The impact of Green Training on Green Manufacturing with a mediating effect of Firm size

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Abstract

Green manufacturing is a common jargon used by many manufacturing companies and researchers. There is a dire need for companies, and especially those engaged in manufacturing activities, to take a proactive, rather than a reactive, approach in this regard. The aim of the paper is to find the impacts of green training on green manufacturing practices with a mediating effect of firm size in Apparel Manufacturing Industry. The study investigates the effects using a pretested structured questionnaire. Data was collected using a survey method using a scales with 120 complete and usable responses. We find that constructs and indicators of our theoretical framework meet the criteria, and find them to be a good fit based in SEM model made by smart PLS software. The analyses outputs suggest that there is significant impact of Green Training on Green Manufacturing and our hypotheses are supported, which further supports the extant literature. Research also suggest there is no significant mediating role of Firm Size on impact of green training on green manufacturing.
Theoretical and Practical Implications: *Our present study is unique in terms of scope and contribution to apparel manufacturing theory and practice. The study has tested empirically the research calls of various researchers and extended them to green supply chain networks. Furthermore, researchers should continue to investigate green training, firm size and green manufacturing to understand its implication in apparel garment industry*

Keywords: *Green training, Green manufacturing, regression analyses and hypothesis testing.*

1. Introduction

Green manufacturing is a term associated with production practices, which use more environmental friendly resources and provide maximum output with little or no waste or pollution in production (Gopalakrishnan et al., 2012; Baines et al., 2012). Green manufacturing can lead to reduced usage of raw materials, reduction in energy consumption, fewer manufacturing steps, lower environmental and occupational safety expenses, along with an improved corporate image (Porter and Van der Linde, 1995). Without environmental awareness, it is difficult to implement green practices. According to another definition of green manufacturing, it is design, processing and commercial use of materials processes and products, which are economical and sustainable while minimizing pollution and risk to human health and the environment. Green manufacturing is more of a philosophy rather than an adopted process or standard [6].
Guo-Ciang et al. presented a model for Taiwan textile and apparel industry in which drivers for green supply chain management were identified [19]. Several researchers have discussed about evaluating present green manufacturing practices in different department of apparel and textiles globally [20, 21].

Green Training can be defined as a process of on-the-job training and continued education intended to achieve corporate environmental management targets and purposes (Daily and Huang, 2001). According to Pailleetal.(2014)and Mudulietal.(2013),GTisatypeof training related to relevant environmental topics; it enables all staff (top, senior, and middle managers and the workforce) to integrate the firm's performance with environmental issues. According to Sarkis et al. (2010) GT was relevant to the adoption of advanced environmental practices among companies in Spain.
Daily et al. (2012) stated that GT is relevant to green teams. Jabbour (2015) indicated that GT is positively related to

the evolution of environmental management in firms. Other studies have reinforced the importance of GT for a green economy (Jackson et al., 2014; Renwick et al., 2013).
However, based on the available knowledge, the following gaps still remain in the current literature. These works do not directly discuss the link between GT and Green manufacturing. On the other hand, many works on green training are qualitative (Perron et al., 2006; Teixeira et al., 2012) or conceptual, such as literature reviews (Jabbour, 2013). More quantitative studies are still needed (Jabbour and Jabbour, 2016). As a consequence, this is a useful avenue for future research.
A research gap also exists regarding whether green training is positively related to green manufacturing. Furthermore, considering that firm size (FS) plays a major role in the adoption of more sustainable goals.
Based on the above, the objective of this study is to investigate the variables green training, green manufacturing and firm size. Also to find the impact of green training on firm size with mediating effect of firm size. The results of this study provide managerial and theoretical approaches for different industries in India to focus on environmental awareness by improving their GSCM practices adoption. Garment industry being a defragmented and unorganized industry requires a systematic framework for green manufacturing which will help manufacturers to analyze their current status and further help to take suitable policy decisions to make their process more sustainable and green.

2. Research method

This research was quantitative and based on an electronic survey. We proposed the research framework shown in Fig. 1.

