CHAPTER 6
STRUCTURAL EQUATION MODELING

6.1 INTRODUCTION

The factors of LMPs and Sustainability performance identified by conducting Exploratory Factor Analysis (EFA) of variables and survey results were explained in chapter 5. Five constructs were derived to represent LMPs and three constructs to represent the sustainability performance. These constructs are used in SEM to analyse the effect of five LMP constructs on the three sustainability performance constructs. The formulation of SEM models, hypotheses development and the results of SEM analysis are described in this chapter.

The influence on operational and financial outcomes, generating from the lean implementations on various sectors of manufacturing firms were reported by several researchers (Filho et al., 2016; Bonavia and Marin, 2006; Upadhye et al., 2013; Rahman et al., 2010; Panizzolo et al., 2012; Khanchanapong et al., 2014; Zhou, 2012). The recent researches are conducted on sustainable growth of manufacturing MSMEs (Ciasullo and Troisi, 2013; Cherrafi, et al., 2016). Government authorities are giving more emphasis on developing policies for the sustainable growth as well.

The contributions of lean practices on various dimensions of sustainability performance grouped into economic, social and environmental performances, especially in manufacturing MSMEs are least reported in literature. The researchers have brought out that the adoption of lean principles in various operations of the firms in general is one of the efficient ways towards sustainability (Piercy and Rich, 2015). However, there is no much information available about the interrelationship of sustainability performances grouped into economical, environmental, and social performances.

With the inspiration from literature, three hypotheses of LMPs effects on sustainability performances and three hypotheses of interrelationships of sustainability performances were formulated. Measurement models and structural models were developed and analysed using SEM technique to test the proposed hypotheses. Measurement model and fit indices were checked to test how well the measured variables represent the constructs. Then structural model results were evaluated and summarised to derive the conclusions.

6.2 HYPOTHESIS DEVELOPMENT

Figure 6.1 shows the research framework that expresses the relationship of the LMPs towards the sustainability performance. In this framework, LMP is a construct generated from the supporting five constructs. LMP leads to the environmental sustainability performance, economic sustainability performance, and social sustainability performance. The interrelationship of three-sustainability performance also expressed in this framework. Detailed hypotheses are formulated based on the support of extant literature.

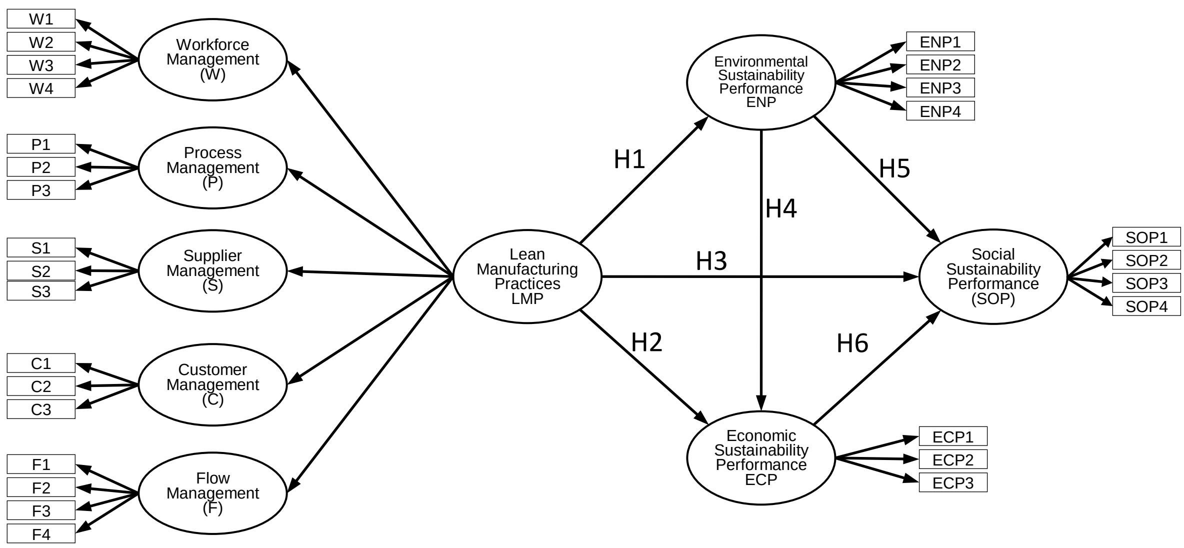

Figure 6.1 Research Framework

6.2.1 RELATIONSHIP BETWEEN LMPs AND SUSTAINABILITY PERFORMANCE

Researchers in different countries have studied the LMPs and its effect on sustainability performance. Three hypotheses were prepared that link between LMPs with environmental, economic and social performances. The development of the hypotheses, its literature support and the probable reasons for linkage are explained here.

