Chapter 9

Exploring Sustainability in Indian Pharmaceutical Industry

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Abstract Use of technology in this era requires organizational goals to be met more than just maximizing profit and capturing more and more market share. The aim of this research is to explore sustainability awareness in Indian pharmaceutical industry by considering social well-being along with economic and environmental aspects and attainment of key drivers. Despite moving towards 21st century, it is a fact that sustainability and related practices in Indian pharmaceutical industry is still in its infancy. Thus, looking at sustainability comprehensively, its awareness and related practices needs to be explored by incorporating them at strategic, tactical and operational level functions of a pharmaceutical organization. Once these aspects are explored, this will not only help to improve the environmental performance of an organization but also enhance managerial capability and decision-making capacity. This work has been carried out as a part of an ongoing research to identify and establish theoretical relationship between sustainability awareness, triple bottom line and key drivers. Therefore, it is expected that its practical implementation can be achieved in future with greater clarity.

Keywords Sustainability · Sustainability awareness · Pharmaceutical industry

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9.1 Introduction

Achieving sustainability is one of the major concerns in the pharmaceutical industry (Amran and Ooi 2014; Agar et al. 2016; Sheldon 2016). Pharmaceutical manufacturing is complex in nature, and associated with high waste generation (Sheldon 1993) and GHG emissions. Researchers have shown greater environmental impact of pharmaceutical per kilogram production compared to basic chemicals because of the complex chemical formulation involved that also leads to higher waste per kg product, and, consequently higher fossil-fuel consumption. Cumulative energy demand is 20 times greater and GWP is 25 times higher than basic chemical product's production (Wernet et al. 2010; Cespi et al. 2015). Having its concerns on climate change (<http://web.unep.org/>), reported that green-house gas emissions are the main culprit and dominant factor for climate change. Thus, with a goal of exploring sustainability awareness in Indian pharmaceutical industry this work aims to establish its relation with environmental aspects, economic aspects, social aspects i.e. triple bottom line (TBL) and external forces that can act as a key driver and contribute to achieving sustainability. Raman (2006) have studied that Indian pharmaceutical corporate are still hesitant while disclosing on environmental and energy issues. Further, Goyal (2014) concluded that the disclosure index on environmental practices considering clean technology, energy consumption, environmental management etc. for Indian Pharmaceutical Industry was only 22.0 (Industry-wise disclosure index is calculated by dividing total scores attained by all the companies related to particular sector with the total maximum score that can be attained, as studied by Goyal (2014), while the highest disclosure was from Oil and Gas industry at 41.42 followed by Cement industry at 40.28. This shows that environmental reporting is one of the strongest ways to achieve sustainability since it helps monitor the environmental performance and thus aids in exploring the avenues for improvement. Most if not all, the published literature in Indian context is not adequately proposing a model to highlight sustainability awareness (Goyal 2014) and its relation with TBL and key drivers. With the perspective of managerial implementation and ongoing research, this paper presents a relationship model between sustainability awareness and factors contributing to environment, economic and social aspects, along with key drivers in context of Indian pharmaceutical industry.

9.2 Research Methods

For this study mainly methodology reported in Malhotra (2004) was followed. The same was found to be more pertinent for this particular research, among others surveyed. The adoption of such methodologies also supports the survey-based research approach because data collected through survey-based methods allows researchers to observe a real-world phenomenon in greater detail. Further, it helps to test a newly formed construct (Sihvonen and Partanen 2016). Constructs (Table 9.2)

pertaining to sustainability, TBL and key drivers were identified through extensive literature review as done by authors (Peukert and Sahr 2010; Mitra 2012; Watson 2012; Lozano et al. 2016; Chaturvedi et al. 2017). For this research, a survey tool was developed on a five-point Likert scale. After its construct validation, the tool was deployed for pilot testing. 53 out of 57 responses were received since the remaining four responses were not received even after many request reminders. Reliability testing was then performed to validate the constructs in the questionnaire and to see whether indicators under each constructs behave suitably and indicate what they are meant to. The observed Cronbach's alpha values ranged from 0.853 to 0.862 which were well above the threshold value of 0.70 (Nunnally 1978), assuring internal consistency of measured items. Thereafter the survey tool was sent for final survey. The sampling frame considered all the pharmaceutical companies who were registered in the directory of National Pharmaceutical Pricing Authority (NPPA). A total of 2147 Indian pharmaceutical companies were contacted via email. Selection of these companies for establishing contact had been done through convenient, random and snowball sampling technique. Out of all the total companies contacted, responses from 439 were obtained. Out of these 439 respondents, 393 (i.e. response rate of 18.30%) were found suitable based on complete information provided against each items of questionnaire, for further analysis. The response rate was found to be similar in line with other such web-based surveys carried out by researchers like Sihvonen and Partanen (2016) with 15.5%, Lozano et al. (2016) with 8.9% and Gopal and Thakkar (2015) with 16.2% response rate. The comparison of response rates is relevant here since the response rate in industrial surveys is usually very low and hence the rate of 18.3% obtained in this work is supported by the rates reported in other similar works done for other industries elsewhere.