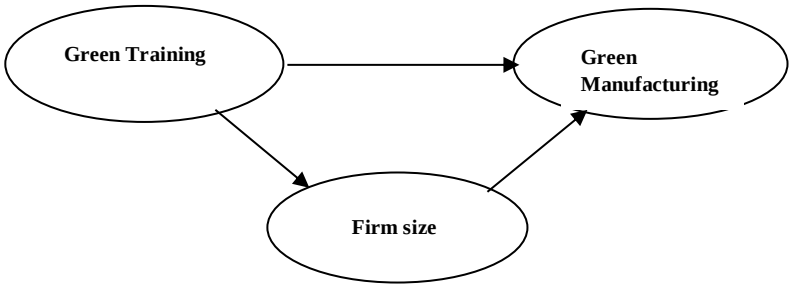

Fig 1: Conceptual framework

As a consequence, we tested the following relationship
(H1): GT has significant impact on green manufacturing in apparel industry.
(H 2): Firm size has a mediating effect on the impact of green trains on GM.
In survey questionnaire the construct green manufacturing included 15 items and the construct Green training included 7 items practices/items The selected GM practices scale was validated by (Shang et al., (2010) and the Green Training was based on the validated scale from Daily, et al. (2012) and Sarkis et al. (2010) Table 1 shows the references for all the selected items in the research questionnaire. As explained above, all the selected items were validated by the literature.
In addition, we measured the Firm Size variable using four types of patterns in India based on the number of employees: micro-sized firms (up to 19 employees), small firms (20-99 employees), medium-sized firms (100-499 employees), and large firms (500 or more employees). Based on data from 2021, there are about 6400 garment manufacturing firms in India. An online link to this research questionnaire was sent by email to sustainability/operations managers/production managers and to owners of manufacturing firms.
About 190 potential participants were contacted for the electronic survey and 125 questionnaires were collected; thus, a return rate of 65.78% was obtained. Of the participants in the final research sample, were from the manufacturing sector, 20% from. This sample representation comprised 2.1% micro-sized firms, 18.9% small firms, 42.1% medium-sized firms, and 36.9% large companies, all of which had ISO 14001 certification.
The data was analyzed with structural equation modelling (SEM) using partial least squares (PLS) with the support of the SmartPLS 2.0 M3 software.

3. Methodology and Research Design

The research analyzed the data through SEM and in order to process the collected data, a path diagram was built to show the relationship between the dependent and independent as shown in Table 2
Fig. 2 shows the first step of the two-stage approach. In this stage, all the first-order constructs were linked to assess the validity and reliability of the outer model PLS. Fig. 2 shows that the loading factors for all the indicators were greater than 0.7 and that the values of AVE and loadings generated by each construct were compliant (see Tables 2 and 3). After all the criteria were met, the score of each latent variable was used for the second step to test the hypothesis of the inner model PLS.

