Influence and relation of sustainability drivers in footwear manufacturing firms using structural equation modelling

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Abstract: Contemporary manufacturing firms are now in the transition from conventional manufacturing practices into sustainability practices. These firms often find it difficult in dealing with the drivers of sustainability and understanding their effects. The objective of this research work is to bridge this gap and to find out the influence of social, economic and environmental drivers on SM. Along with this, the effects on modest competencies like cost reduction, improving production rate were estimated using structural equation modelling (SEM). The study was conducted in a footwear manufacturing firm, where environmental and social impact plays a key role towards imbibing sustainability using a systematic approach based on the enablers and drivers of sustainability. A theoretical model was developed and validated using covariance based structural modelling approach in AMOS. The results obtained showed positive influence of sustainable drivers over the competitive proficiencies of a footwear manufacturing company.

Keywords: sustainable manufacturing; sustainable practices; structural equation modelling; SEM; validation and estimation; competitive proficiencies.

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1 Introduction

Since 1913, there was a drastic change in the way things are being produced in manufacturing firms. To meet the demand of producing huge quantity of goods, mass production came into existence. Right form then, the world has witnessed evolution of different types of manufacturing methods, from mass production (1913) – lean manufacturing (1960) – mass customisation (1980) – reconfigurable manufacturing (2000) to the present sustainable manufacturing (2010). From one manufacturing system to other, there was a huge change in the way things are being produced.

In the recent decade, SM has emerged as a relatively new field in manufacturing sector. Operational practices have slowly transformed from conventional methods to contemporary techniques in manufacturing firm based on three domains of SM (Carter and Rogers, 2008). As the competition in manufacturing sector is increasing, there is an imperative need for manufacturing firms to improve consumer demand with the understanding of sustainability drivers (Jayakrishna et al., 2019). Manufacturing firms must encourage sustainable practices, so that they remain competitive and achieve their growth targets (Moldavska and Welo, 2017).

In order to accomplish those results, companies must have a clear understanding of how sustainable criteria impacts enablers and drivers. Sustainable criteria, enablers, and drivers can be identified as latent variables that may not be identified or measured directly but could be inferred through characteristics of measured variables (Aboelmaged, 2014). The main objective of this research is to measure the influence of sustainable criteria on enablers and drivers with respect to the footwear manufacturing firm. The novelty of this work is identifying the relation and importance of SM model in a footwear manufacturing firm based on structural equation modelling (SEM). The case industry possessed wide scope for analysing the impact of sustainable practices where production and allied activities have their direct impact on environment. The solid, slurry and water waste from the processing units of this firm have considerable impact on the environment. Proper post processing activities could reduce the damage caused on the environment. This influenced to do an extensive study about the practices and factors influencing the sustainability of the firm (Jakob et al., 2013). This will be helpful for the manufacturing firms across the world to measure their sustainability performance and relations using this approach. The framework model developed will be useful for manufacturing firms to measure their sustainability practices as well as to know the extent of improvement required for their firms.

2 Literature review

2.1 Literature review on sustainable manufacturing

New regulations and policies are required for ensuring sustainability will be crucial if countries were to meet the demand. Kaebernick et al. (2003) presented a method to develop a product which is based on the concept of SM which represents sources of environmental impact of a product. The authors concluded that environmental requirements and conventional requirements of cost and quality must be considered equally. Rusinko (2007) presented a method to evaluate sustainable manufacturing in carpet manufacturing company in USA. The author used a survey method for evaluation and concluded that some SM practices are associated with competitive outcomes. Phungrassami (2008) presented a study on eco-efficiency for SM studying about metal plates restoration firms in Thailand. Different case studies were performed and to the study focused on reduction of toxic emissions, cost incurred for restoring goods, usage of energy and water which results in better sustainability in the firm. Schoenherr (2012) presented a research hypothesis that showed the importance of business sustainability and its improvement in manufacturing firms. The author concluded that ecological initiative has constructive development and influence on firm’s competitiveness. These outcomes ensure the key role of amount invested on business strategies which is related to practitioners, managers and employees of the firm to utilise optimised resources. Fatimah et al. (2013) presented an article on “The extent of implementing green practices”. The survey was done at various level of firms located in Malaysia and the authors concluded firms practicing SM concept lead to enhancement of green life cycle of the product. Chen et al. (2015) presented a model for SM and performed a case study across different companies in Sweden. The authors succeeded in development of universal model for measuring sustainability in manufacturing firms. Chuang and Yang (2014) presented a study on evaluating sustainable manufacturing performance. The authors performed a survey across various resistors and inductor companies in Taiwan. The authors suggested a model for assessing SM practices in the firm inclusive of green practices in design, process and packaging based on 74 factors. Gupta et al. (2015) presented an analytic hierarchy process (AHP) model for sustainability through different manufacturing practices. The author concluded practicing and implementing SM concepts will improve the firm’s ability to compete in global market. Ho et al. (2016) presented an empirical method that explores the importance of green manufacturing for improving organisational performance. Developing moderated hierarchical regression analysis, the authors evaluated overall relationship between specific green manufacturing practices and performance. Islam et al. (2017) presented a study on green supply chain aspects and its implications. In this study, the authors presented list of organisations in Malaysia which practices green supply chain, around 58 different practices with 15 features inclusive of all green concepts. Linke et al. (2019) identified key parameters in manufacturing firm such as quality, tool design, labour expertise and relate the same with process sustainability-based data obtained from parameters. Malek and Desai (2019) identified the inter relationship between various factors influencing sustainable manufacturing using interpretive structural modelling approach based on 29 criteria model developed considering Indian scenario. Digalwar et al. (2020) created a framework for assessing social sustainability based on Indian manufacturing industries. The framework helped to know the social sustainability of the organisation and to improve relation between their workers. Beekaroo et al. (2019) had done their work on developing sustainable index for manufacturing firms in Mauritius. The results showed that 15 criteria related to sustainable manufacturing played key role in Mauritian manufacturing context. Baba et al. (2019) presented their work related to improving sustainability in automotive sector, considering recent challenges faced by the sector with respect to global environmental measures. Thus, researchers concentrated on various activities involved in production, post production, recycling possibilities and corresponding environmental impacts. This made them to emphasise sustainability in processes involved in production as well as product sustainability (Jayakrishna et al., 2015). Montazerolhodjah (2019) studied sustainability impact over urbanisation. The impact of urbanising the region particularly with respect to water pollutants and emissions due to development was analysed in this study. The objective was to develop low impact model to overcome the issues in urbanisation. Zheng et al. (2020) explored the possibilities of efficient utilisation of resources and energy. Conventional method which was most time consuming can be improvised using suitable optimisation techniques. Weiser et al. (2020) done their work related to sustainability measures in metal usage. The researchers developed a strategy to utilise natural resources based on development of sustainable production. Extensive work was done and developed protocol for metal company focusing towards the reduction of negative impacts considering sustainability aspects. Fitcher and Tiemann (2020) explored their research in the field of developing a generic model to develop sustainability in entrepreneurship. This work focused towards enhancing sustainability practices from the beginning of business development.

