Chapter 2
Identifying Drivers of Sustainability Initiatives in Manufacturing Organizations—An Exploratory Study from the Indian Cement Industry

S. Kumaravel and Ayon Chakraborty

Abstract In the current business scenario, firms need to increasingly focus on environmental sustainability issues, as a result of stricter regulatory enforcements that lay emphasis on cleaner production, and also due to growing pressures from the stakeholders. This paper aims at understanding the organizational factors that contribute towards the successful implementation of sustainability initiatives in a process industry setup. A qualitative case study from a major cement manufacturing firm located in India helps us to identify the key drivers in the context of sustainability. The case findings reveal that organizational culture and practices followed lead to the emergence of innovative and economically viable solutions, which help in achieving the sustainability targets. These exploratory results obtained can be further analysed in the backdrop of other industries.

Keywords Operations strategy · Sustainable operations · Green manufacturing

2.1 Introduction

The concept of 'sustainability' in the business world involves inclusion of sustainable development goals, namely social equity, economic efficiency and environmental performance, into a company's operational practices (Labuschagne, Brent, & Van Erck, 2005). Organizations which compete globally are increasingly required to commit to and report on the overall sustainability performances of their operational initiatives. As it involves mutliple objectives of social, economic and environmental sustainability, some of them may be conflicting (Zhou, Cheng, & Hua, 2000). In the light of increasing importance to sustainability in business operations, there have been many streams of emerging research that include

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developing metrics and frameworks for measurement of sustainability across firms (Seuring & Muller, 2008; Krajnc & Glavic, 2005; Clift, 2003) and analytical optimization models to incorporate sustainability goals (Al-Sharrah, Elkamel, & Almanssoor, 2010).

This paper focuses on how organizational factors contribute towards the implementation of sustainability initiatives taken in a process industry setup, through a qualitative case study. The next section provides a brief literature review that explores the state of present research and the questions we try to address. Subsequently, we present an overview of the research methodology adopted for our study of a major cement manufacturing firm in India. Finally, we report our findings and the implications of this study to industry and academia.

2.2 Theoretical Background

Though the initial research on sustainability focused only on the technological aspects of the manufacturing process, for finding newer methods of economical and cleaner production, in the last two decades, there has been a growing academic interest in the sustainability theme amongst organizational theorists too (Wong, Lai, Shang, Lu, & Leung, 2012). The emergence of topics, such as green logistics (Lai & Wong, 2012; Murphy & Poist, 2000), sustainable operations (Gimenez, Sierra, & Rodon, 2012; Kemp et al. 1998; Kleindorfer, Singhal, & Wassenhove, 2005), and green supply chain management (Srivastava, 2007), stands testimony to this fact. The work of Sarkis, Zhu, and Lai (2011) provides a mapping of green supply chain management literature to nine broad organizational theories.

Hansen, Grosse-Dunker, and Reichwald (2009) provide a framework called the Sustainability Innovation Cube (SIC) by trying to link sustainability initiatives to innovation management. In their view, sustainability puts a normative demand on innovation to become more environmentally and socially benign and, at the same, provides a new source of innovations and competitive advantage.

A more recent literature review by Adams, Jeanrenaud, Bessant, Denyer, and Overy (2015) shows that research on Sustainability Oriented Innovation (SOI) is widely distributed, of variable quality, immature and skewed. Based on their study, they have developed a model that could classify SOI into three approaches: (1) Operational Optimization, (2) Organizational Transformation and (3) Systems Building.

However, the extant literature does not investigate the mechanism of how organizational factors, such as organizational culture, leadership pattern, team performance influence the implementation of innovative solutions for attaining the firm's sustainability goals. In this paper, we attempt to elucidate these organizational drivers that complement the emergence of sustainable solutions, through a qualitative case study, thereby providing an exploratory insight for future work.

2.2.1 The Cement Manufacturing Process[1]

The primary raw material for manufacturing cement is limestone (calcium carbonate—$CaCO_3$). Hence, most cement manufacturing plants are located in the vicinity of limestone deposits. The quarried material is reduced in size, by processing through a series of crushers. Normally, primary size reduction is accomplished by crusher, followed by secondary size reduction with a roller or hammer mill. In the next step, the raw materials are further reduced in size by grinding to produce 'raw meal'.

The subsequent step involves the production of an intermediate called clinker, from the raw meal in large kilns. These kiln systems evaporate the inherent moisture in the raw meal by heating through the multistage suspension preheaters (called cyclone). Then, the process of calcination takes place, i.e. removal of carbon dioxide (CO_2) from $CaCO_3$, resulting in calcium oxide (CaO). Further, a series of chemical reactions convert the calcium oxides to silicates, at a very high temperature of about 2700 °F in the rotating furnace. This pyro-processing stage is the heart of the cement-making process. While many different fuels can be used for firing the kiln, coal is the primary fuel used since the 1970s. At the lower end of the kiln, the raw materials emerge as red-hot particles called clinker.