The concept of lean management and environmental sustainability are complementary and governed by three principles, namely the ‘process centred focus,’ ‘waste reduction,’ and ‘high level of people involvement and participation’ (Martínez-Jurado and Moyano-Fuentes, 2014). LMP’s target of zero wastage or zero defect leads to the prevention and reduction of environmental harm. This target is achieved by the efficient use of resources from reduced waste, reduced quantity of material lost to scrap and less energy or time consumed in producing the required output (Chugani et al., 2017; King and Lenox 2001; Ball, 2015). Lean is an effective method for the conservation of resources, combating global warming and saving energy (Chugani et al., 2017). Just in time (JIT) strategy has a positive linkage with waste reduction, pollution prevention, and the reduction of emission of Volatile Organic Compounds (VOC) (Rothenberg et al., 2001). The concurrent lean and green practices have a synergistic effect on environmental performances by reduction of gas emissions in transport and logistics operations of the firms (Garza-Reyes et al., 2016).

Information sharing by the impact of lean practices reduces ‘bullwhip effect' thereby plummeting overproduction and transportation, results in a decrease of waste and pollution (Kainuma and Tawara 2006). Similarly, lean practices such as 5S and Kaizen encourage a neat and organised work environment, which motivates employees to properly discard of the production rejects (Vinodh et al., 2011). Kaizen helps to trim down material wastes and pollution, which ensures a safe and healthy place to work (Fliedner, 2008; Pampanelli et al., 2014; Vinodh et al., 2010). Pull production practice focus on reducing inventory levels and provides the right materials at the right time to support operational needs. This concept could help increase environmental performances by reducing potential waste from damaged, spoiled, or deteriorated products, avoid excess consumption and waste (Fliedner, 2008; Ng et al., 2015; Rothenberg et al., 2001; Vinodh et al., 2010).

The increased level of people involvement and participation inherent in LMPs such as employee participation in work standardisation, teamwork, and continuous improvement can facilitate environmental focus by adopting environmentally friendly practices, tools, and techniques (Rothenberg et al., 2001). Some authors propose that the environmental considerations are the inherent part of lean and some others suggest it as a coincident part. Continuous improvement of operational performances helps to diminish the use of energy and material and bring down transportation (Ball, 2015). As the energy and transportation costs increase, an increasing number of companies have begun thinking and targeting the energy consumption for Kaizen which is also a reduction of environmental waste (EPA 2003; Overturf et al., 2011, Ball, 2015; Pampanelli et al., 2014). This experience with lean manufacturing leads firms to take up environmental management practices. Thus, the hypothesis H1 is proposed.

Hypothesis1: (H1) - ***Lean manufacturing practices in MSMEs are positively associated with environmental sustainability performance***.

Previous empirical researches are showing significant evidence on the influence of LMPs to operational (Filho et al., 2016; Narasimhan et al., 2005; Shah and Ward, 2003; Rahman et al., 2010; Belekoukias et al., 2014) and financial (Hofer et al., 2012; Fullerton and Wempe 2009; Yang et al., 2011; Camacho-Miñano et al., 2013) performances. Improving operational performance such as delivery time, speed, quality, and flexibility lead to cost and waste reduction (Khanchanapong et al., 2014, Bortolotti et al., 2015) which would positively affect financial performances (Hofer et al., 2012). Reducing waste in the form of defect and improving productivity leads to lowering costs and increases return on assets of organisation (Yang et al., 2011). TQM practices in SMEs are indirectly related to financial performances (Herzallah et al., 2014). Organizations can improve their market acceptance, and turnover, with their reputation for quality (Mosey et al., 2003). Most of the LMPs such as JIT, Kaizen and TQM are efficiently instituted for sustainable and cost-effective growth (Yang et al., 2011; Martínez-Jurado and Moyano-Fuentes, 2014). Hence, the second hypothesis H2 is proposed.