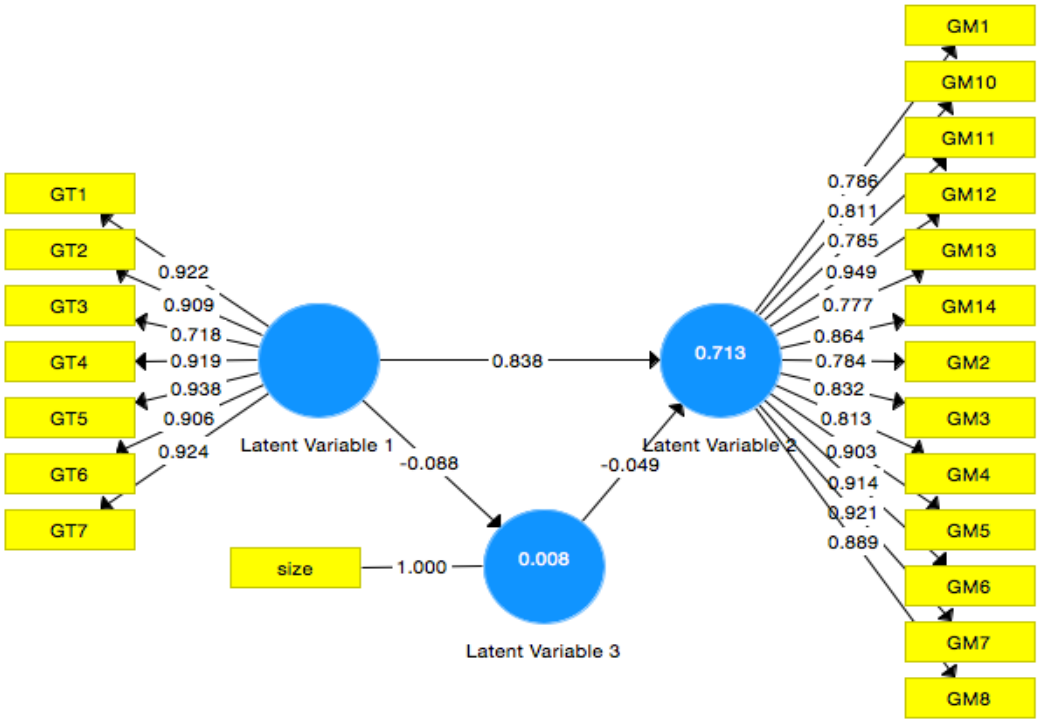

Fig 2: SEM Model 1 from smart PLS

Convergent validity and internal consistency reliability (factor weighting scheme; mean 0, Var 1; Max. Iteration 300).Reliability lower than 0.6 and AVE lower than 0.5, both of which were lower than recommended (Latan and Ghozali, 2012). The figure are mentioned in figure 2.

	Cronbach's Alpha
Latent Variable 1 (GT)	0.947
Latent Variable 2 (GM)	0.93
Latent Variable 3 (FS)	1.00

Table 1: Construct Reliability and Validity

	Latent Variable 1 (GT)	Latent Variable 2 (GM)	Latent Variable 3 (FS)
GM1		0.786	
GM10		0.811	
GM11		0.785	
GM12		0.949	
GM13		0.777	
GM14		0.864	
GM2		0.784	
GM3		0.832	
GM4		0.813	
GM5		0.903	
GM6		0.914	
GM7		0.921	
GM8		0.889	
GT1	0.922		
GT2	0.909		
GT3	0.718		
GT4	0.919		
GT5	0.938		
GT6	0.906		
GT7	0.924		
Size			1.000

Table 2: Outer loadings

After removing two dimensions GM 9 and GM 15 in two-stage approach, the convergent validity, internal consistency reliability, and discriminant validity showed improved statistical fit, as suggested by the literature (Latan and Ghozali, 2012; see Table 1).

Going ahead with the statistical analysis, to obtain better statistical fit and check the statistical significance of the obtained coefficients, a structural model was estimated based on boot- strapping with 1000 subsamples (Tables 2 and Figure 2).

	R Square	R Square Adjusted
Latent Variable 2 (GM)	0.713	0.708
Latent Variable 3 (FS)	0.008	-0.001