9.3 Research Results and Data Analysis

The Survey responses (through survey questionnaire pertaining to constructs and its indicators and Item Statistics in Table 9.3) were analyzed using descriptive and inferential statistics. The mean value from item statistics table with corresponding standard deviation ranged from 3.46 to 4.53, showing that majority of the respondents agreed with the scaled variables. After getting mean importance value of all scaled items, reliability and validity analysis was done. Cronbach's alpha values varied from 0.701 to 0.774 ensuring internal consistency between items pertaining to sustainability, TBL and key drivers. Next to reliability, KMO and Bartlett's test of sphericity were performed to check sampling adequacy. KMO measures of sampling adequacy were 0.767 for items pertaining to sustainability and 0.791 for items consisting to TBL and key drivers, thus ensuring sampling adequacy. This further confirmed that the items listed in the questionnaire were valid and relevant in terms of both the questions themselves and the study as a whole.

9.3.1 Factor Analysis

After reliability and sampling adequacy tests, factor analysis tests (the Kaiser criterion (Eigen Value > 1), in conjunction with evaluation of scree plot) were performed. Primary component analysis followed by varimax rotation component matrix was conducted. Value of factor loading ranges from 0.452 to 0.895 > 0.4, showing strong loadings on its original factors (Hair et al. 2006). The results of factor loading show that the variables consisting sustainability were loaded on three factors and named as sustainability awareness, sustainability planning and sustainability implementation whereas variables of environmental aspects were loaded on two factors and were named as material impact and process optimization. Variables consisting of economic aspects, social aspects and key drivers were remaining loaded on its original form. Reliability of newly formed constructs was further tested and found to be above the minimum accepted value i.e. 0.70.

Following Hypothesis was framed to test the relation between sustainability awareness and the enablers/factors identified through factor analysis.

H₁ = There is significant association between sustainability awareness and material impact, process optimization, economic aspects, social aspects and key driver.

9.3.2 Inferential Statistics

After factor analysis, inferential statistical analysis was performed to explore the relation between sustainability awareness and TBL along with key drivers. The correlation table (Table 9.1) shows a strong correlation between material impact and sustainability awareness ($r = 0.888$, $p < 0.001$), followed by process optimization ($r = 0.639$, $p < 0.0001$).

Results depict that awareness about impact of materials in use will help organization to optimize the whole process. In other words, we can say that once an organization knows about impact of materials and its environmental consequences, it will help engineers, strategists and managers to optimize the whole process in order to enhance its environmental performance. Once the process optimization is implemented it will reduce waste generation, ensure less emission and increased yield thus ensuring economic and social benefits. Moreover, closely linked social aspects ($r = 0.308$, $p < 0.001$) with sustainability awareness depicts that while becoming socially responsible organizations, companies have to attempt many goals simultaneously such as employee training and development, health and safety issues, employee participation in decision making etc. Additionally, globally-driven initiatives, legislative decisions, R&D facilities and mandatory reporting (Key drivers) will help organizations to improve their public corporate image for a long term. The result shows a positive association between sustainability awareness and predictors.

Table 9.1 Pearson correlation (2-tailed) between sustainability awareness and predictors

	Parameter	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
		Material impact	Process optimization	Economic aspects	Social aspects	Key drivers	Sustainability awareness
Factor 1	Cor.	1					
	Sign.						
Factor 2	Cor.	0.449**	1				
	Sign.	0.000					
Factor 3	Cor.	0.314**	0.175**	1			
	Sign.	0.000	0.001				
Factor 4	Cor.	0.233**	0.351**	0.281**	1		
	Sign.	0.000	0.000	0.000			
Factor 5	Cor.	0.290**	0.146**	0.553**	0.052	1	
	Sign.	0.000	0.004	0.000	0.305		
Factor 6	Cor.	0.888**	0.639**	0.268**	0.308**	0.296**	1
	Sign.	0.000	0.000	0.000	0.000	0.000	

