony *et al.* (2002), Seuring and Müller (2008) and Fadly Habidin and Mohd Yusof (2013), support these initiatives and recommend the use of appropriate frameworks and statistical models, so that the relationships between various factors could be understood and used for decision making.

1.1 Importance of the study in Indian and global contexts

According to UN Climate Change Conference (2015) and its declarations, attempts must be made to save this planet, and preventive measures should not be restricted only to manufacturing, rather should include organisational, social and economic aspects as well. Naturally, everybody expects industry-specific GM frameworks and allied contributions from those economies which are important on world map from environment unfriendliness point of view. That is why this study becomes important for the world as a whole. From Asian countries like China and India, world expects useful GM contributions in the form of frameworks.

These days in India, according to (Seth and Panigrahi, 2015), six identifiable changes are happening, which are as follows: the enterprises are finding themselves almost forced to open up to international markets due to globalisation and entry of cheaper products from Korea and China causing hypercompetition among players; the fluctuating demand from domestic customers for a greater variety of products in different packaging formats with high quality, shorter delivery windows, competitive prices and best after-sales services; the new business models through e-commerce and m-commerce to reach buyers, suppliers and even end customers facilitated by mobile telephony, internet-based support tools and integrated databases-based technologies offering quality products and services (Mohanty *et al.*, 2007;

Lande *et al.*, 2016); the rapid changes in oil prices and resulting recession in financial and capital markets around the world influencing Indian markets; rapid rise in the family income and spending potentials of middle-income group fuelling growth for "own house" and other luxuries of life; and enhanced and government supportive focus on "make in India" rather than "made in India", through direct investments in infrastructure and residential projects to sustain urban growth, introduction of tax-free infrastructure bonds to pump money for dams, roads, over-bridges, and canal construction and other redevelopment activities in cities to offer low-price housings (Rehman *et al.,* 2014; Behera *et al.*, 2015).

These changes encourage the participants from all over the globe to use India for making (as manufacturing platform) and not just marketing their products. These changes are creating a whirlpool in the markets, infrastructure industry and for the business world (Rehman *et al.*, 2016). These changes are encouraging researchers and practitioners to try new techno-managerial solutions like GM both as standalone and in hybrid manner to understand the relationships with respect to critical success factors (CSFs) and performance measures (PMs). Similarly, these changes are boosting Indian industrial activities at all levels. Researchers and practitioners support that there is a lack of studies in cement and processing industry sectors in a developing country context. The importance of study like ours increases if it is carried out in the context of an emerging and developing economy like India, which poses challenges on account of its geographical spread, diversity and heterogeneity. Like China, because of its size in terms of area, population and low-cost manufacturing capabilities, India is not only emerging as a strong market in itself but is also becoming an important sourcing base for the world as a whole (Seth and Tripathi, 2005, 2006).

This study is especially motivated by India's fast-changing business scenario influencing infrastructure and housing sectors which are the backbone of industry, corporate and economy. This change on one side is creating havoc due to green-based developments, sustainability pressures and stringent laws and on the other side is offering tremendous opportunities to try newer techno-managerial models, practices and frameworks. Indian companies, in today's era, face a dilemma – customers demand customised products, variety, packaging formats and require that their orders be filled quickly without compromising on quality and delivery. Offering variety for competitiveness with inventory margin considerations becomes an important trade-off not only at the operations-supply chain-marketing interface (Seth and Pandey, 2009) but even at other business links and can emerge as an important study area influencing the quality and green requirements. Investigating cement sector and the frameworks attacking on various wastes like inventory, variations and delays influencing its quality, productivity and responsiveness to achieve strategic competitiveness is interesting and challenging. The Indian cement industry is gearing up for growth, marked by increase demand of products coupled with the GM performance requirements influencing quality and productivity.

It is being felt that in the Indian context, adopting and implementing newer frameworks which attack on quality issues and wastes through as value stream mapping to offer value for the customer (Seth *et al.*, 2008; Shrivastava *et al.*, 2006; Seth and Rastogi, 2009), will dominate the show along with green-based sustainability pressures. That is why these techno-managerial solutions are gaining popularity day by day. On one side, this urgent need is being felt, and on the other, practically no research study is available to guide academicians and practitioners in identifying and prioritising the relevant CSFs for GM.

The paper establishes the relationships between a distinctive set of CSFs for cement industry (process industry) in the Indian context and links with PMs. The authors believe that the findings can also be used in other economies and process industry setups. Relatively very little research on operational and managerial insights has been reported to identify the CSFs that either drive the adoption of GM or act as obstacles that thwart the successful implementation of GM framework. The study addresses these gap areas and guides researchers and practitioners.

1.2 Objective, overall methodology and organisation of paper

The basic objective of the study is to establish and analyse the relationships between CSFs and PMs to support GM by developing a framework, for the Indian cement industry. The authors extracted factors and measures through detailed literature and prioritised them through Delphi technique. After prioritising CSFs and its sub-factors, authors analysed relationships through regression analysis and linked them with PMs. Authors thus extended CSFs-based analysis towards achieving GM framework. Authors covered a wide spectrum of cement plants pan-India and carried out a survey-based analysis for data collection and model development.

The rest of paper is organised as: Section 2 describes literature review and covers identification of PMs and CSFs for GM. Section 3 discusses research methodology and covers data collection. It is followed by Section 4 that covers data analysis and results. Next sections cover regression modelling, discussions, findings and conclusions, respectively. Last section discusses limitations of study and indicates directions for future research.

2. Literature review covering CSFs, PMs and GM

The purpose of this review is twofold, first to extract and tabulate the PMs and CSFs using select studies and second to indicate gap areas in the existing studies, so as to justify this research.

The authors would like to initiate literature review by quoting two widely referred studies (Sarkis, 2001; Seuring and Müller, 2008) to set the tone. Both studies clearly indicate that GM and sustainability cannot be discussed only on the basis of manufacturing issues. For a holistic framework, it is important to link PMs with manufacturing uniting social, managerial and corporate aspects. The conceptual study by Sarkis (2001), focusses on manufacturing but indicates need for incorporating social and managerial aspects and encourages sector-specific studies linking manufacturing with corporate performance. The review study by Seuring and Müller (2008), indicates that three main sustainable research areas will be risks and PMs, social and corporate aspects influencing manufacturing and sustainable supply chain management. Both studies encourage sector-specific and country-specific researches like ours. The authors extend the review by introducing reader about CSFs, followed by PMs and GM.