Clinker production is the most energy-intensive stage in cement production, accounting for over 60% of total industry energy use, and virtually all of the fuel use.

Once the clinker is formed in the rotary kiln, it is cooled rapidly. This fast quenching process is important to ensure the hardening properties and high strength of cement. After cooling, the nodules of clinker are ground with additives (such as gypsum, fly ash) to produce the required variant of cement. This process is called cement grinding. The two major variants used for construction purpose are Ordinary Portland Cement (OPC) and Portland Pozzolana Cement (PPC). These differ in their compositions and have varying applicability. The final stage involves packing and shipping of cement bags.

A simple schematic depicting the manufacturing process is shown in Fig. 2.1.

2.3 Research Methodology

Amongst the process industries, the cement manufacturing industry is classified as one of the 17 most polluting industries by the Central Pollution Control Board (CPCB) in India. Also, the cement industry is found to be the most energy-intensive of all manufacturing industries, as per the Manufacturing Energy Consumption

[1]Adapted from: https://www.energystar.gov/sites/default/files/tools/ENERGY%20STAR%20Guide%20for%20the%20Cement%20Industry%2027_08_2013_Rev%20js%20reformat%20111920 14.pdf, Accessed on 30 May 2016.

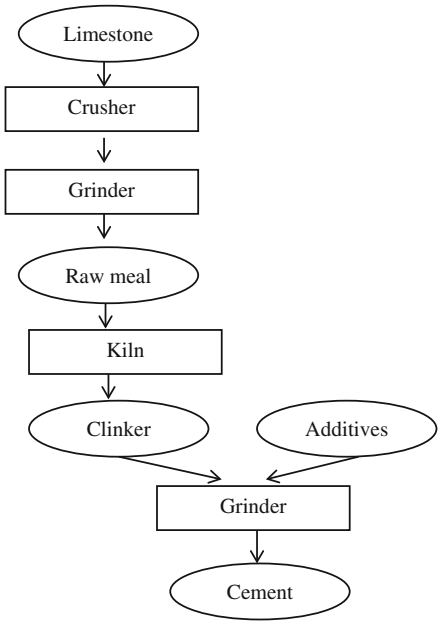

Fig. 2.1 Cement manufacturing process schematic

Survey (MECS, 2010). Hence, our focus lay on understanding how an organization operating in such a polluting and power-thirsty industrial sector is able to achieve its sustainability targets.

Based on published data sources, we found that a firm has won the Energy Efficiency Award for the cement sector, instituted by the Bureau of Energy Efficiency, from the President of India. Henceforth, it shall be referred to as KBL Cements. The actual identity of the firm is concealed here, on request of non-disclosure in public domain, for competitive reasons. We found that KBL Cements is a pioneer in the cement manufacturing sector, with a great legacy. Our objective was to understand the underlying mechanism and organizational drivers, by which KBL was able to attain its sustainability target in terms of energy efficiency.

We adopted the interviewing technique to collect data for this study. Groves and Kahn (1979) describe an interview as a purposeful discussion between two or more people that can help gather valid and reliable data relevant to research objectives. Based on the initial discussion with the manufacturing unit head, we understood that there is an energy management task force, which is an eight-membered cross-functional team which specifically works towards energy efficiency initiatives. Table 2.1 shows the composition of the team, the designation and interview duration.

We took personal in-depth interviews, on the company premises, using a semi-structured questionnaire, with six out of eight members in the team. When we completed the sixth interview, we had almost reached a theoretical saturation of

Table 2.1 Interview respondent profiles

Team member	Designation	Department	Interview duration (min)
TM1 (Lead)	Assistant General Manager	Mechanical	68
TM2	Senior Manager	Production	31
TM3	Senior Manager	Electrical	39
TM4	Assistant Manager	Mechanical	38
TM5	Senior Engineer	Electrical	40
TM6	Engineer	Process	72
*TM7	Senior Manager	Instrumentation	–
*TM8	Senior Manager	Power plant	–

*The last two team members were not interviewed, as we attained theoretical saturation of data

data. The objective of the interview was to understand the individual's engagement with the energy management initiatives of KBL, the functioning of task force, their communication, mode of decision-making, problems faced in terms of sustainability and if any effective and innovative solutions emerged.

All interviews were audio recorded and transcribed. Summaries of the transcripts were produced and were verified by both, the interviewer and an additional researcher. This enabled multiple source triangulation (Denzin, 1978). To corroborate our findings, we also used the secondary data sources, such as documented minutes of meetings and audited annual financial reports.