2.2 Literature review on SEM

Kadipasaoglu et al. (1999) explored global manufacturing practices and assessed them using SEM. The researchers applied SEM with statistical method to relate variables and its quantification. Cronin et al. (2000) determined that relation between service quality with behavioural intentions by considering six different industries. While computing industry data individually, it is evident that the relation between service quality with behavioural intentions was important and affects the organisational performance directly. Curkovic (2003) carried out the study in a relatively new field namely environmentally responsible manufacturing (ERM). The ERM model was developed and validated using SEM technique. Golob (2003) explored travel research using SEM approach. The author tested various travel models using SEM in their study. Finally, best model for the real time working condition was located using SEM model. The author claimed that the main application of SEM was that it can compare the experiences. Shah and Goldstein (2006) published an article related to the improved use of SEM after reviewing various articles. The authors concluded their work by stating that SEM is a contemporary tool for testing and has good scope for researchers in operations management. Prajogo and McDermott (2005) mapped the relationship and differences between the implementation of total quality management strategies in manufacturing and service sectors. The researchers extended their study from countries to a group of industries, which in turn led the SEM analysis from macro level to the micro level. Fitch (2007) focused on work related to SEM for risk assessment instruments. The instrument used is decision support system (DSS). The proposed model and assumptions are validated using SEM. Wallgren and Hause (2007) presented an article related to the use of SEM, for determining the relation between job characteristics and perceived stress. A survey was taken based upon web questionnaire and the model was validated using SEM. Bustelo et al. (2007) explored the drivers and enablers on agility. A conceptual model was developed based upon turbulent business environment. Research findings focused that AM practices was used to handle uncertain business environment. The authors proposed an AM model considering the drivers, enablers and outcomes of agility. The proposed model was tested and validated using SEM approach. To improve business performance, organisations need to focus on their new product development, supplier management and knowledge transfer (Huang et al. 2009). Jiang et al. (2010) presented a Bayesian nonlinear based SEM approach for assessment of dynamic systems with uncertainty. Using Bayesian network, influencing factors were calculated and confidence level of predicted model was computed using Bayesian hypothesis. The proposed methodology was useful to address various stages of hierarchical validation. Lau et al. (2010) in their work on supply chain integration and modular product design used SEM model to validate test conditions. They proved that company which concentrate towards product development and modularity had better performance. Ramanathan and Muyldermans (2011) developed a model to identify demand based on the promotions using SEM. The authors developed a concept to identify various factors influencing demand. The model was validated from the data collected from Soft Drinks Company. Finally, they concluded that promotional and seasonal factors play a vital role in sale of products. Vinodh et al. (2012) presented a systematic method to apply SEM to conduct statistical validation of an agile manufacturing model. Five different agility drivers are constructed in this model and a survey was conducted from different automobile manufacturing companies in Tamil Nadu, India. Aboelmaged, (2014) presented different drivers in SM practiced by manufacturing organisations in Egypt. The author explored the impact of sustainable drivers towards SM and validated the model using partial least square approach of SEM (PLS-SEM). Research findings necessitated the importance of SM that relies on various stakeholders of the organisation. Zhai and An (2020) explored green transformation of manufacturing firms in Chinese context and analysed the influencing factors using SEM. Yusliza et al. (2020) developed SEM model for analysing the green intellectual capital for manufacturing organisations. The results of this study focused developing nations to enhance their sustainable practices using this model. Çakıt et al. (2020) used adaptive neuro fuzzy inference system (ANFIS) and SEM for assessing work safety. Seven hypotheses were formulated related to work safety and it showed mobile technology played a vital role in work safety. Yang et al. (2020) explored the relation between risk factors involved in health workers’ deployment in intensive care division of hospital using SEM approach. 984 questionnaire were collected from various nursemaid used in this study to identify the critical relationship. The SEM based results from the projects indicated the validation of various kind of human factors-based risk involved in their work. Li et al. (2020) used SEM based model to find landscape effectiveness for newly developed commercial streets. Theoretical model for validating the efficiency was developed based on the major factors of landscaping. Using SPSS Amos, the path between various factors of landscaping was quantified. Multiple regression analysis was used to map best suited results. Fitcher and Tiemann (2020) developed a SEM model for analysing the relationship between sustainability factors with the new start-up business. In this study, PLS approach was used to identify the critical relationship between various factors in start-ups with respect to sustainability. The results provided insights for new ventures to understand the importance of sustainability and relation between factors using SEM approach. Devika et al. (2020) presented their work on selection of compatible transport solution either public or private by an individual with respect to their physiological influences. SEM approach was used to identify the influencing factors more in decision making or prioritising the choices while selecting the transport mode. The results showed ‘attitude’ play a vital role in selection of preferred transport mode which clears understanding about human behaviour.