The concepts of CSFs were introduced by Daniel (1961), and were popularisatised by Rockart (1978), of Sloan school of management. Since then, CSFs have been used extensively in many sectors and areas. CSFs are those few things/limited number of areas to focus on which will ensure success and competitive differentiation for an organisation and must be given special and continual attention to bring about high performance. CSFs include issues and areas vital to an organisation's operating activities influencing quality and its future success (Antony *et al.,* 2002; Fadly Habidin and Mohd Yusof, 2013; Zhao *et al.*, 2010). Management should be careful about CSFs and its continuous scrutiny. It is expected that identification and use of CSFs in the form of a framework should guide management to initiate changes and to track its progress through appropriate PMs.

An important component of framework design and its analysis is the establishment of appropriate PM(s). A set of PMs can also be used for assessing efficiency/effectiveness of a framework, for its designing or even comparing alternative competing frameworks. PMs can also be used for designing a framework by determining the values of decision variables that yield most desirable levels of performance. According to Beamon (1998, 1999) and Kirchoff *et al.* (2016), most commonly used PMs are customer satisfaction, service or responsiveness and cost, but these are not the universal PMs. The authors followed studies by Azzone and Noci (1998) and Zhu and Sarkis (2004), for guidance regarding PMs. According to these studies, PMs should be decided on the basis of sector- and industry-specific needs and should include manufacturing, business and social aspects linking with GM requirements. The variety and level of PMs depend on the needs of the research and may encompass multi-dimensional measurement aspects.

In the context of the cement industry, GM can be understood and interpreted in many ways. GM is a collection of methods and concepts that minimises energy consumption and facilitates reduction in wastes, resources and pollution for the concerned industry (cement). It helps to slow down the depletion of natural resources and lowers atmospheric, water, land pollution and wastes by lowering trash. Its emphasis is also on reducing and rationalising materials, reusing components, and ensuring efficiency to build (Rehman *et al.*, 2016; Sahu *et al.*, 2013). According to Haleem *et al.* (2012), GM influences ecological and sustainability-related measures and, therefore, should encompass much more than air, water and land pollution; energy usage efficiency; waste generation and recycling. GM should also include customers and should help them to be more mutually profitable (Chuang and Yang, 2014). It can also include variety of practices covering recycling, substitution of less hazardous alternatives and consumption of waste internally.

Sometimes GM is linked with life cycle assessment (LCA) as an additional aspect, which is rapidly emerging as a useful tool worldwide for process industries including cement manufacturing.

In the context of cement industry, GM is accomplished by operational elements, including the supply and acquisition of upstream materials, research and development, manufacturing and packaging, marketing, promotion and education activities (Mittal and Singh, 2014). In this manner, one finds that GM in the context of cement industry is not only restricted to manufacturing and environment aspects but also covers corporate areas as well. It is expected that CSFs and PMs involved in GM should not remain confined to the cement manufacturing, emission norms and carbon dioxide-based measures but should also include requirements like how to reduce energy, how to involve and educate customers, supply chain issues, boost the work force morale and how to assess and include community impacts caused by the industry influencing company culture and social image.

Scholars such as Mohanty and Prakash (2014), performed study to assess whether greening scores and pressures from stakeholders have any influence on GSCM practices in the Indian context, whereas Mittal and Singh (2014), proposed a technique for identifying the challenges of end-to-end process management to generate managerial guidance. They identified drivers, developed a model based on drivers and tested it using structural equation modelling (SEM). The basic steps of methodology were drivers development, survey instrument finetuning, data collection, model proposition and model validation.

Similarly, Chuang and Yang (2014), proposed a three-layer assessment model to evaluate the performance of green manufacturing system and guided about factors for its implementation. The model includes green design, green-manufacturing process and green packaging. Brun (2011), proposed method to reduce energy consumption. In this paper, the authors reviewed energy usage of different sections of cement industries, specific energy consumption, the types of energy use, details of cement manufacturing processes and various energy saving measures. Scholars Thomas *et al.* (2016), discussed about strengthening the foundations of the existing framework by uncovering evidences for some of its elements and suggested revisions in the framework, especially on its applications in manufacturing. Similarly, Fadly Habidin and Mohd Yusof (2013), discussed about environmental evaluation of the cement industry in Iran. The chosen indicators were prioritised, and improvement strategies for cement industry were established. Scholars Rehman *et al.* (2014), discussed about energy consumption and pollution by reviewing different fuels and their impacts on the plant performance. Scholars Van den Heede and De Belie (2012), investigated the available literature on LCA of concrete. Another important and recent Indian study by Sharma *et al.* (2015), proposed key performance indicators for GSCM implementation in the Indian dairy sector. For this, they used factor analysis and analytic hierarchy process to form an effective framework for successful GSCM implementation. Scholars Khanna *et al.* (2011), reviewed CSFs of total quality management with technique for order preference by similarity to ideal solution to rank them in the Indian manufacturing industry.

Scholars Koo *et al.* (2014) explained about how ecological responsibility influences firms' environmental and economic performance and discussed cases to facilitate the transition from laboratory to industrial scale. Maddern *et al.* (2014) identified the challenges of end-to-end process management and offered managerial guidance about process infrastructure and its management. A recent study by Prasad *et al.* (2016) discusses lean and green practices in the Indian foundry industry by using survey method and statistical analysis. This study depicts the moderate status of lean and green in the Indian context and recommends more studies in the Indian context. Scholars like Hu and Hsu (2010) discussed CSFs for implementing GSCM in the context of electrical and electronics industries of Taiwan by using case-study approach and cross-case comparative analyses. Similarly, Sami El-Khasawneh (2012), discussed new challenges and presented potential solutions in the context of Jordon, a developing country, by using interviews and critical observations. Whereas Soda *et al.* (2015) investigated the implementation of GSCM practices in the context of Indian industries. The scholars carried out an extensive review to determine the current status of implementation of GSCM in the context of Indian industry. They also compared the PMs used by foreign companies to highlight status. Similarly, Barve and Muduli (2013), identified challenges faced by the Indian mining industries for GSCM implementation and used interpretive structural modelling technique for the relationships.