2.4 Findings

2.4.1 Organization Background

The Dalmia Group of companies is a large industrial and diversified group with a chronicle of over seven decades in India. It was founded by Jai Dayal Dalmia in the year 1935. It is headquartered in New Delhi with cement, sugar, travel agency, magnesite, refractory, and electronic operations spread across the country. The group has an annual turnover of over USD 1 billion (*INR 7000 crores, assuming a conversion rate of 1 USD = 66 INR)*. A brief history of the company's significant milestones is presented in Table 2.2.

The Dalmia Bharat Group was incorporated as a public limited company in February 2006.[2] It comprises the following businesses:

- Dalmia Cement Bharat Limited (DCBL), which started operating in 1939, in the state of Tamil Nadu;

[2]http://economictimes.indiatimes.com/dalmia-bharat-ltd/infocompanyhistory/companyid-14789.cms, Accessed on 30 May 2016.

Table 2.2 Significant milestones of Dalmia group

Year	Events
1939	Dalmia Cement Unit was started. Installed 250 tonnes per day kiln to manufacture cement by semi-dry process. Machinery was then supplied by M/s Polysius, Germany, KRUPP
1949	Installed a 500 tonnes per day wet process kiln supplied by M/s F. L. S. Smidth, Denmark
1958	Magnesite operations commenced
1959	Expansion was undertaken with the installation of another 500 tonnes per day wet process Folax Kiln supplied by M/s F. L. S. Smidth, Denmark
1970	Govan travels acquired
1976	Developed specialty cement for railway sleepers
1981	First to install raw meal roller mill
1984	Developed specialty cement for oil wells
1986	Introduced polybags for cement packing
1989	The only company in South India getting assistance from World Bank (DANIDA, Denmark) to set up its Regional Training Centre
1992	Computerized quarry scheduling
1994	Entry into sugar business
2005	Brownfield expansion of cement capacity from 1.5 to 3.5 MT
2008–09	Integrated 3 sugar plants with total capacity of 22,500 TCD (tonnes of cane per day)
2009–10	Ariyalur unit, in Tamil Nadu commissioned (2.5 MT)
2010	Commissioned refractory plant at Katni Commissioned 27 MW captive thermal power plant at Ariyalur, Tamil Nadu
2012	Enters Northeast India, Acquired Calcom Cement and Adhunik Cement Total capacity of the group—21.8 MTPA including Belgaum Plant. Dalmia Bharat Cement as a top quartile producer in India Became one of the three cement companies in India to adopt the Cement Sustainability Initiative Charter

Source Company website (https://www.dalmiabharat.com) Accessed on 30 May 2016

- Dalmia Bharat Sugar and Industries Limited, which commenced operations in 1994, in Uttar Pradesh;
- Dalmia Refractories, with units in the states of Gujarat and Madhya Pradesh; and
- Dalmia Power, established to meet the power requirements of the Group's cement and sugar plants.

DCBL is a leading player in the Indian cement manufacturing space with a production capacity of 24 million tonnes, with 11 cement manufacturing plants across East and South India, as shown in Fig. 2.2.

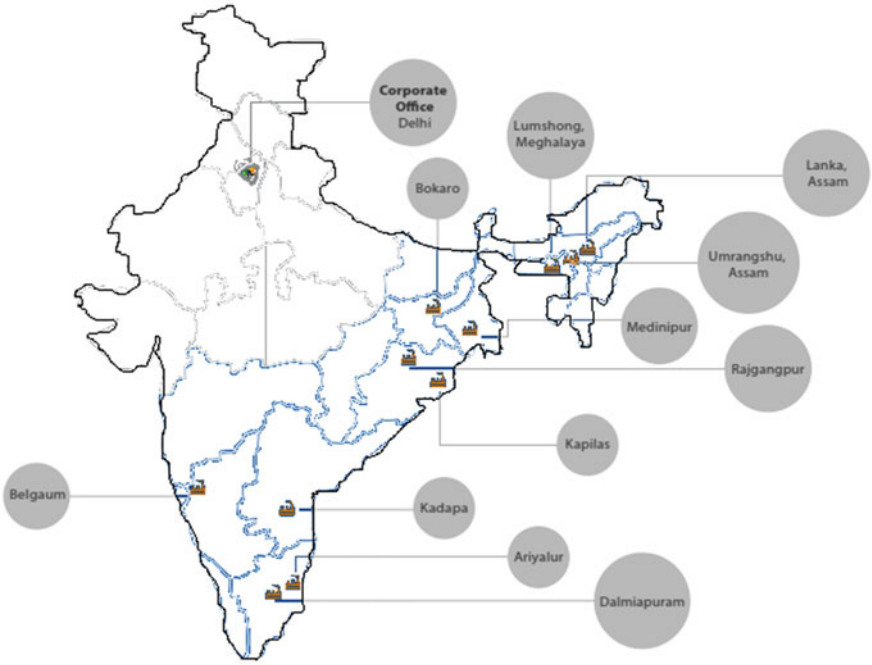

Fig. 2.2 Map showing plant locations of DCBL. *Source* Company annual report 2014–15