Though researchers have studied the drivers and strategies of SM (Despeisse et al. 2012; Rusinko, 2007), there exists a need for the development of a theoretical framework to quantify their effect over the competitive proficiencies. To bridge this gap, the study aims at finding the influence of sustainability drivers on manufacturing practices considering the competitive proficiencies like cost reduction and improving production rate using covariance-based SEM model.

3 Methodology

The research is divided into four stages:

1. identifying and deriving different factors, competitive proficiencies which will make a manufacturing firm to remain sustainable
2. development of a theoretical model and validation based on previous research
3. preparation and scrutinisation of questionnaire to obtain input data from the foot wear manufacturing firms
4. validation of the model by performing appropriate statistical measurements using AMOS.

Table 1 Sustainable manufacturing drivers

Goals	*Sustainability criteria*	*Sustainability drivers*
Measurement of impact of sustainability drivers of foot wears manufacturing plants	Economic	Financial health
		Economic performance
		Potential financial benefits
		Trading opportunities
	Environmental	Air resources
		Water resources
		Land resources
		Mineral and energy resources
	Social	Internal human resources
		External population
		Stake holder participation
		Macro social performance

Source: Adopted from Jayakrishna et al. (2015)

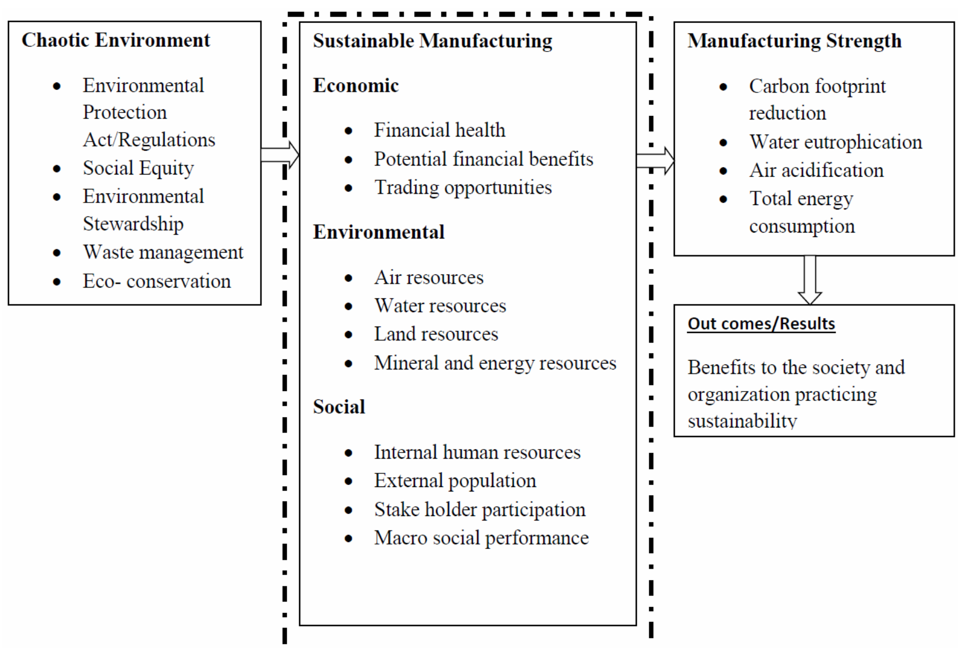
3.1 Identification of sustainable drivers

The study begins with understanding the need for sustainable manufacturing practices in comparison with present manufacturing practices from literature review of sustainable manufacturing, modelling and optimisation challenges. The enablers considered in this study were developed based previous literature by the author (Jayakrishna et al., 2015). Environmental regulations include different emission standards which are to be met by an organisation to get government assurance. Also, organisations need to follow waste management policies so that different solid and liquid wastes are properly disposed (Singh et al., 2014). Considering environmental aspects based on stakeholders' feedback, SM model was formed.