Hypothesis 2: (H2) - *Lean manufacturing practices in SMEs are positively associated with economic sustainability Performance.*

The initial focus of lean manufacturing is on the people and then on processes while maintaining an enterprise view as well (Martínez-Jurado and Moyano-Fuentes, 2014). The human element is standing as an essential primary component of any LM sysyem (Mostafa et al., 2013). The leading strategy of lean is the respect for people, followed by continuous process improvement (Longoni et al., 2013). There is a real concord on the LM to incorporate ergonomic standards in the design of workstations to ensure the safety and health in the work milieu (Vinodh et al., 2011; Longoni et al., 2013). Besides the welfare of the workers, lean focuses on the quality and safety of the products (Khanchanapong et al., 2014; Belekoukias et al., 2014). The 5S practice encourages the maintenance of a clean and organised work environment which helps to improve the handling and storage of materials including hazardous materials. This modified workplace reduces the risks of spills and mishandling and provides clean and accident-free work places (Fliedner, 2008; Vinodh et al., 2011; Chiarini, 2014). Vinodh et al. (2011) have justified an evolution from 5S to 7S to admit a broader range of topics relating to health, safety, and sustainability.

Kaizen Provides a problem–solving culture with scientific and structured thinking, which helps organisations to develop the engagement of employees and unleash their creativity for the promotion of innovation for the environmental and social progress (Fliedner, 2008; Pampanelli et al., 2014; Vinodh et al., 2010). Total Productive Maintenance (TPM) promotes preventive and proactive maintenance of equipment to maximise its useful life and avoids processed failures that reduce breakdown and labour rates. This situation increases employee health and safety because new technologies are often substituted for older machines which would result in reducing breakdowns with potential for injury (Chiarini, 2014; Fliedner, 2008; Vinodh et al., 2010).

Lean practices have a positive influence on the attitude of workers (Womack and Jones, 1996) as the employees in lean organisations assume responsibilities that extend beyond their production tasks. Some research reports adverse effects of LMPs such as the stress of the workforce, due to fear of the deprivation of their occupation, low quality of life at work, the repetitiveness of standardised work tasks and loss of autonomy (Hines et al., 2004; Martínez-Jurado and Moyano-Fuentes, 2014). However, teamwork, employee participation, and top management support reduce the stress on employees (Conti et al., 2006). Therefore, the following hypothesis is proposed.

Hypothesis 3: H3 - ***Lean manufacturing practices in MSMEs are positively associated with social sustainability performance.***

6.2.2 RELATIONSHIP BETWEEN ECONOMIC, ENVIRONMENTAL AND SOCIAL SUSTAINABILITY PERFORMANCES

Sustainability performances, namely economic performance, environmental performance and social performance are interlinked. The adoption of environmental management practices by a firm increases the cost burden which changes the cost structures, leading to the reduction of profitability. However, these investments, improve environmental performance regarding the reduction of emission, waste, on-site waste treatment and energy consumption, which are associated with improved financial benefits (King and Lenox, 2001: Jayaraman et al., 2012). Environmental sustainability is a strategic business imperative and must be aligned with the profitability, efficiency, customer satisfaction, quality and responsiveness of organisations (Garza-Reyes, 2015 a, b). The improved environmental performance of a firm enhances its status for the commitment to reduce their ecological change (Starik and Rands, 1995) which in succession positively affects market performance (King and Lenox, 2001).

The market and financial performance of the firm have a positive influence due to the improved business image acquired by the customer satisfaction, customer-firm identification and loyalty derived from the improved environmental performance of the enterprise (Luo and Bhattacharya, 2009). Reduced business waste or non-value-added activities using less material, energy, and resources are environmentally as well as economically beneficial as they reduce operational costs (Azevedo et al., 2012).

Improved economic and environmental sustainable performances have direct and indirect effects on social performances. The increased production rate and workloads cause a more social impact as higher workload results in more mental and physical challenges of workers and may lead to frequent worker injuries. Ineffective waste management and environmental management may lead to many social and public health problems. Reduced air emission, wastage, and energy consumption lead to significant benefits to society regarding the improvements in comfort, health, and better labour relationships. Thus the following three hypotheses (H4, H5, and H6) were proposed.

Hypothesis 4: (H4) - ***Environmental sustainability performance and economic sustainability performance in MSMEs are significantly correlated.***

Hypothesis 5 (H5) - ***Environmental sustainability performance and social sustainability performance in MSMEs are significantly correlated.***

Hypothesis 6: (H6) - ***Economic*** **sustainability** ***performance and social sustainability performance in MSMEs are significantly correlated.***

6.3 CONFIRMATORY FACTOR ANALYSIS

CFA is used to provide a confirmatory test of the measurement theory. Measurement theory specifies how measured variables logically and systematically represent constructs involved in a theoretical model (Hair et al., 2013). Six hypotheses supported by literature review were present in the previous section. Details of questionnaire development, sample selection, respondents details and description of variables are already described in the earlier chapters.