Table I presents PMs and Table II CSFs identified based on the literature review for cement industry. Using key words like GM, GSCM, CSF, PM, process industry, Indian, cement industry and developing country, recently appeared referred and indexed journal articles were collected. First, these research studies were separated on the basis on green and process industry perspectives. Later on, they were filtered for CSFs and

Authors/critical factors	Quality performance	Resource utilisation performance	Financial performance	Green performance	Employee satisfaction	Customer satisfaction
Prasad *et al.* (2016), Barve and Muduli (2013), Soda *et al.* (2015), Mohanty and Prakash (2014)	X		X	X		X
Sami El-Khasawneh (2012), Koo *et al.* (2014)		X	X		X	X
Chuang and Yang (2014), Mohanty and Prakash (2014)	X	X		X	X	
Barve and Muduli (2013), Sharma *et al.* (2015)			X	X		X
Rehman *et al.* (2014)	X	X		X	X	
Maddern *et al.* (2014), Koo *et al.* (2014)			X		X	
Brun (2011), Mohanty and Prakash (2014)	X	X	X		X	X

Table I.
Identified PMs for GM based on literature review

PMs of concerned industry, Indian contexts, and reduced further after consulting industry experts and following Delphi method. As the authors have tabulated both PMs and CSFs, the description of referred studies has been kept to minimum.

2.1 Research gaps

Based on literature review, following observations, research gaps and weaknesses are identified. These gaps clearly indicate that researchers are not considering management aspects while discussing GM. Researchers are focussing on emission-control technologies, and are advocating manufacturing-based frameworks, whereas cement industry is a process industry and behaves in a different manner. Similarly, there is lack of studies in the developing country contexts. Other gap area is in terms of lack of empirical studies in the cement sector. It is observed that majority of the studies are discussing modelling aspects, and studies covering empirical relationships are practically missing. It is also observed that while dealing with "green" researchers often mix the issues between GM and GSCM. Authors are attempting to explain these research gaps.

Scholars Despeisse *et al.* (2012), while discussing green and green framework requirements do not focus on managerial requirements like human resource management, supply chain management and organisational culture and focus on waste management and environment pollution. This creates a research gap for excluding corporate measures for green-related studies. Ideally, a framework should be much more than waste management and environment-based factors. This leaves a gap area for a study like ours which bridges this gap by offering a GM model considering management factors along with process management and green practices.

It is observed that mostly modelling-based studies centre on GM in terms of manufacturing only as "a system whose main objective is to eliminate waste and reduce emissions, energy by considering manufacturing aspects only by minimising internal variability and focussing on cleaner technology" (Ehie and Muogboh, 2016; Dubey, 2015; Lai and Lau, 2012). One finds two distinguished trends besides

Table II. Identified CSFs based on literature review

Authors/critical factors	Top management for GM process cement plant	Human capital	Organisational practices/ culture	Customer requirements	Green infrastructure/ policies/ practices	Process management	GM-legal/ regulatory framework	Suppliers involvement and supply chain management	Technology management
Singh and Smith (2004), Koo *et al.* (2014), Mishra *et al.* (2016)	*		*	*		*	*	*	
Seliger *et al.* (2008), Sami-El-Khasawneh (2012)	*	*		*	*	*	*	*	
Badurdeen *et al.* (2014), Mittal and Singh (2014)		*	*	*		*			*
Deif (2011), Chuang and Yang (2014), Awheda *et al.* (2016)	*	*	*	*			*	*	*
Chuang and Yang (2014), Dubey (2015)	*	*			*	*		*	*
Lai and Lau (2012), Chen (2008), Zhao *et al.* (2010)	*		*	*	*	*	*	*	
Barreto Ligia (2007), Hosseini (2007), Soda *et al.* (2015)		*		*	*				
Hosseini (2007), Hicks and Dietmar (2007), Soda *et al.* (2015), Thomas *et al.* (2016)	*	*		*		*	*	*	*

manufacturing focus. First, use of modelling tools like SEM and interpretative structural modelling that too without considering the dynamics between various CSFs, and PMs influencing management role and competitive strategy. Qualitative models are important for any research work but have their own limitations like lack of empirical data-based backing and lack of validation. Second trend is also observed that scholars often neglect managerial and social aspects. Reader will agree with authors that comprehensive empirical studies establishing the relationships between CSFs and PMs are better than just modelling studies, and to study process industry, one cannot totally rely on conventional manufacturing-based framework.

One more gap area is in the developing country context. There is a lack of empirical studies in the areas of GM, in process industry in a developing country context. India is not only emerging as a strong market in itself but is also becoming an important sourcing base for the world as a whole (Seth *et al.*, 2008; Rehman *et al.,* 2016; Chuang and Yang, 2014). Although some attempts have been made, like a recent study by Mittal and Singh (2014), but much more needs to be done.

3. Research framework for study

Figure 1 represents the major activities and components of research methodology. While carrying out research, it was necessary to understand and make use of gaps in literature review, CSFs, PMs along with feedback of cement industry executives in the research instrument to ensure the capturing of important research messages and empirical relationships. These inputs were taken while deciding the contents for research instrument. Further refinements in the form of fine-tuning of questions and removing redundancy were based on pilot study along with statistical checks to ensure statistical validity. Authors after extracting CSFs, chose to link them with other studies (Cummings and Holmberg, 2012; Jeyaraman and Kee Teo, 2010) and with the feedback by cement industry experts so that key aspects influencing management commitment, human-factors and process aspects could be included in research by properly aligning instrument.

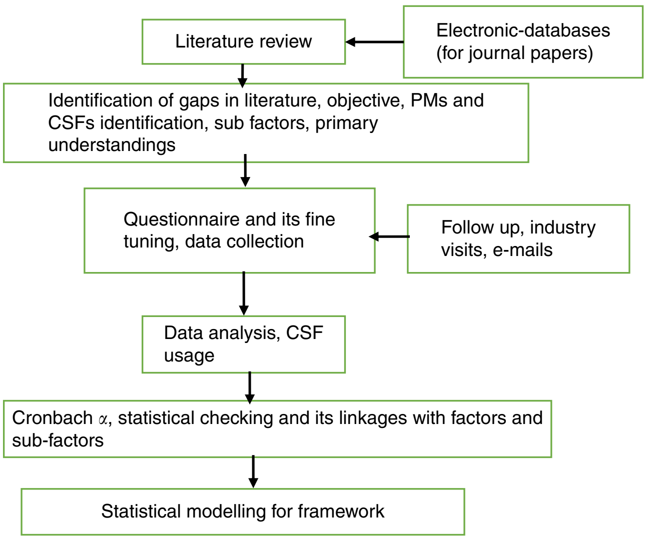

Figure 1.
Research framework for the study

First, literature review was conducted identifying the cement industry GM needs based on nine CSFs with 101 attributes. In the second stage, authors developed questionnaire based on earlier studies. For pilot study, these questionnaire were floated in the local cement companies coupled with personal interviews of executives from cement industry to seek their opinions on the subject matter. This was necessary to ensure about the contents of research instrument and to fine tune it before administering it at the national level. Similarly, authors applied Delphi method, as per the guidelines of Hasson *et al.* (2000) on responded data of pilot study, and divided the data into nine factors as shown in Table III and Figure 2, so that after capturing industry views, CSFs could be meaningfully shortlisted. Authors refined and used final questionnaire with six CSFs and 43 attributes.