3.2 Formulation of conceptual model

Based on the observed factors, a theoretical framework model was developed as shown in Figure 1. This conceptual model was developed using the reference model on agile manufacturing (Bustelo et al., 2007).

Figure 1 Sustainable manufacturing conceptual model



3.3 Formulation of questionnaire and collection of data

The sustainability drivers were identified on the basis of triple bottom line (TBL) of sustainability. Data was collected in the form of questionnaire from a couple of foot wear manufacturing firms in Nellore, Andhra Pradesh, India. Questions are modified and improvised based on the suggestion given by the managers of the company. Each and every question was explained clearly to the employees in order to create a hassle-free survey. It was assured with the firms that their company/employee details will not be disclosed to the public, in order to obtain an unbiased survey from the employees.

3.4 Estimating and validating the model using AMOS

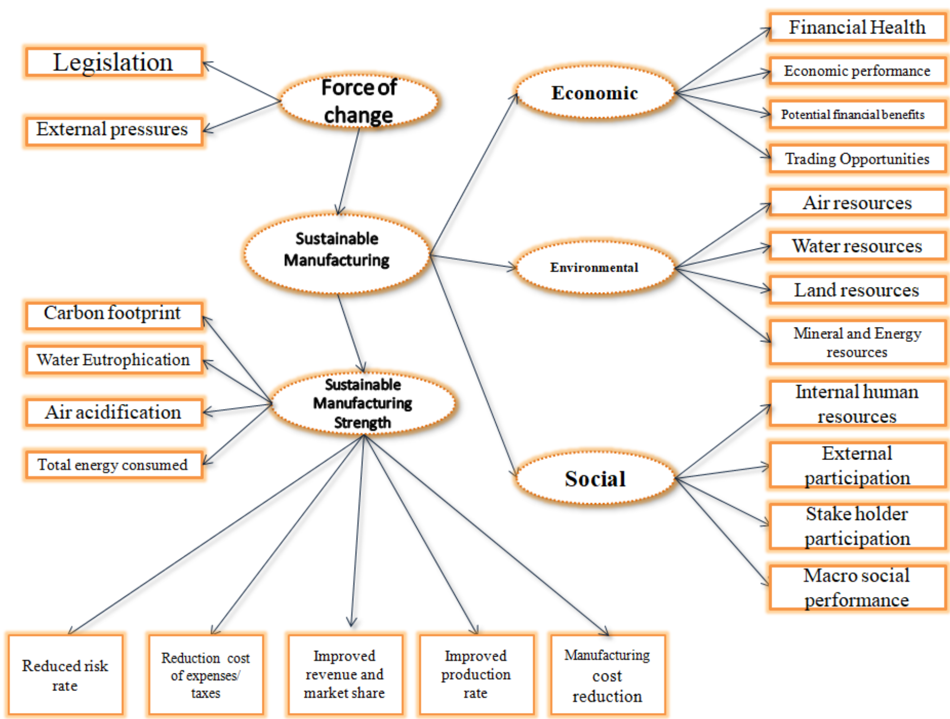
SEM approach can be modelled and solved using AMOS. Figure 2 depicts the conceptual SEM model used in this study. Following tests and analysis were performed to estimate and validate the model (Chan et al., 2017):

1 confirmatory factor analysis

2 path analysis

3 reliability tests and validity measures.

Figure 2 Conceptual model of sustainable manufacturing and its drivers (see online version for colours)



4 Experimental work

4.1 Research hypothesis

The research hypothesis is divided into five clusters. First cluster comprises two factors motivating the transformation towards SM. In the next three clusters, two hypotheses related to TBL of sustainability were formed. The final cluster advocates three hypotheses dealing with the impact of SM on competitive proficiencies.

4.1.1 Need for sustainable manufacturing

Due to stringent environmental regulations, manufacturing organisations are forced to adopt SM strategies. Governments are imposing stringent rules and regulations to minimise the impact caused due to human interference with the surroundings. As a result, changing environmental regulation made it compulsory for companies to change the present manufacturing practices and move towards more efficient manufacturing method which uses optimum quantity of raw materials and to keep wastes generated by the company is within the norms of Government (Zhu and Geng, 2013).

The subsequent hypotheses can be defined as:

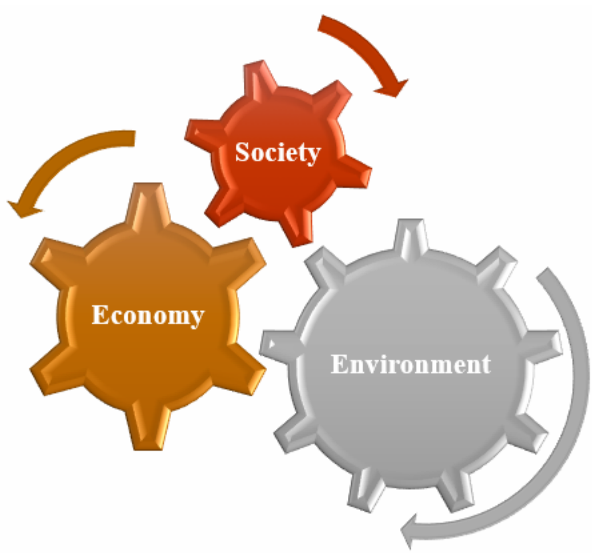
Hf1 Sustainable practices definitely impact sustainable manufacturing.