6.3.1 CONSTRUCTS AND VARIABLES

Based on chapter 5, the five constructs selected for LMPs are named and coded as workforce management(W), flow management(F), process management(P), customer management(C), and supplier management(S) practices. The 'workforce management' comprising of four variables (W1 to W4), 'flow management' comprising of four variables (F1 to F4), 'process management' consisting of three variables (P1 to P3), 'customer management' comprising of three variables (C1 to C3) and 'supplier management' comprising of three variables (S1 to S3). Similarly, sustainability performance has three constructs namely economic sustainability performance (ECP) environmental sustainability performance (ENP) and social sustainability performance (SOP). This includes economic sustainability performance' with three variables (ECP1 to ECP3), 'environmental sustainability performance' with four variables (ENP1 to ENP4) and 'social sustainability performance' with four variables (SOP1 to SOP4). The explanations of this variables have given in Table 5.14 of chapter 5.

6.3.2 SAMPLE SIZE ADEQUACY

SEM needs to set a prior sample size based on the latent variables, observed variables and through the power analysis (Westland, 2010; Hair et al., 2013). Sample size criterion was determined traditionally by the use of thumb rules. However, recent researchers are using a priori sample size calculator for SEM (Soper, 2015) based on the power analysis.

1 Thump rule

According to a thumb rule, a simple SEM model can meaningfully test if the sample size is 100 or more (Tuanmat and Smith, 2011). Usually, a sample size of between 100 to 150 is considered the minimum size (Anderson and Gerbing, 1988; Ding et al., 1995). In a different opinion, a sample size of 200 may be required to generate valid fit measures and to avoid drawing incorrect inferences (Smith and Langfield-Smith, 2004). According to '$N \geq 100$' thumb rule, a sample size of less than 100 is often considered small, a sample size between 100 and 200 is medium, and a sample size exceeding 200 is large (Kline, 2005). Since this study has 252 samples, sample size is adequate.

2 Priori sample size calculator for SEM (Soper, 2015)

The sample size criterion should be determined through power analysis for SEM (Hair, et al., 2013). Soper (2015) has proposed a-priori sample size calculator for SEM. It is available as a free page in the internet. The screen shot of the output returned by sample size calculator is shown in Figure 6.2. This calculator requires input data, such as the anticipated effect size, statistical power levels, the number of observed and latent variables in the model, and the desired probability, to detect the minimum sample size for SEM technique (Westland, 2010).