3.1 Data collection: pilot study, research instrument, validity checks and administration

This research derives data by conducting a survey through a refined questionnaire as research instrument. This research was conducted between July 2014 and January 2015 across India, and a sample size of 500 was used for primary data collection through

Factor no.	Factors based on survey	Mean
Factor-1	Top management for GM process cement plant	0.773
Factor-2	Human capital	0.843
Factor-3	Organisational practices/culture	0.678
Factor-4	Customer requirements	0.607
Factor-5	Green infrastructure/policies/practices	0.767
Factor-6	Process management	0.796
Factor-7	GM-legal/regulatory framework	0.481
Factor-8	Suppliers involvement and supply chain management	0.412
Factor-9	Technology management	0.398

Table III. Delphi method for CSFs with mean value

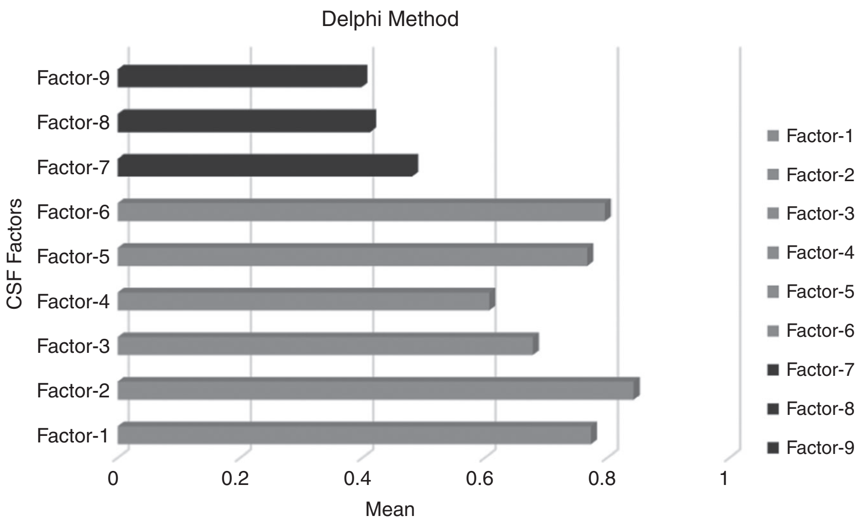

Figure 2. Delphi method for shortlisting CSFs

questionnaire. A total of 347 valid and usable responses were received. The information was collected from the engineering and management professionals serving as employees and stakeholders of the cement industry.

For this research, a pilot study was conducted. It was conducted by using test questionnaire, which was developed taking into account experts' opinions and industry needs and through referring earlier studies. The feedback by experts from cement industry was used to improve the contents of research instrument and eliminate redundancies.

It was also tested for content validity and reliability through pretesting as suggested by Nunnaly *et al.* (1967). The respondents were asked to assess the questions based on CSFs, on a five-point Likert scale (where "1" means very low importance and "5" means very high importance). Validity and reliability of the questions based on CSFs were pretested involving experts from the industry. Reliability evaluates accuracy of the measures by assessing internal stability and consistency of items in each variable. In this manner, final questionnaire was prepared for subsequent administration.

Questionnaire-based survey method for data collection relies on random sampling and uses structured research instrument that takes into account diverse experiences into predetermined categories. According to Nunnaly *et al.* (1967), this method has many challenges such as low response rate in the form of completed questionnaires, and bias due to no response is often indeterminate. It can be used when respondents are educated and cooperating. The control over questionnaire may be lost once it is sent. There is also the possibility of ambiguous replies or omission of replies of certain questions. Interpretation of omissions is difficult, and this method is considered as slow (Ehie and Muogboh, 2016; Fonseca and Jabbour, 2012; Holt and Ghobadian, 2009). To overcome these challenges, enough care was taken to ensure good response. The questionnaire was mailed along with a prepaid envelope to facilitate quick reply (Laureani and Antony, 2012; Sami El-Khasawneh, 2012).

Anticipating the difficulties of mail and postal-based surveys and the possibility of respondents misunderstanding the questionnaire items, authors personally contacted executives and interviewed various top-/middle-level managers/engineers of cement industries to assess first-hand situation and for verification of the facts given by the respondents. This helped in cross checking the facts (Holt and Ghobadian, 2009).

The authors were aware of the difficulties usually experienced by survey method, and therefore, relied on personal follow-ups and interactions along with postal mail- and e-mail-based communications. Overall, 210 responses were possible through personal interactions, 40 through postal mail based and 97 through e-mail based. The authors chose to cover majority of the levels to capture diversity of views, accordingly, the respondents include managing director/CEOs, directors, general managers, managers, deputy general managers, senior engineers, engineers, executive officers and senior supervisors from the cement industry across India.

The hectic efforts and personal follow-up resulted in 69.423 per cent response rate, which was encouraging. This data collection exercise indicates both sincere follow-up by the researchers and an urgency being felt by the industry. It seems that companies are under pressure from stakeholders to improve their GM performance and market image. It can also be argued that these organisations in India are representative of GM practices adopters, and their experience will influence other process industries as well.

4. Data analysis

For data analysis, the authors used SPSS 20.0 and relied on valid responses received from the industry executives. The authors began with different type of statistical analyses like reliability, Kaiser-Meyer-Olkin (KMO) tests, along with factor analysis using the recommendations of Nunnally *et al.* (1967), Ehie and Muogboh (2016), Fadly Habidin and Mohd Yusof (2013) and Chen and Lyu (2009).

4.1 Reliability checks and other supportive details

The purpose of factor analysis is to find a way of summarizing the information contained in a large number of original variables into a smaller set of new composite dimensions with a minimum loss of information. The Bartlett's test of sphericity and the KMO measure of sampling adequacy (Nunnally *et al.*, 1967) were employed to test the appropriateness of the data for factor analysis. Eigenvalues of discontinuity in excess of 1.0 and factor loading exceeding 0.5 (Nunnally *et al.*, 1967) were used as guiding principle in selecting factors. For reliability estimation, Cronbach's α value exceeding 0.7 was considered to have high internal consistency of the scale. The Bartlett's test of sphericity and the KMO measure of sampling adequacy (Nunnally *et al.*, 1967) were employed to test the appropriateness of the data for reliability analysis. Eigenvalues of discontinuity in excess of 1.0 and reliability loading exceeding 0.5 (Nunnally *et al.*, 1967) were used as the principles in choosing reliability analysis. For reliability estimation, Cronbach's α value exceeding 0.7 was considered to have high internal consistency of the scale.