Hf2 Environmental governance definitely impact sustainable manufacturing.

4.1.2 TBL of sustainability

For any organisation to remain sustainable, it needs to satisfy the TBL condition. TBL consists of three drivers which comprises social, environmental and economic impact it has on an organisation. A few companies have embraced this structure to understand their working operations in a broader perspective to make more noteworthy net returns to the organisation (Reimers-Hild, 2010). Figure 3 depicts the pictorial representation of TBL of sustainability.

Figure 3 TBL of sustainability (see online version for colours)



4.1.2.1 The economic bottomline

It deals with the net profit or monetary value that an association has after removing or deducting the costs inculcated in manufacturing a product which include costs of procurement of raw material, processing costs, machining costs and costs associated with capital tied up. The term 'profit' should be viewed as the economic benefit that the society or the customer has after purchasing the product. It is related to the economic impacts in case organisation with respect to its environment. It should not be confounded with the profit that is made within the company. It must be one of the objectives of the company but should not be the only objective.

As a result, the below hypotheses are made:

He1 Financial health completely impact sustainable manufacturing.

He2 Potential financial benefits positively impact sustainable manufacturing.

He3 Trading opportunities positively impact sustainable manufacturing.

4.1.2.2 The environmental bottom line

The environmental factors deal with the ecological impact that an organisation has on its environment. These criteria aim at creating an organisation that has a minimum or null effect on its environment (Despeisse et al., 2012). A TBL endeavours to diminish its environmental impact (Singh et al., 2014) by, efficiently controlling the amount of energy, raw material and non-renewable fuels that are used (Rusinko, 2007). Cradle to Grave approach helps to understand the real ecological impact starting from raw material extraction to disposal of used products (Hart, 1995).

Accordingly, the subsequent hypotheses can be delineated:

Hev1 Control of air resources positively impact sustainable manufacturing.

Hev2 Control of water resources positively impact sustainable manufacturing.

Hev3 Control of land resources positively impact sustainable manufacturing.

Hev4 Control of mineral and energy resources positively impact sustainable manufacturing.

4.1.2.3 The social bottom line

The social bottom line considers the social welfare of the community in which the company is located (Wallgren and Hanse, 2007). It also considers that the wellbeing of the workers and the interest of other stakeholders. An enterprise devoted to 'the TBL' aims at achieving profit to a number of supporters and not criticises any of them. Based on this, the following hypotheses were made:

Hs1 Internal human resources positively impact sustainable manufacturing.

Hs2 External population positively impact sustainable manufacturing.

Hs3 Stake holder participation positively impacts sustainable manufacturing.

4.1.3 Competitive proficiencies

Competitive proficiencies of a manufacturing company mean creating higher quality product for a consumer that outclasses other manufacturing companies in the manufacturing sector. According to Schoenherr (2012), factors like quality of the product, cost associated with manufacturing the product, efficiency with which products are produced, responsiveness it has to the consumer demands, flexibility that the company has with respect to the variety or demand from the customers, inventing new methods to perform a given operation and productivity are the dimensions of competitiveness. Offering low cost, faster response to circumstances are some of the outcome that a manufacturing firm can expect in achieving sustainable manufacturing. Porter and Linde (1995) believed that 'green practices' are directly related with the highly competitive environment. 'Green practices' can help a company to save a wide range of resources (Wong et al., 2012), decrease downtime, efficient utilisation of by-products, creating a safer working conditions for employees (Yusoff et al., 2016), reducing different costs such as 'operation and product handling costs', 'higher product quality', and 'higher product rescale and scrap value' (Porter and Linde, 1995). Thus, these upgrades in items and procedures can expand the flexibility of different operations in manufacturing firms and agility to consumers (Bhardwaj, 2016). Consequently, sustainable manufacturing can help an organisation to yield higher valuable products which will be high sustainable and that also influence through the proficient utilisation of raw materials (Mittal and Sangwan, 2014). Adopting SM practices will help organisations in gaining competitive environmental benefits and enhance their profit in long run (Agan et al., 2013). On basis of the stated argument, it is hypothesised that sustainable manufacturing drivers have a constructive influence on competitive environment capabilities as mentioned below:

Hc1 Sustainable manufacturing practices positively impact on reducing carbon foot print in foot wear manufacturing.

Hc2 Sustainable manufacturing practices positively impact on reducing the total energy consumption in foot wear manufacturing.

Hc3 Sustainable manufacturing practices positively impact on reducing risk rate in foot wear manufacturing.

Hc4 Sustainable manufacturing practices positively impact on reducing cost of expenses in foot wear manufacturing.

4.2 Case study

4.2.1 Type of organisations

Based on the hypotheses developed, an exhaustive survey was conducted among manufacturing organisations located in India. Most of the industries selected for this survey were either practicing sustainable manufacturing strategies or involved in the process of implementing sustainability or willing to implement the same in their organisation. The survey was conducted with the help of a questionnaire developed with a clear idea over the factors and parameters in improving and affecting the sustainable manufacturing.