**Correlation is significant at the 0.01 level (2-tailed)

9.3.3 Multiple Regression Analysis

In this step multiple regression analysis was employed to test the relationship between five predictors and sustainability awareness. From the Coefficient table (Table 9.4) it is observed that all five predictors had a tolerance value > 0.10 and their VIF (variance inflation factors) value ranges from 1.243 to 1.619 thus ensuring strongly that no multi collinearity exists. Further from the model summary, the coefficient of determination R^2 was 0.867, indicating 86.7% sustainability awareness can be achieved because of five factors, and the R value was 0.931. Thus, the effect size of this research is found to be large. The multiple regression model was obtained which produced $R^2 = 0.865$, $F = 504.100$, $p < 0.05$. This indicated that overall model is statistically significant at $p = 0.000 < 0.05$. The individual model variables indicated that the material impact ($\beta = 0.693$, $p < 0.05$), process optimization ($\beta = 0.269$, $p < 0.05$), economical aspects ($\beta = -0.060$, $p < 0.05$), social aspects ($\beta = 0.035$, $p < 0.05$) and key drivers ($\beta = 0.069$, $p < 0.05$) were statistically significant with sustainability awareness. However economic aspects have significant but negative relation with sustainability awareness. It is believed that while responding, respondents may have considered the fact that improvements at any stage will have their economic consequences without considering long-term benefits. Thus, it may have significance but has a negative relation. Following Regression, an equation was developed using Table 9.4, representing regression model to explain liner relation between sustainability awareness and its independent factors.

Table 9.2 Constructs and items mentioned in the questionnaire for survey

Factors	Indicators	
Sustainability	Awareness of sustainability concept	Influence on R & D practices
	Involvement of management	Increase transparency
	Improve supportive functions	Setting benchmark companies
	External environment	Impact on manufacturing cost
	Code of conduct for supplier	Improvement in org. performance
	Internal sustainability policy	R & D during design phase
	Internal motivation and external stimuli	Understanding of environ. aspect
	External pressure	Incorp. in vision and mission
	Impact on stakeholders	Envi. impact as funct. requirement
Environmental aspects	Material impact on environment	Consider biodegradable materials
	Identification of hot spots	Waste reduction (zero landfill)
	Energy consumption and CO ₂ emission	Use of recyclable product
	Consideration of GHG emission	
Economic aspects	Purchase materials from certified supplier	Considering environmental aspect will improve financial performance
	Reduced energy and resource consump	Invest to minimize CO ₂ emission
	Use of recyclable packaging material	
Social aspects	Consider health and safety issues	Provide opportunity for employees
	Incorp. of edu. and training of employees	Ensures employees participations
	Transparency in organizational policies	
Key drivers	Global initiative	Policies for green project
	Government initiatives	Use of LCA and other metrics
	Research and development facility	

Source Peukert and Sahr (2010), Mitra (2012), Watson (2012), Lozano et al. (2016), Chaturvedi et al. (2017)

$$\begin{aligned}
 \text{Sustainability Awareness} = & -0.075 + 0.693M.I. + 0.269P.O. \\
 & -0.060E.A. + 0.035S.A. + 0.069KD \quad (9.1)
 \end{aligned}$$

In Eq. (9.1), *M.I.* = Material impact, *P.O.* = Process optimization, *E.A.* = Economic aspect, *S.A.* = Social aspect and *KD* = Key driver.

Therefore, hypothesis H_1 was supported (Tables 9.3 and 9.4).

9.4 Discussion

The results indicate existence of sustainability awareness in the Indian pharmaceutical industry. However, passé to adopt related practices is slow. This concurs with the findings of Goyal (2014), Kolk (2010) and Thijssens et al. (2016). Findings from this research support the hypothesis. The observed value of Mean i.e. 3.46–4.53 (Table 9.3) shows that organizations are accepting that sustainability awareness can be explored by considering practices pertaining to TBL and in presence of key drivers. Further beta value from regression equation shows significant amount of variance in the dependent variables i.e. sustainability awareness because of each independent variable. On the basis of findings, it is highlighted that sustainability awareness is mainly driven by consideration of material impact, process optimization, economic aspects, social aspects and presence of key drivers.