Authors analysed respondent's responses for internal consistency (Chuang and Yang, 2014; Small, 2007). The reliability analysis of a questionnaire determines its ability to yield consistent results. Reliability was operational as internal consistency, which is the degree of intercorrelation among the items which comprise a scale. Internal consistency can be established using a reliability coefficient such as Cronbach's α. α is the average of the correlation coefficient of each item with every other item. The Cronbach's α of questionnaire with 81 attributes/items was found to be 0.992, which implies that the questionnaire is reliable. Similarly, the reliability of individual scales was tested and was found to be varied between 0.892 and 0.895. Since the reliability coefficients of all the individual scales were above 0.7 (considered adequate), all the developed scales indicated acceptable reliability. The collected data were analysed (using SPSS 20.0 software) by following reliability analysis procedure as suggested by Bai and Sarkis (2013). In research survey, there may be a large number of variables, and most of them are correlated. These variables must be reduced to a level that is relatively easy to manage and interpret. The first step, prior to conducting reliability analysis, the KMO measure of sampling adequacy and the Bartlett's test of sphericity were conducted (Nunnaly *et al.*, 1967). The KMO value was found to be 0.787, which is greater than 0.5, which indicated sample adequacy for reliability and supported the appropriateness of using reliability to explore the underlying attributes. The Bartlett's test of sphericity was highly significant ($p < 0.000$) with a significance value of 0.000, rejecting the null hypothesis that the 36 important attributes are uncorrelated in the population. Table IV represents the important verification results.

4.2 Correlation analysis

Table V reports correlation matrix for the six CSFs with scales. All items have correlations of 0.760, 0.691, 0.696, 0.790, 0.705 and 0.711 with the six scales in six factors.

Since scale six represents the average score obtained for all 81 items, highest correlation between scale six and item number 81 was expected. In addition, since item 81 indicated relatively smaller correlations with the other scales, it was concluded that it had been assigned appropriately to scale 9. As shown in Table V, all items had high correlations with the scales to which they were assigned relative to all other scales. Hence, it was concluded that all items in the instrument had been appropriately assigned to respective scales (Nunnaly *et al.*, 1967).

4.3 Communalities

The communalities of the data were reported greater than 0.600 for all the items of the scale. Communality referred to as the percentage of total variance explained by the common factors. Communalities represent the proportion of the variance in the original variables that is accounted for, by the factor solution (Nunnaly *et al.*, 1967; Rehman *et al.*, 2016). The factor solution should explain at least half of each original variable's variance, so the communality value for each variable should be 0.600 or higher. This term may be interpreted as a measure of "uniqueness". A low communalities figure indicates that the variable is statistically independent and cannot be combined with other variables. In the research instrument, the communalities value is more the 0.700 (Hair *et al.*, 2006). Please refer to Table VI for details.

4.4 Usage of communalities and correlation analysis for factors

The Pearson correlation coefficient measures the linear association between two scale variables. Detailed item analysis is used to construct reliable measurement scales, improve existing scales and evaluate the reliability of scales already in use. Specifically item analysis aids in the design and evaluation of sum scales, that is, scales that are made up of multiple individual measurements. Table VI represents all items having

Table IV.
Factors based verification on KMO-Cronbach α results

Factor	Factors based on survey results	Cronbach's α	KMO	The average variance explained by these factors (cumulative)
Factor-1	Top management	0.833	0.573	4.320
Factor-2	Human resource management	0.832	0.643	4.103
Factor-3	Organisational culture	0.830	0.678	4.574
Factor-4	Green practices	0.827	0.707	4.605
Factor-5	Process management	0.830	0.667	4.107
Factor-6	Supply chain management	0.833	0.696	3.874

Table V.
CSF factor-based correlation result

	CSF FS 1	CSF FS 2	CSF FS 3	CSF FS 4	CSF FS 5	CSF FS 6
CSF F1	1					
CSF F2	−0.052	1				
CSF F3	−0.003	0.105	1			
CSF F4	0.003	0.167	0.148	1		
CSF F5	0.006	0.146	0.344	0.843	1	
CSF F6	−0.016	0.041	0.150	0.021	0.118	1

S no.	Attribute	Initial	Extraction
1	Top management's clarity of vision, mission and strategic direction for GM	1.000	0.834
2	Top management's ability to take responsibility for continuous improvement in the environment	1.000	0.834
3	Adequate budgetary allocation for green improvement initiatives	1.000	0.833
4	Recognition of constructive efforts of employees by management	1.000	0.830
5	Management's commitment for providing good GM work environment	1.000	0.833
6	Employee involvement, generation and recognition	1.000	0.828
7	Work-life balance, health and safety	1.000	0.832
8	Employee growth and development	1.000	0.832
9	Planning, implementation and procurement policy	1.000	0.834
10	Performance incentives to employees	1.000	0.831
11	Staff training and awareness programmes for performance	1.000	0.834
12	The company make the best use of the employee skills to develop better products/services	1.000	0.831
13	The organisation search for new green products/services	1.000	0.828
14	Any competitiveness in relation to other organisations measured	1.000	0.832
15	Employees in the firm will always be willing to help customers	1.000	0.831
16	Customer's expectation and feedback on green product	1.000	0.829
17	Conducive environment for implementation of green environment	1.000	0.830
18	Motivation to the employees for implementing green environment	1.000	0.824
19	Disposal planning and scientific management of all types of wastes are critical	1.000	0.824
20	Green disposal by identifying different ways of reuse, recycle, remanufacture and promoting	1.000	0.830
21	Environmental mission statement, green packaging, government policies, rules and regulations	1.000	0.825
22	Legal, ethical and societal responsibilities to its key communities	1.000	0.826
23	Successful transformation into GM will bring tangible and intangible benefits to the cement community	1.000	0.830
24	Extent to which GM products have competitive quality with good reliability, durability and reusability	1.000	0.830
25	Adequate budgetary allocation for green improvement initiatives	1.000	0.830
26	Accountability by top management in GM ensures brand value enhancement and better regulatory compliance	1.000	0.828
27	Well-defined organisational structure and governance system	1.000	0.828
28	Well-defined rules, regulations and operating procedure	1.000	0.828
29	Elimination of CFCs and HCFCs in production	1.000	0.826
30	High solids paint programme and high particulate filtration	1.000	0.826
31	Ultra-violet/infra-red curing process and waste integration programme	1.000	0.833
32	Closed loop water system/ processing grey/black water system	1.000	0.834
33	Spreading risk of environmental problems	1.000	0.828
34	Substituting environmentally problematic materials	1.000	0.831
35	Remanufacturing and environmental department/teams	1.000	0.832
36	Applying product innovation, end of life (EOL), cradle to cradle and close loop approach for GM	1.000	0.829
37	Participation in environmental initiatives and certification programs	1.000	0.833
38	Environmental auditing, activity assessment and measurement of carbon footprint in organisation to ensure GM	1.000	0.833
39	Pollution/chemical, solid waste, water and energy use management system	1.000	0.835
40	New GM technologies should eliminate non-value added actives	1.000	0.829
41	Supplier's involvement and assessment system for successful GM	1.000	0.834
42	Extent to which technical assistance provided to suppliers so as to improve their green commitment and responsiveness	1.000	0.832
43	Environmental standards and audit for suppliers	1.000	0.834