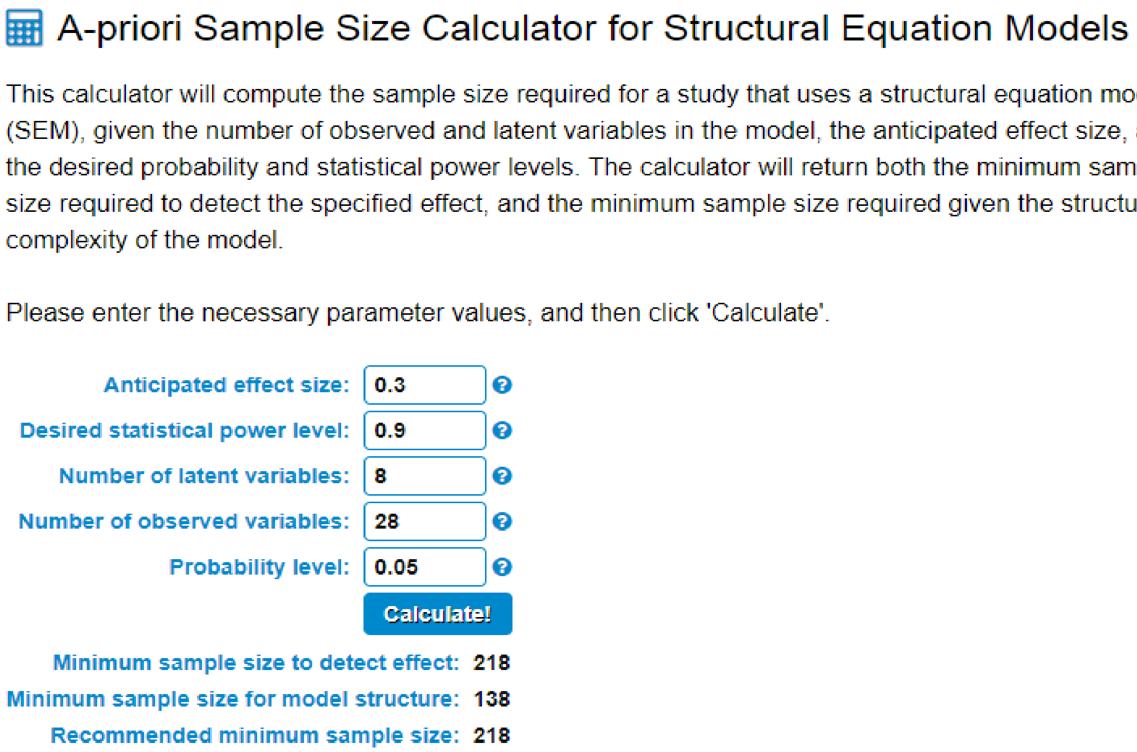

Figure 6. 2 The Screen Shot of the Output of a Priory Sample Size Calculator.

Inputting the required information such as,

Desired statistical power level = 0.90 (should be 0.8 or above)

No observed variables = 28 (17 variable for LMP + 11 variables for sustainability performance)

No of constructs = 8   (5 for LMPs and 3 for Sustainability Performance)

Probability level = 0.05 (95% confidence level)

Anticipated effect size of = 0.3 (0.5-High, 0.3- Medium, 0.1-Low effect size).

The calculator show the minimum sample size to detect the effect as 218 and minimum sample size for model structure as 138. The recommended minimum sample size is the highest value of the minimum sample sizes of both to detect the effect and model structure. Hence, the required number of the sample size from the calculator is 218. Since 252 usable samples are available for this study, the sample size is sufficient for getting the reliable results.

6.4 MEASUREMENT MODEL

SEM is an effective statistical method that seeks to analyse the relationship between multiple variables by the measurement and structural models ((Hair et al., 2013; Vinodh and Joy, 2012). The measurement model defines the relations between the observed variables to unobserved variables (Byrne, 2010). It presents how the measured variables represent the theory (Hair et al., 2013).

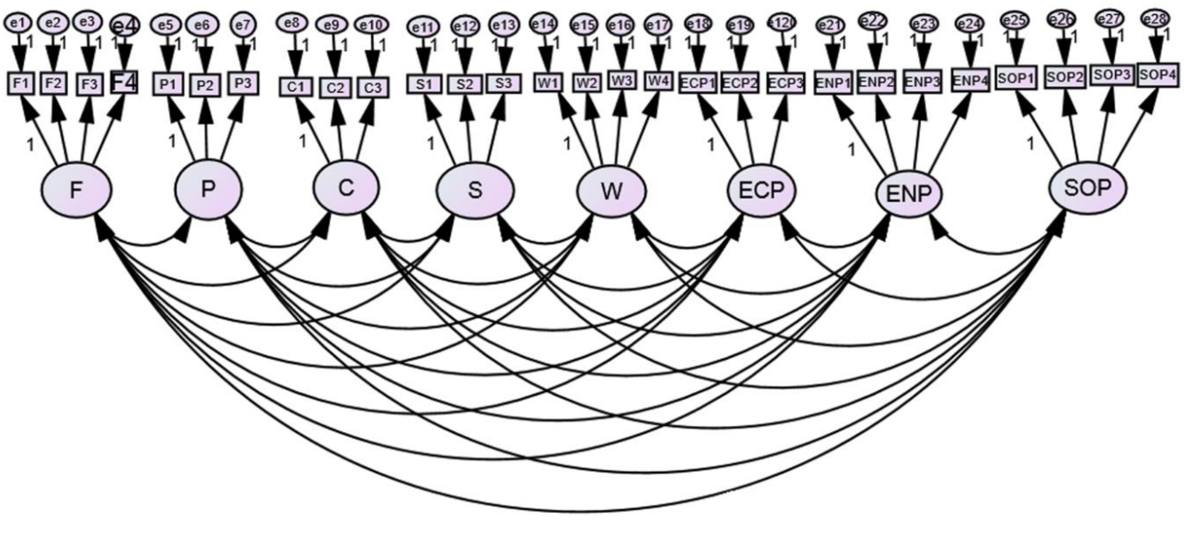

Figure 6.3 Measurement Model

Figure 6.3 shows the measurement model developed for this study The hypothesised relations between variables are calculated through AMOS in SPSS with the maximum likelihood estimate. CFA entail the data which satisfy the normality assumptions essential for SEM (Bortolotti et al., 2015). An iterative alteration procedure, based on CFA, permitted concurrent modification of the measures for the evaluation of the uni-dimensionality of the first- and second-order constructs.