4.2.2 Examinee's summary

Table 2 shows that the major examinees were shop floor workers and employees in the organisation (63%) and more than 80% of the internal populations have more than three years of work experience in precise 54% are within 3yrs-8yrs of work experience and 32% have above 8 years of work experience. From the profile of various examinees, it is evident that they had adequate knowledge acquired based upon their experience in their firm.

Table 2 Respondents' profile and work experience

Respondents profile			*Work experience*		
Position	*No. of employees*	*%*	*No. of years*	*No. of employees*	*%*
Owner/CEO/GM	55	26%	0–3	30	14%
Shopfloor workers/employees	134	63%	3–8	114	54%
Others	23	11%	>8	68	32%

4.2.3 Data collection and characteristics of data collected

A questionnaire was framed on a Likert's scale which varies from 1 – 'strongly disagree' to 5 – 'strongly agree' to measure the sustainability characteristics, its strength and possible outcomes. The developed questionnaire model was subjected to review with experts and consultants involved in the survey design to check the validity and improving its structure. After review, the questionnaire was sent to the plant heads, managers, and supervisors of the case organisation involved in production of different products between January 2020 to February 2020 with brief brainstorming session about the questionnaire. Around 212 questionnaires were completed in the survey and returned. The position of the respondents of the manufacturing organisations were found to be satisfactory over the requested details for this study and thereby avoiding the necessity of a non-response bias check over the data collected in this survey.

5 Results

Covariance based approach to SEM using AMOS 25.0 is applied for analysis of the research data through five phases which include 'model specification', 'model identification', 'model estimation', 'model assessment' and 'model re-specification'.

5.1 The measurement model

Hoyle (1995) indicated that to test a set of regression equations simultaneously, SEM can be used as an effective tool to analyse such equations. SEM software can test conventional models, but also allow us to examine models which are complex in nature and hard to resolve manually. In SEM, researcher can perform confirmatory factor analysis and time series analyses. The reliability and effectiveness of the measured model is estimated by various processes. Composite reliability shown in Table 3, for all the unobserved variables is between [0.9–1.0] that shows the internal reliability pertaining to variables (Straub et al., 2004). Average variance extracted (AVE) was fixed limit of 0.5 and computed results were greater than 0.780 shows valid result. The 'standardised outer factor loading' for structured factors are shown in Table 4.

Table 3 Composite reliability (CR) and AVE

	CR	*AVE*
sms	1.000	0.780
fc	0.925	0.861
sm	0.981	0.835

Table 4 Standardised factor loading

	FC	*SM*	*SMS*
ENR	0.627		
ENP	0.516		
SHP		0.403	
ETP		0.473	
UHP		0.318	
LNDR		0.519	
MER		0.374	
ARR		0.409	
PFB		0.381	
WTR		0.209	
TRO		0.087	
FNH		0.523	
RMC			0.492
RRR			0.362
TEC			0.424
RCFP			0.48

Table 5 depicts Cronbach's alpha value which is more than 0.7 in all cases, shows an acceptable internal consistency (Vinodh et al., 2012).

Table 5 Item-total statistics

	Scale mean if item deleted	*Scale variance if item deleted*	*Cronbach's α if item deleted*
ENP	48.69	91.709	0.731
ENR	49.06	88.734	0.726
FNH	49.25	86.445	0.716
WTR	49.16	93.647	0.741
TRO	49.00	96.599	0.754
ARR	49.03	89.828	0.726
MER	49.76	90.590	0.735
LNDR	49.34	86.253	0.720

Table 5 Item-total statistics (continued)

	Scale mean if item deleted	*Scale variance if item deleted*	*Cronbach's α if item deleted*
IHP	49.06	91.844	0.737
ETP	48.96	88.377	0.724
SHP	49.14	91.115	0.729
PFB	49.06	91.259	0.734
RCFP	49.00	87.700	0.721
TEC	49.60	88.804	0.729
RRR	49.22	90.323	0.730
RMC	49.01	87.410	0.720