Table VI. Communalities for CSFs

high correlations with the scales to which they are assigned to relative to all others, and Table VII indicates item to scale loading for input factors.

As mentioned earlier, factor analysis helps to find out underlying variables (factors) which illustrate the correlations pattern within a set of observed variables. Factor analysis can be used for meaningful data reduction so as to find out a small number of factors influencing a model/framework/phenomenon that explain most of the variance observed in a much larger number of manifest variables influencing model/framework/phenomenon. Other use of factor analysis is to generate hypotheses relating causal relationships or to screen relevant variables for the next level of analysis before performing a linear regression analysis (Nunnaly *et al.*, 1967; Hair *et al.*, 2006).

5. Regression analysis for modelling

Regression analysis is a statistical method for determining the relationships among number of independent variables and dependent variable. For investigating the effects of factors (predictors) on various organisational PMs, regression analysis was performed (shown as model summary for the concerned PM), so that the effect and impact of various factors could be understood. The symbols used for regression modelling follow standard terminology and have standard meaning and interpretations (Tables VIII-XIII).

6. Discussion of results

This study empirically discusses GM for the Indian cement industry linking PMs (dependent variables or criteria) and CSFs (independent variables or predictors) in the form of a modelling-based framework. Based on the inputs from Hair *et al.* (2006), the authors used regression analysis for analysing the relationships between dependent (criterion) variable and several independent (predictor) variables, so that the value of dependent variable could be predicted. To ensure maximal prediction from the set of independent variables, each independent variable is weighted by the regression analysis. The weights denote the relative contribution of independent variables to the overall prediction and facilitate interpretation, indicating the influence of each variable. R^2 or co-efficient of determination, which ranges between 0 and 1, indicates how the model is applied and used for estimation. A higher value indicates greater explanatory power and also signifies better prediction. In this model, authors also worked out adjusted R^2 which covers CSFs (as independent) and sample size. With the addition of independent variables, R^2 will rise but adjusted R^2 may fall depending upon the added independent variables have little explanatory power and/or if the degrees of freedom become too small. The authors after ensuring standardisation also worked out coefficients (β-coefficients) so that the relative effect of each CSF on chosen PM (dependent) could be directly compared.

Upon comparing, one finds that the coefficients of two CSFs green practices (ranging from 0.730 to 0.555) and process management (ranging from 0.283 to 0.170) are much higher in comparison to the coefficients of other CSFs for different PMs. The coefficients of other CSFs are smaller in comparison to these two dominating CSFs but cannot be neglected for the concerned PM. This clearly establishes "what to prioritize" for GM but at the same time generates other question whether GM achieved only on focussing "green practices" and "process management" will be logical and complete.

The answer is certainly no, which means GM if attempted only on focussing "green practices" and "process management" will not be complete and logical. Thus, the study

Item no./attributes	Correlations IF1	IF2	IF3	IF4	IF5	IF6
1. Top management's clarity of vision, mission, and strategic direction for GM	0.821**	−0.004	0.037	−0.018	0.111*	0.043
2. Top management's ability to take responsibility for continuous improvement in environment	0.756**	−0.025	0.022	0.020	0.096	0.035
3. Adequate budgetary allocation for green improvement initiatives	0.752**	0.111*	0.022	0.061	0.107*	0.006
5. Management's commitment for providing good GM work environment	0.713**	0.083	0.065	0.003	0.112*	−0.023
1. Employee involvement, generation and recognition	−0.062	0.776**	0.235**	0.309**	0.194**	0.056
2. Work-life balance, health and safety	−0.003	0.859**	0.082	0.128*	0.169**	−0.004
3. Employee growth and development	−0.047	0.813**	0.061	0.149**	0.208**	−0.035
5. Performance incentives to employees	0.402**	0.317**	0.257**	0.066	0.080	0.004
1. The company make the best use of the employee skills to develop better products/services	0.137*	0.171**	0.573**	0.062	0.112*	0.119*
2. The organisation search for new green products/services	0.051	0.193**	0.708**	0.579**	0.175**	−0.026
4. Employees in the firm will always be willing to help customers	−0.038	0.016	0.746**	0.093	0.206**	0.135*
5. Customer's expectation and feedback on green product	−0.019	0.144**	0.760**	0.226**	0.180**	0.105
1. Conducive environment for implementation of green environment	0.000	0.159**	0.448**	0.700**	0.115*	0.004
8. Extent to which GM products have competitive quality with good reliability, durability and reusability	0.016	0.132*	0.209**	0.710**	0.085	0.006
9. Adequate budgetary allocation for green improvement initiatives	0.035	0.160**	0.208**	0.849**	0.135*	−0.004
10. Accountability by top management in GM ensures brand value enhancement and better regulatory compliance	0.041	0.229**	0.316**	0.890**	0.167**	−0.035
12. Well-defined rules, regulations and operating procedures	−0.005	0.217**	0.324**	0.802**	0.154**	−0.032
1. Elimination of CFCs and HCFCs in production	0.087	0.205**	0.140**	0.146**	0.770**	0.148**
2. High solids paint programme and high particulate filtration	0.157**	0.210**	0.168**	0.171**	0.817**	0.145**
5. Spreading risk of environmental problems	0.126*	0.124*	0.047	0.058	0.839**	0.167**
8. Applying product innovation, end of life (EOL), cradle to cradle and close loop approach for GM	0.023	0.141**	0.400**	0.126*	0.395**	0.252**
1. Supplier's involvement and assessment system for successful GM	0.046	−0.038	0.094	−0.039	0.131*	0.758**
2. Extent to which technical assistance provided to suppliers so as to improve their green commitment and responsiveness	0.038	0.026	0.129*	−0.016	0.175**	0.739**
3. Environmental standards and audit for Suppliers	−0.030	0.024	0.014	0.016	0.206**	0.636**