6.5 MEASUREMENT MODEL VALIDITY AND RELIABILITY

The First-order measurement models of the constructs are derived, and overall fit is evaluated. The degree of freedom is calculated as the difference between a number of distinct sample moments and number of distinct parameters to be estimated from the model (Byrne, 2010). The number of distinct sample moments is the sum of unique variance and co-variance terms in the model. According to Hair et al (2013), if there are p measured items, the number of unique variance and covariance can be calculated using the formula$1/2p(p+1)$. In this model, 28 measured items and hence the number of distinct sample moments was calculated as 406. The number of distinct parameters or free parameters to be estimated is the sum of factor loadings, factor covariance terms and error variance terms and computed from the model as equal to 84. Table 6.1 gives the calculation of degree of freedom and equal to 322. As the degree of freedom is greater than zero, the derived model is over-identified. Over identified model, satisfy minimum condition to conduct CFA with enough information to identify the solution to a set of structural equations (Hair et al., 2013, Byrne, 2010).

Table 6.1 Computation of Degrees of Freedom

A number of distinct sample moments	406
Number of distinct parameters to be estimated	84
Degrees of freedom (406-84)	322

6.5.1 INTERNAL CONSISTENCY RELIABILITY

Internal consistency reliability of all constructs can be assessed using Cronbach’s alpha. Cronbach's alpha exceeds 0.7 is typically considered adequate (Cronbach, 1951; Nunnally. 1978) and acceptable if at least 0.6 (Chen and Paulraj, 2004). From Table 5.13 of chapter 5, the values of Cronbach's alpha for each construct are already shown. The values are found to be between 0.6 and 0.9 which are in the acceptable range, which demonstrates satisfactory internal consistency reliability of all dimensions. Table 5.13 also provides the codes of each construct and variables used in the further analysis.

6.5.2 CONVERGENT VALIDITY

The variables which represent the indicators of a particular latent variable should converge or share a significant proportion of variance in common is the condition for convergent validity (Fullerton and Wempe, 2009; Hair et al., 2013). Table 6.2 gives the results from CFA with individual constructs and its indicators, standard coefficients and corresponding critical values obtained from the analysis. A high loading on a latent factor by each indicator is the requirement for the higher convergent validity (Anderson and Gerbing, 1988). The researchers are commonly followed standardized estimates for the evaluation of convergent validity, as they are constrained to a range between -1.0 and +0.1 (Hair et al., 2013, Byrne, 2010). The common thumb rule for convergent validity is the standardized loading should be 0.5 or higher, and ideally 0.7 or higher (Hair et al., 2013). From Table 6.2, values of all standardized coefficients are above the minimum threshold value (0.5) and most of the values are near or higher than the ideal value (0.7). ‘Critical ratios’ or ‘t-values’ are calculated by dividing standardized estimate by the standard error calculated. Additionally, these values shown in Table 6.2 also indicate convergent validity, significant at $p < 0.001$ with lowest critical ratio values being 8.00.

6.5.3 DISCRIMINANT VALIDITY

Discriminant validity indicates the degree to which each construct is distinct from one another (Schermelleh-Engel et al, 2003; Anderson and Gerbing, 1988, Hair et al., 2013). Discriminant validity occurs if the square root of the Average Variance Extracted (AVE) by each construct go above the corresponding inter-variable correlation (Fornell and Larcker, 1981).

Table 6.2 Results from CFA Summary Data for Individual Construct Indicators

Construct Indicators	Standardized coefficients	Critical ratio
Workforce Management Practices		
W1	0.666	a
W2	0.707	9.173
W3	0.694	9.056
W4	0.791	9.843
Flow Management Practices		
F1	0.673	a
F2	0.746	9.274
F3	0.661	8.362
F4	0.612	8.000
Process Management Practices		
P1	0.725	a
P2	0.794	10.497
P3	0.661	8.734
Customer Management Practices		
C1	0.605	a
C2	0.772	8.889
C3	0.829	9.530
Supplier Management Practices		
S1	0.810	a
S2	0.603	8.224
S3	0.678	8.720
Economic Sustainability Performances		
ECP1	0.676	a
ECP2	0.709	8.611
ECP3	0.750	9.228
Environmental Sustainability Performance		
ENP1	0.707	a
ENP2	0.713	9.600
ENP3	0.654	8.897
ENP4	0.768	10.094
Social Sustainability Performance		
SOP1	0.808	a
SOP2	0.656	9.751
SOP3	0.686	10.854
SOP4	0.686	10.255