Table 3: R Square

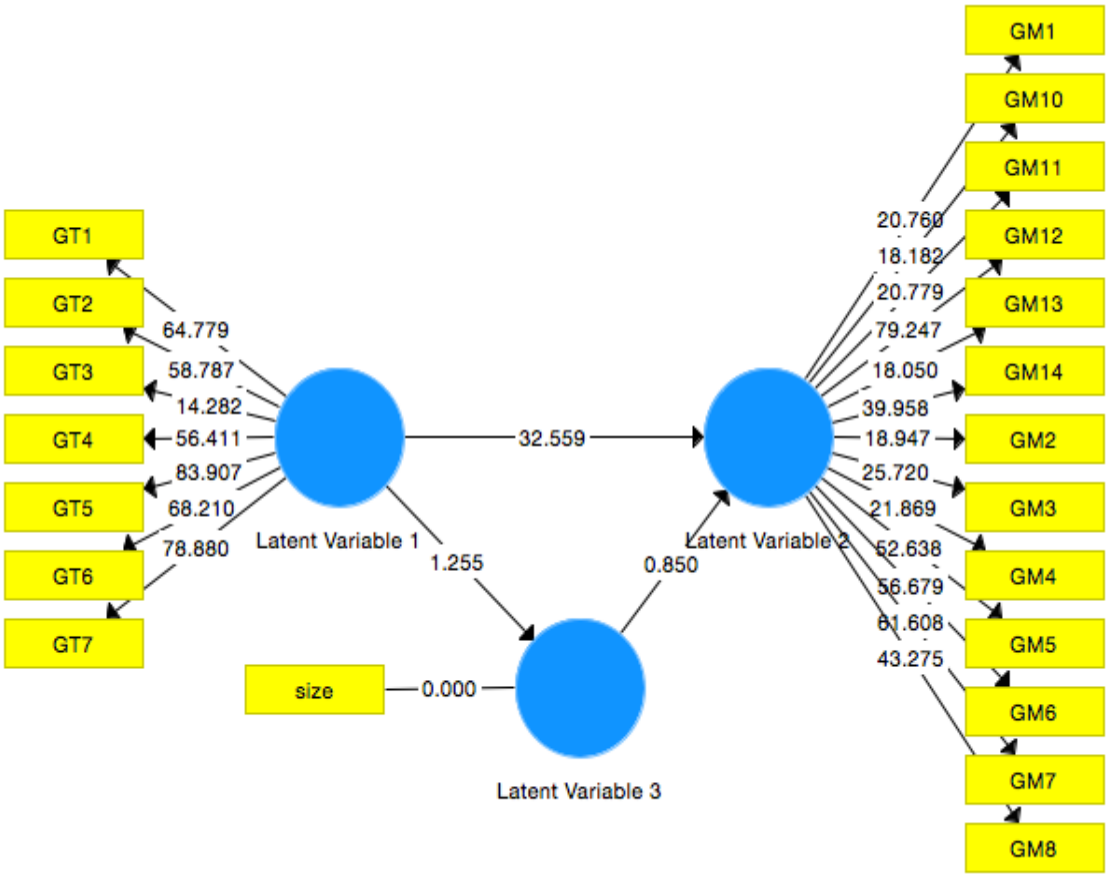

Fig 3: Path diagram outer model with SmartPLS 3.0 using Two-Stage Approach.

This test obtained the following results (Fig. 3). The R-squared (R2) values were, according to Cohen (1992), large and satisfactory. The variance inflation factor (VIF) was less than 1.21, which is considered adequate (Latan and Ghozali, 2012).

4. Results

GT's effect size (f2) on GM was 0.708 (adjusted R2, which is large (Latan and Ghozali, 2012). The R2 set was considered small when it was less than 0.25, medium when it was less than 0.50, and large when it was less than 0.70. Finally, the goodness of fit (GoF absolute) is model's statistical adequacy, was equal to 0.718, which is considered large; therefore, the model was considered valid, based on Latan and Ghozali (2012).

Figure 3 also show that mediating effect of Firm Size has insignificant on impact of Green training on Green Manufacturing

5. Conclusion

Thus, responding to the first research question, the research results (Figure 3) show that H1 should be considered valid, as GT was positively related with GM.

Regarding the second research question Firm Size has insignificant mediating effect on impact of Green training on Green Manufacturing. These results suggest that firms adopting GM practices should empower their employees with green awareness and skills through GT. If employees have more environmental training then they can influence the green manufacturing activities and can improve them significantly.

Some managerial implications emerged from the above- mentioned results. Employees' GT content requirements

of green manufacturing irrespective of size of the firm. As a consequence of these actions, firms will reach internal environmental targets and make external environmental improvements through green training programs from time to time. This work added empirical evidence on GM in India, an under-studied region. It contributed to a better understanding of the integration between GT and GM, where Firm size has no mediation role between the mentioned variables. Finally, the role of firm size in the interaction between GM and GT may be a relevant research avenue, as it did not seem to be significant in this research.
This work has some limitations. First, social desirability bias has become a concern in sustainability studies, as the respondents try to perform as they believe interviewers expect. Under this circumstance, less accurate responses can be obtained (Roxas and Lindsay, 2012). Furthermore, this work was only related to the Indian context in apparel Industry.

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