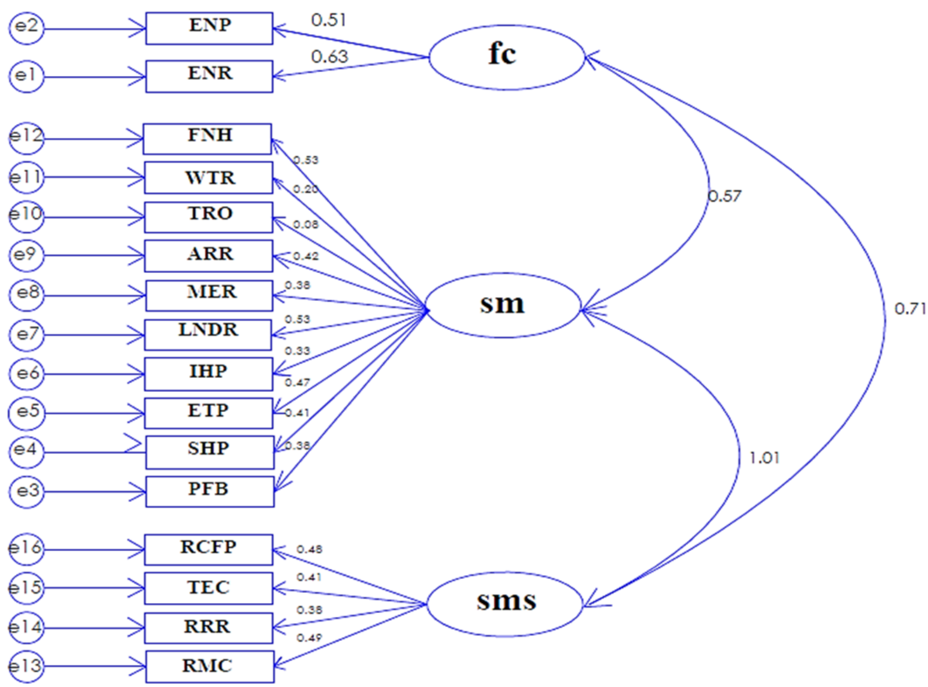
5.2 *Analysis of model*

Henseler and Sarstedt (2013) explained that the standardised path coefficients values of hidden variables helped to evaluate sustainable model's reliability. Using AMOS version 25, the convergence and consequences were computed. Constant values from AMOS guide for model are as follows: NFI = 0.583, CFI = 0.698, IFI = 0.709, TLI = 0.644, NCP = 136.926, Chi-square = 238.926. The factor estimate prove that all the variables attained significance level at p-value ≤ 0.001 and this is shown in Table 6 and the CFA model is depicted in Figures 4 and 5.

Table 6 Path coefficients and β values of the structural model

	Path	*β*	*Result*
Hf1	Hf1 → sm	0.627	Supported
Hf2	Hf2 → sm	0.516	Supported
He1	He1 → sm	0.381	Supported
He2	He2 → sm	0.523	Supported
He3	He3 → sm	0.087	Not Supported
Hev1	Hev1 → sm	0.409	Supported
Hev2	Hev2 → sm	0.209	Not Supported
Hev3	Hev3 → sm	0.519	Supported
Hev4	Hev4 → sm	0.374	Supported
Hs1	Hs1 → sm	0.318	Supported
Hs2	Hs2 → sm	0473	Supported
Hs3	Hs3 → sm	0.403	Supported
Hc1	sm → Hc1	0.480	Supported
Hc2	sm → Hc2	0.424	Supported
Hc3	sm → Hc3	0.362	Supported
Hc4	sm → Hc4	0.492	Supported

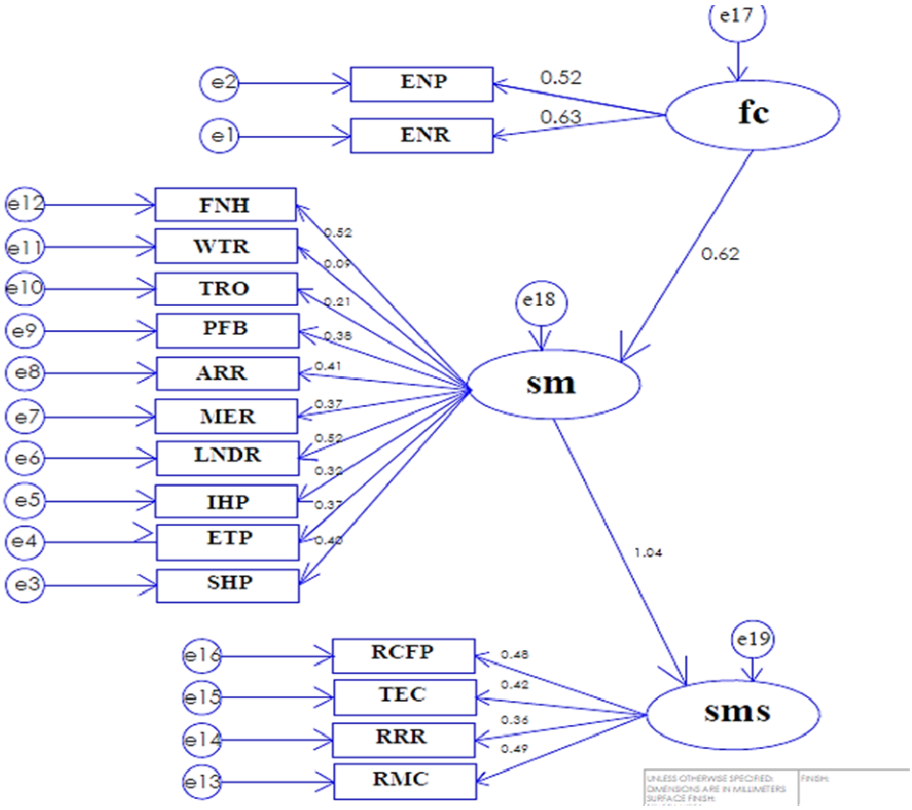
Figure 4 Standardised estimates in confirmatory factor analysis (see online version for colours)



Hypothesis *Hf1* and *Hf2* predicted that environmental regulations and environmental pressures positively impact sustainable manufacturing in footwear manufacturing companies.