Note: *,**Significant at the 0.05 and 0.01 levels, respectively (two-tailed)

Table VII. Item to scale loading for input factors

Model summary

Model	R	R^2	Adjusted R^2	SE of the estimate
1	0.744[a]	0.553	0.545	0.385

Dependent variable: quality performance

Coefficients[b]

Model		Unstandardised coefficients		Standardized coefficients		
		B	SE	β	t	Sig.
1	(Constant)	0.042	0.360		0.117	0.907
	Top management commitment	0.023	0.035	0.024	0.662	0.508
	Human resource management	0.015	0.022	0.026	0.698	0.486
	Organisational culture	0.035	0.042	0.033	0.835	0.404
	Green practices	0.628	0.059	0.555	10.586	0.000
	Process management	0.256	0.062	0.228	4.120	0.000
	Supply chain management	0.012	0.030	0.015	0.411	0.681

Notes: [a]Predictors: (Constant), supply chain management, green practices, top management commitment, human resource management, organisational culture, process management; [b]$Y1 = 0.042 + 0.024$ (top management commitment) + 0.026 (human resource management) + 0.033 (organisational culture) + 0.555 (green practices)+0.228 (process management) + 0.015 (supply chain management)

Table VIII.
Quality performance

Model summary

Model	R	R^2	Adjusted R^2	SE of the estimate
1	0.866[a]	0.749	0.745	0.251

Dependent variable: resource utilisation performance

Coefficients[b]

Model		Unstandardised coefficients		Standardized coefficients		
		B	SE	β	t	Sig.
1	(Constant)	0.061	0.235		0.259	0.796
	Top management commitment	0.050	0.023	0.059	2.175	0.030
	Human resource management	0.012	0.014	0.023	0.841	0.401
	Organisational culture	0.019	0.028	0.021	0.694	0.488
	Green practices	0.720	0.039	0.730	18.594	0.000
	Process management	0.166	0.041	0.170	4.103	0.000
	Supply chain management	0.019	0.020	0.026	0.956	0.340

Notes: [a]Predictors: (Constant), supply chain management, green practices, top management commitment, human resource management, organisational culture, process management; [b]$Y1 = 0.061 + 0.059$ (top management commitment) + 0.023 (human resource management) + 0.021 (organisational culture) + 0.730 (green practices) + 0.170 (process management) + 0.026 (supply chain management)

Table IX.
Resource utilisation performance

exposes lack of connectivity between CSFs and PMs for a holistic GM framework over emphasis on "green practices" and "process management" and indicates weaknesses of the cement industry in this regard. Authors believe that it is not only happening in the cement industry but other industries and sectors as well. Unfortunately, researchers and practitioners are over emphasising these two CSFs and are expecting "total or holistic GM".

Model summary

Model	R	R^2	Adjusted R^2	SE of the estimate
1	0.734[a]	0.539	0.531	0.327

Dependent variable: financial performance

Coefficients[b]

Model		Unstandardised coefficients		Standardized coefficients		
		B	SE	β	t	Sig.
1	(Constant)	1.139	0.357		3.842	0.000
	Top management commitment	0.008	0.035	0.015	0.357	0.722
	Human resource management	0.010	0.022	0.057	1.335	0.183
	Organisational culture	0.018	0.042	0.035	0.752	0.453
	Green practices	0.547	0.059	0.433	7.129	0.000
	Process management	0.182	0.062	0.226	3.531	0.000
	Supply chain management	0.018	0.030	0.041	0.951	0.342

Notes: [a]Predictors: (Constant), supply chain management, green practices, top management commitment, human resource management, organisational culture, process management; [b]Y1 = 1.139 + 0.010 (top management commitment) + 0.021 (human resource management) + 0.020 (organisational culture) + 0.577 (green practices) + 0.193 (process management) + 0.027 (supply chain management)

Table X. Financial performance

Model summary

Model	R	R^2	Adjusted R^2	SE of the estimate
1	0.772[a]	0.596	0.589	0.343

Dependent variable: green performance

Coefficients[b]

Model		Unstandardised coefficients		Standardized coefficients		
		B	SE	β	t	Sig.
1	(Constant)	−0.701	0.321		−2.183	0.030
	Top management commitment	0.025	0.031	0.027	0.792	0.429
	Human resource management	0.019	0.019	0.035	0.993	0.321
	Organisational culture	0.016	0.038	0.016	0.411	0.681
	Green practices	0.654	0.053	0.616	12.356	0.000
	Process management	0.203	0.055	0.192	3.663	0.000
	Supply chain management	0.020	0.027	0.026	0.735	0.463

Notes: [a]Predictors: (Constant), supply chain management, green practices, top management commitment, human resource management, organisational culture, process management; [b]Y1 = −0.701 + 0.027 (top management commitment) + 0.035 (human resource management) + 0.016 (organisational culture) + 0.616 (green practices) + 0.192 (process management) + 0.026 (supply chain management)

Table XI. Green performance

Senior management executives should understand that GM in the name of "green practices" and "process management" just does not depend only upon the cleaner technologies, better process management and emission reduction approaches, rather demands a deeper understanding of socio, organisational and managerial factors

Model summary

Model	R	R^2	Adjusted R^2	SE of the estimate
1	0.817[a]	0.668	0.662	0.276

Dependent variable: employee satisfaction

Coefficients[b]

Model		Unstandardised coefficients B	SE	Standardized coefficients β	t	Sig.
1	(Constant)	0.640	0.259		2.473	0.014
	Top management commitment	0.016	0.025	0.020	0.648	0.517
	Human resource management	0.033	0.016	0.068	2.133	0.034
	Organisational culture	0.008	0.030	0.009	0.254	0.800
	Green practices	0.545	0.043	0.579	12.802	0.000
	Process management	0.265	0.045	0.283	5.947	0.000
	Supply chain management	0.008	0.022	0.011	0.355	0.723

Notes: [a]Predictors: (Constant), supply chain management, green practices, top management commitment, human resource management, organisational culture, process management; [b]Y1 = 0.640 + 0.020 (top management commitment) + 0.068 (human resource management) + 0.009 (organisational culture) + 0.579 (green practices) + 0.283 (process management) + 0.011 (supply chain management)

Table XII. Employee satisfaction

Model summary

Model	R	R^2	Adjusted R^2	SE of the estimate
1	0.766[a]	0.587	0.580	0.33438

Dependent variable: customer satisfaction

Coefficients[b]