2.4.2 Energy Management Taskforce

DCBL has always nurtured a work culture that fosters the employees to work towards continuous improvement in energy conservation. The management welcomes suggestions from employees of all cadres, right from the shop floor employee. A person can convey the improvement suggestion through his supervisor or through the suggestion box at the Central Control Room (CCR) building.

A monthly award is given for the best improvement project undertaken. Once in every 6 months, a brainstorming session is held for employees to pool in their ideas for improvement. Ideas and suggestions of all kinds, irrespective of their feasibility, are most welcome in these open-house brainstorming sessions.

To further aid process improvement and energy conservation, Krishna Kumar, the unit head of the Ariyalur plant, constituted an exclusive team called the energy management taskforce in 2012.

This team comprises members from different departments of the manufacturing plant. The composition of the team is shown in Exhibit 4.

The team met once a month to discuss the updates from the last month and they set themselves the targets for energy reduction for the subsequent month. Based on the initial analysis of the transcripts, we found that an innovative solution has emerged through this task force. The idea was to minimize the power consumed by

the fan, by implementing a duct modification. It has significantly brought down the energy costs for production.

In the team meetings, the status of the backlogs of the previous month is reviewed and the targets for the current month are set. The team is always open to suggestions from all.

In 2012, the Ariyalur unit bagged the "Green Award" instituted by the State Government of Tamil Nadu. The concerted efforts of the team paved way for this unit to the win accolades in the national arena too. One such recognition is the National Energy Conservation Award for the cement sector, instituted by the Ministry of Power, Government of India. The President of India presented the prestigious award to Krishna Kumar, the unit head.

We could find certain themes emerging from all the interviews:

1. ***Presence of communication channels***: The senior leadership has fostered a culture of openness and practiced employee engagement in sourcing ideas for improving energy efficiency in the plant operations. This is evident from the fact that all the interviewees recollected the incentive schemes (such as special recognition and team awards) to motivate employees. They mentioned the presence of a suggestion box where any employee, even the one working on the shop floor, could communicate her suggestion. This is consistent with the findings of Fairbank and Williams (2001).
2. ***Empowerment***: From the interviews, we found that the energy management task force had the decision-making authority and the power to implement new practices and modifications to the existing process, which do not require any major capital expenditure. The team was self-propelled and required senior management intervention only when huge financial investment was needed. Thus, the empowerment of the team has fostered the spirit of creativity (Burpitt & Bigoness, 1997).
3. ***Strengths of cross-functional team***: Being a cross-functional team with members having varying experience and level of expertise (with different designations, as shown in Table 2.1), the knowledge sharing and trust have been instrumental in the successful functioning of the team. Literature suggests a similar outcome in the use of cross-functional teams, as seen in the context of New Product Development (Love & Roper, 2009).
4. ***Openness of team meetings***: The interviewees mentioned that they were free to voice their views, even when it could lead to a conflict in the team. This constructive conflict in a cross-functional team leads to the emergence of an innovative solution, within the given constraint (Lovelace, Shapiro, & Weingart, 2001).

This case provides an empirical support to the claim of Nidumolu, Prahalad, and Rangaswami (2009) that sustainability targets provide the push for companies to go for innovative solutions.

2.5 Implications and Future Work

From a theoretical perspective, this research study shows that organizational practices lead to emergence of sustainable solution under the normative pressures of sustainability. To a practitioner, this exploratory work highlights the importance of key enablers within an organization that would drive the emergence of innovative solutions in the firm's journey towards sustainability.

The findings of this study affirm the stance presented by Nidumolu et al. (2009) that sustainability targets set forth by regulatory agencies need not be seen as only constraints that would erode a firm's competitiveness in the market but can be viewed as opportunities for innovation. However, we need to observe these factors in the context of other process industries to verify our findings. Multiple cases with cross-case analyses would help us confirm the results obtained through this study. Moreover, it would help us present a broader perspective and develop a conceptual model to understand the drivers of Sustainability Oriented Innovations (SOI), which would be of academic interest to management scholars and of corporate interest to firms, which are keen on driving innovation towards sustainability.

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