9.5 Implications

A major contribution of this paper is the statistics-based regression model, which integrates elements of TBL, key drivers and sustainability awareness. Contributions of findings are useful to explore the independent influences of predictors on sustainability awareness. This regression model is considered as a part of ongoing research thus it will be helpful to develop sustainability model whose use can be explored in the Indian pharmaceutical industry to achieve overall sustainability. Since regression model has been developed by direct survey method and statistical tools to analyze collected data have been used, it is thus deemed to be considered suitable for its practical usage. Since every firm has its own decision-making criteria thus managers have to fix up their priorities related to TBL and key drivers to enhance sustainability awareness by looking on hazardousness' and impact of used material, thus can take proactive actions.

9.6 Conclusions

Theoretical development and statistical analysis support this research work which builds up on the hypothesis that practices related to TBL and key drivers are useful and can be utilized as important factors to explore sustainability awareness in Indian pharmaceutical industry. More importantly, this research can possibly be used to diagnose

Table 9.3 Item statistics

Item	Mean	S.D.	N
1. Proper understanding of concept	4.39	0.750	393
2. Involvement of management	4.28	0.796	393
3. Incorporation of the concept in the vision and mission	4.09	0.830	393
4. Improvement in supportive function	3.81	0.854	393
5. External environment	3.70	0.731	393
6. Organization has code of conduct for suppliers	4.04	0.755	393
7. Organization has internal sustainability policy	4.16	0.882	393
8. Internal motivations	4.12	0.781	393
9. External pressure	3.46	1.070	393
10. Impacts on stakeholders	3.53	1.020	393
11. It influence research and development facilities	4.19	0.611	393
12. Transparency policy	4.21	0.840	393
13. Benchmark for other companies	4.09	0.714	393
14. Manufacturing cost	3.88	0.867	393
15. Overall performance	4.30	0.731	393
16. Through formal management	3.96	0.844	393
17. During product design phase	3.75	0.830	393
18. Environmental impacts as functional requirement	3.77	0.907	393
19. Considers impact of material used for mfg	4.04	0.706	393
20. By identifying hot spots of manufacturing process	3.72	0.901	393
21. Consider process specific energy and CO ₂ emissions	3.58	0.865	393
22. Consider green house gas (GHG) emissions	3.77	0.926	393
23. Uses biodegradable materials	4.07	0.842	393
24. Ensures zero landfill (effluent and waste)	3.93	0.884	393
25. Use of recyclable material	3.98	0.973	393
26. Purchase materials from certified suppliers	4.09	0.689	393
27. Invest to minimize energy and resource consumption in the production	4.18	0.571	393
28. Use recyclable packaging materials	4.05	0.971	393
29. Consider financial implications in purchasing	3.86	0.743	393
30. Health and safety issues	4.30	0.706	393
31. Education and training of employees	4.30	0.755	393
32. Transparency in policies	4.18	0.782	393
33. Opportunities for employees	4.00	0.732	393
34. Employee's participation	3.86	0.789	393
35. Globally driven initiatives	3.98	0.612	393
36. Government initiative	3.88	0.734	393

(continued)

Table 9.3 (continued)

Item	Mean	S.D.	N
37. Research and development facility	4.21	0.750	393
38. Policies for green projects	4.18	0.759	393
39. Innovative thinking such as use of green chemistry, energy efficient manufacturing process, use of LCA of product etc.	3.93	0.863	393

Table 9.4 Coefficients used in the model

Model 1	Unstandardized coefficients	Standardized coefficients	t	Sig.	Collinearity statistics	VIF
	B	Beta			Tolerance	
(Constant)	−0.075		−0.732	0.465		
Material impact	0.693	0.749	34.41	0	0.726	1.377
Process optimization	0.269	0.288	13.29	0	0.732	1.365
Economic aspects	−0.06	−0.072	−3.05	0.002	0.618	1.619
Social aspects	0.035	0.049	2.38	0.018	0.804	1.243
Key drivers	0.069	0.073	3.22	0.001	0.661	1.513

and analyze which practices of TBL and key drivers are effective in influencing more on exploring sustainability awareness. The findings of this work indicate that consideration of material impacts and related process optimizations have strong association with organizational environmental performance thus leading to enhanced sustainability awareness. Conversely, managers have to accept the challenges of economic consequences associated with immediate investments and long-term return with sustainability awareness in the Indian pharmaceutical industry. In addition to these, this research provides a broad understanding of how different aspects of TBL and key drivers can be adopted as an informative tool to explore sustainability awareness, thus to achieve overall sustainability in Indian pharmaceutical industry.

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