As Table 6 shows the impact of environmental regulations ($\beta = 0.63$, $p < 0.001$) and environmental pressures ($\beta = 0.52$, $p < 0.001$) (i.e. force of change) towards sustainable manufacturing is significant, *Hf1* and *Hf2* are supported. With regard to the TBL of sustainability, the economic drivers which include financial health ($\beta = 0.52$, $p < 0.001$), potential financial benefits ($\beta = 0.41$, $p < 0.001$) and trading opportunities ($\beta = 0.09$, $p = 0.271$), showed that, predicted hypothesis *He1* and *He2* have a positive influence where as *He3* (i.e., trading opportunities) showed no such impact on sustainable manufacturing. Environmental drivers show that control on air resources ($\beta = 0.41$, $p < 0.001$), land resources ($\beta = 0.52$, $p < 0.001$) and mineral resources ($\beta = 0.37$, $p < 0.001$) have a positive impact on sustainable manufacturing whereas, control on water resources ($\beta = 0.21$, $p = 0.013$) shows no such impact. Thus, *Hev1*, *Hev3* and *Hev4* are supported and Hev2 is not supported. Social drivers show that internal human resources ($\beta = 0.32$, $p < 0.001$), external population ($\beta = 0.47$, $p < 0.001$) and stake holder participation ($\beta = 0.40$, $p < 0.001$) have a positive impact on sustainable manufacturing. Thus, *Hs1*, *Hs2* and *Hs3* are supported. With respect to the drivers of sustainable manufacturing on competitive proficiencies. Hypothesis *Hc1*, *Hc2*, *Hc3*, *Hc4* and *Hc5* capture the effect of sustainable manufacturing on competitive proficiencies. Standardised estimates in path analysis is shown in Figure 5.

Figure 5 Standardised estimates in path analysis (see online version for colours)



5.3 Discussions

This study helped to get insights regarding the drivers of sustainable manufacturing. It provided a new perspective to the known concepts of sustainable manufacturing. It also helped to understand how these drivers will impact competitive proficiencies such as reducing the cost of manufacturing, improving the production rate and reducing the lead time of the product. Evaluation of the survey data from 212 respondents from a group of footwear companies resulted in deriving results related to social factors and environmental importance based on SM aspects.

On contrary, the results showed no support of trading opportunity factor on sustainable manufacturing, the impact of environmental aspects and social factors were substantially conserved. With respect to significance of SM practices, the results obtained demonstrate a constructive impression on competitive abilities of footwear manufacturing companies. Though these results derived from analysis of hypothesis, they provided interesting perceptions compared to prior studies reported by Zhu and Geng (2013). The influence of sustainable drivers, which are responsible for the force of change towards SM.

Based upon TBL of sustainability, the results suggest that economic, environmental and social drivers partially satisfy formulated hypothesis in this study. With regard to stake holder's participation on SM, the findings offer coordination towards implementation. Schrettle et al. (2014) emphasised significant influence of financial health, external population and stakeholders participation on implementing sustainable manufacturing.

Influence of drivers of sustainability on competitive proficiencies is satisfactory with the hypothesis. The obtained results are in consistent with the previous research work reported by Schoenherr (2012) which states positive effects of SM practices on flexibility, responsiveness, lead time, reduction in costs & expenses and increasing the product durability. Numerous SMEs across the world, facing problems in implementing SM practices, have a lasting impact on competitive proficiencies in a long run.

6 Conclusions

6.1 Contribution to the literature

Analysing and comprehending the drivers, results obtained in AMOS software will give a new perspective to the sustainability theory. This research work aimed in bridging the gap between theory and practical application of sustainability in footwear manufacturing firm. Results showed that, sustainable drivers positively impact in reducing carbon foot print ($\beta = 0.48$, $p < 0.001$), reducing total energy consumption ($\beta = 0.42$, $p < 0.001$), reducing risk rate ($\beta = 0.36$, $p < 0.001$) and reducing manufacturing costs ($\beta = 0.49$, $p < 0.001$) of a footwear manufacturing company. Thus, the obtained results showed that footwear organisations which practices and implements sustainable manufacturing will improve its competitive proficiencies like reducing cost of expenses, reducing risk rate and improving production rate in long run. This will be helpful to research community about the understanding of critical drivers of SM practices in SMEs and acquaintance about TBL skeleton to define the view of these drivers (Aboelmaged, 2014). A new implication of this study is relating SM practices to competitive proficiencies. The proposed sustainable model hypothesises the effect of social, economic and environmental drivers on SM and impact towards five competitive proficiencies.

The model is experimentally certified using covariance based SEM in AMOS software using data from 212 respondents which include owners, managers and workers from several small and medium foot wear companies. This article substantiates that ‘environmental regulation’, ‘environmental pressures’ predicts sustainable manufacturing in footwear industries. The association between SM practices and competitive proficiencies of foot wear manufacturing firms were confidently considerable which strength the role of SM practices to boost the firm’s efficiency.

6.2 Future scope for research

This study focuses on validation of sustainable parameters considering only a couple of manufacturing firms. Further, the study can be improved by comparing sustainable practices and implementation by considering various types of manufacturing organisations or considering an enterprise level organisation. Also, a pilot study can be conducted by considering energy utilisation for various processes and implementing optimum usage of energy which is the future for industry. More extensive research should be carried out to understand the drivers of sustainability. These drivers may vary with time so careful literature work should be carried out in understanding the surrounding environment. Also, with regard to the outcomes of implementing sustainable manufacturing, the influence of a particular driver on other sustainability drivers on competitive proficiencies has not been achieved. Therefore, in the future, research model can be formulated considering the impact of the individual driver on competitive proficiencies.

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