Model		Unstandardised coefficients B	SE	Standardized coefficients β	t	Sig.
1	(Constant)	−0.649	0.313		−2.072	0.039
	Top management commitment	0.042	0.031	0.048	1.388	0.166
	Human resource management	0.023	0.019	0.042	1.196	0.232
	Organisational culture	0.034	0.037	0.035	0.920	0.358
	Green practices	0.619	0.052	0.605	12.006	0.000
	Process management	0.195	0.054	0.191	3.606	0.000
	Supply chain management	0.016	0.026	0.022	0.620	0.536

Notes: [a]Predictors: (Constant), supply chain management, green practices, top management commitment, human resource management, organisational culture, process management; [b]Y1 = −0.649 + 0.048 (top management commitment) + 0.042 (human resource management) + 0.035 (organisational culture) + 0.605 (green practices) + 0.191 (process management) + 0.022 (supply chain management)

Table XIII. Customer satisfaction

influencing corporate performance. The design of a GM framework is a challenging exercise, and it demands the translation of stakeholders' needs into corporate business objectives with due considerations of green practices and sustainability-related challenges. It becomes more meaningful if PMs not only capture the business needs by linking CSFs but also guide focussed initiatives.

This empirical research helps to identify both PMs and CSFs for researchers and practitioners and also establishes that GM for the cement manufacturing (process type of industry) needs to be handled in a different manner.

The message is clear and loud that GM demands comprehensive and meaningful treatments. GM should not be discussed, treated and modelled myopically on the basis of cleaner technology and manufacturing-dependent factors only. The identified CSFs clearly link its influence on the PMs in the Indian context. It is expected that this research will be useful not only for the cement industry, but professionals from other industries can also focus meaningfully to direct their efforts in pursuing GM and in making it more effective. It is also expected that this framework attempt will help researchers and professionals in making effective decision makings in the allied areas of GM. They can decide focus areas, measures and overall picture influencing GM.

7. Conclusions and implications of research

The PMs and performance measurement become meaningful if it is linked with appropriate CSFs, indicating contemporary interests of corporate and priority areas. According to Neely *et al.* (2005), researchers and practitioners are generally dissatisfied with conventional backward-looking accounting system-based PMs. Throughout the world, both communities are busy in developing and using balanced and multi-dimensional PMs-based frameworks. These new models and frameworks place emphasis on non-financial, external and future looking PMs duly linked with CSFs. According to authors, it will be in the interest of both researchers and practitioners to focus on using contemporary CSFs and PMs right from the early stages of GM framework design and its developments. There are few empirical studies which discuss this challenging area, and there is a growing need for "holistic or total GM frameworks" which ensure alignment between PMs and CSFs along with regular updating of PMs and continuous scrutiny of CSFs.

According to the authors, the use of GM framework integrating PMs and CSFs can be made in three different manners. Alternatively, three useful lessons can be learnt from this study. First, as both CSFs and PMs are derived from GM needs of the industry, the GM framework can be deployed in measuring the effectiveness of GM and to gauge the success of the implementing GM strategy. Second, the CSFs-based information and feedback from the PMs can be used for challenging the assumptions in the context of an industry and to test the validity/suitability of GM strategy. Third, it can also be used to ensure whether it is leading towards "holistic or total treatment for GM" or there is an "imbalance". The conclusion reached here is if GM-centric strategy and GM-supportive measures are to remain in alignment, then top management must regularly review the CSFs, manufacturing and managerial processes, and PMs, and a framework like ours can help both researchers and practitioners.

In this paper, an attempt was made to analyse and model GM for the cement industry. The authors believe that this exercise would be useful for other setups. This study not only discusses the GM but also links it with both CSFs and PMs influencing business aspects. For example, the model can be useful to guide.

7.1 Top management commitment, efforts and human resource management

The study indicates that investing resources and efforts to raise green organisational identity may improve and offer green competitive benefits over time. It also indicates that an investment in human resource activities to promote and nurture GM may prove to be meaningful for the organisations. It is expected that management commitment should be demonstrative so that GM support could become visible.

Country-wide survey, detailed data analysis and interpretations may help cement companies and other process industries to develop a learning environment and a better enterprise culture. Management by facts requires management decisions based on relevant data and empirical study like ours. Most of the conventional GM research highlights on process management, material substitution, manufacturing aspects and emission reduction. Here, the authors anticipate a change in GM perspectives and its treatments.

7.2 Organisational culture and holistic treatment

The research reveals that for GM, an integrated assessment is needed which not only takes care of green cement production processes but also takes into account managerial and economic aspects.

7.3 Green practices and supply chain management

The study may help in understanding and linking environmental impact of cement industrial activity without losing quality, performance and cost and ensuring the green reach of cement in the form of effective supply chain management. It also guides about the changes in organisational culture, green identity and gain in green competitive advantage influencing cement manufacturing and its subsequent journey.

In this manner, this study contributes towards GM theory extension and enriches the theoretical base by offering empirical relationships linking both CSFs and PMs to examine the role of top management, human resource management, organisational culture, green practices, process management and supply chain management in the context of the cement industry. It is expected that both researchers and practitioners will appreciate the importance of linking CSFs and PMs and their alignment and will use the link in the form of GM framework.

8. Limitation and future scope

This research has certain limitations which are commonly observed in survey-based studies, for example, some subjectivity from the experts about their opinions towards GM-based data cannot be ruled out. In this analysis model, authors got experts' comments as positive, and an urgency was felt towards comprehensive GM implementation, which requires some more validation through process industry-based GM studies. This study establishes the relationships but does not ensure that the variables chosen are optimised or not. Lack of use of simulation also affects the scenario-generation needs for GM investigation. Scholars may try approaches like artificial neural networks for this requirement. While developing regression modelling, the authors did not consider the interrelationships between multiple dependent and multiple independent variables, and researchers may try canonical correlation which takes into account this complexity.

Similarly, this exercise can be combined with lean and added dimensions of waste reduction and energy consumptions. The study can be extended to include the changes in carbon foot prints and LCA approach for some select measures. Similarly, after working on regression equation, researchers may try correlation and structural equation-based modelling to reinforce the findings.

This model can be tried and tested in other developing and developed economies in different industries, to check and verify which CSFs become important for PMs and how factors vary from developing to developed country perspectives. Authors expect that the framework linking CSFs and PMs will raise future studies in the areas of GM in different sectors and setups. Future research in this areas of GM is promising not only for academicians but also for practitioners who wish to gain competitive advantage through GM.

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