Notes: n = 252; a Parameter that was fixed at 1.0

Measurement models are estimated using maximum likelihood

Table 6.3 First-order Inter-Construct Correlations, Reliability and Discriminant validity (n=252)

	C	*F*	*P*	*S*	*W*	*ENP*	*ECP*	*SOP*	*CR*	*AVE*	*MSV*
C	**0.741**								0.783	0.550	0.333
F	0.450	**0.675**							0.714	0.456	0.287
P	0.573	0.450	**0.731**						0.694	0.534	0.329
S	0.577	0.481	0.399	**0.702**					0.742	0.493	0.345
W	0.559	0.536	0.525	0.324	**0.713**				0.807	0.513	0.312
ENP	0.560	0.472	0.423	0.445	0.322	**0.711**			0.804	0.506	0.436
ECP	0.471	0.458	0.522	0.587	0.297	0.647	**0.712**		0.755	0.507	0.419
SOP	0.515	0.432	0.574	0.348	0.428	0.660	0.529	**0.711**	0.803	0.506	0.436

Notes: n = 244.

The square root of AVE on diagonal in boldface.

CR: Construct Reliability; AVE: Average Variance Extracted;
MSV: Maximum Shared Variance

Table 6.3 provides first-order inter-construct correlations, reliability and discriminant validity of all constructs. The square roots of AVEs are indicated daagonally in Table 6.3, and all these values are greater than the construct correlations and thus satisfying the condition for reasonable discriminant validity. The composite reliabilities of all constructs are above the acceptable standard of 0.70, except for only one construct ‘process management practice’ as shown in Table 6.3 shows good construct reliability (Fornell and Larcker, 1981).

6.6 MODEL FIT

The fit indices of the measurement model are evaluated and tabulated in Table 6.4. The fit indices such as chi-square (χ^2), ratio of chi-square to degrees of freedom (χ^2/df), goodness of fit indices (GFI), Normed fit index (NFI), Incremental fit index (IFI), Tucker-Lewis Index (TLI), and Comparative Fit Index (CFI) were used for the evaluation of the measurement model. In addition to these absolute fit indices, namely, Root mean square error of approximation (RMSEA) and Root mean square residual (SRMR), were also used for evaluation of model fit. No strict guidelines are defined to follow to represent an acceptable fit (Schermelleh-Engel et al., 2003). However, several parameters are evidenced from various references and academic works

Table 6.4 Model Fit Indices of Measurement Model

Model Fit Statistics	**Recommended Value**	**Model Value**
Chi-square	-	495.316
df	-	322
Chi-square Ratio	< 5.000	1.538
GFI	>0.8 marginal fit >0.9 good fit	0.880
NFI	>0.8 marginal fit >0.9 good fit	0.838
IFI	>0.8 marginal fit >0.9 good fit	0.937
TLI	>0.8 marginal fit >0.9 good fit	0.924
CFI	>0.8 marginal fit >0.9 good fit	0.936
RMSEA	≤ 0.08 marginal fit ≤ 0.05 good fit	0.046
SRMR	< 0.1 marginal fit < 0.05 good fit	0.053

For Small sample sizes, GFI and NFI, are often underestimated and hence the measurement models can good fit indices with the exclusion of these two indices (Byrne 2010; Kline 2005). According to Shah and Goldstein (2006) CFI, TLI, and IFI are considered fit measures for small sample sizes. The values of GFI, NFI, TLI, CFI, and IFI with close to 1.0 or greater than 0.9 represents a good fit (Byrne, 2010; Kline, 2005). According to Byrne (2010), an RMSEA value of less than 0.08 is reasonable, and a value of 0.05 or less indicates a good fit. According to Schermelleh-Engel et al. (2003) and Kline 2005, an SRMR between 0.05 and 0.10 is considered favourable.

Table 6.4 gives the goodness of fit for our model (χ^2=495.316, χ^2/df=1.538, GFI=0.880; NFI=0.838; IFI=0.937, TLI=0.924; CFI=0.936, RMSEA=0.046; RMR=0.053). All these fit indices are within the recommended values for model fit. Hence the overall fit of the model is acceptable and thus supporting the unidimensionality and convergent validity of all dimensions.

6.7 STRUCTURAL MODEL RESULTS

The structural model developed by path diagram is shown in Figure 6.4. In this path diagram, significant relationships between the constructs are represented by the straight arrows between the constructs. These arrows represent the six hypotheses (H1 to H6). Maximum likelihood estimation (MLE) was used for the analysis of this structural model.

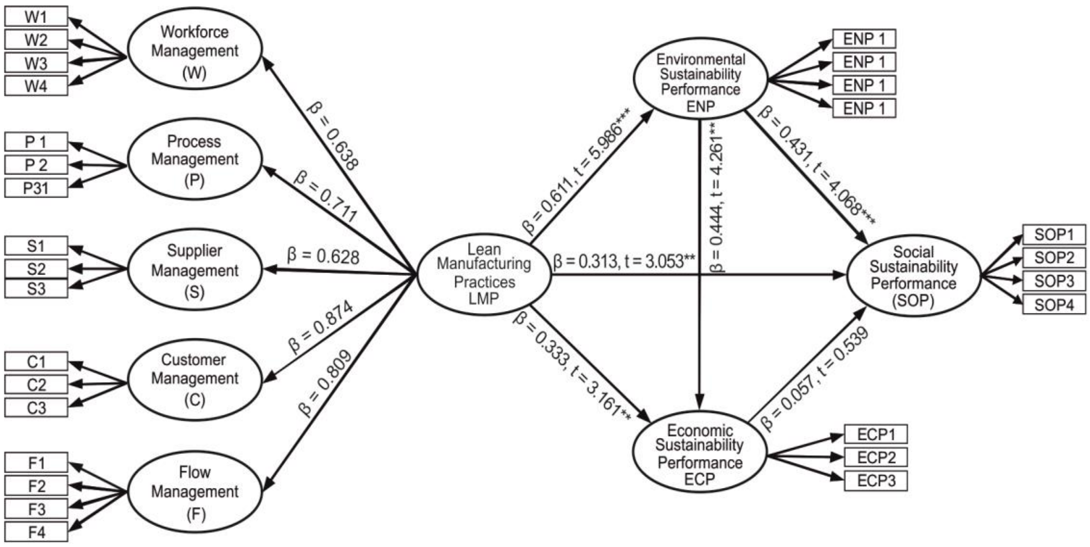

Figure 6.4 Structural Model

The model fit statistics are evaluated from the output of SEM analysis in IBM AMOS 21and shown in Table 6.5.

Table 6.5 Model Fit Indices of Structural Model

Model Fit Statistics	Recommended Value	Model Value
Chi-square	-	538.967
df	-	339
Chi-square Ratio	< 5.000	1.590
GFI	>0.8 marginal fit >0.9 good fit	0.869
NFI	>0.8 marginal fit >0.9 good fit	0.824
IFI	>0.8 marginal fit >0.9 good fit	0.927
TLI	>0.8 marginal fit >0.9 good fit	0.917
CFI	>0.8 marginal fit >0.9 good fit	0.926
RMSEA	≤ 0.08 marginal fit ≤ 0.05 good fit	0.048
SRMR	< 0.1 marginal fit < 0.05 good fit	0.061

The chi square value, degree of freedom and Chi square ratio of the model were evaluated. From Table 6.5, the chi-square ratio of the model is 1.590, which is within the limit of maximum value five. The fit indices, namely, GFI, NFI, IFI, TLI, CFI, were found to be above the minimum values for marginal fit or good fit. The RMSEA value is within the limit for good fit and SRMR values is within the limit for moderate fit.

The results of the SEM with standardised regression coefficients and t values are evaluated. The details of the hypothesis and the corresponding p-values obtained are shown in Table 6.6.

Table 6.6 Results of the Structural Models

Relationship	***Hypothesis***	***Standardised Regression Coefficient (β)***	***t value***	***P value***
LMP--> ENP	H1	0.611	5.986	0.000***
LMP--> ECP	H2	0.333	3.167	0.002**
LMP-->SOP	H3	0.313	3.053	0.002**
ENP-->ECP	H4	0.444	4.261	0.000***
ENP-->SOP	H5	0.431	4.068	0..000***
ECP-->SOP	H6	0.057	0.539	0.590

Notes: N=252

***, **, * indicates the significance of the p-value at < 0.01, 0.05, and 0.10 respectively.

From the Table 6.6, the hypothesis H1, LMPs enhance environmental sustainability performances is accepted. The estimated coefficient of $\beta = 0.611$ ($t = 5.986$, $p < 0.01$) for the relationship between lean manufacturing and environmental sustainability performances is significant indicating strong support for hypothesis H1. This finding is in line with prior study conducted by Yang et al., (2011).

The hypothesis H2, LMPs enhance economic sustainability performances is also accepted. The estimated coefficient of $\beta = 0.333$ ($t = 3.167$, $P < 0.05$) between lean manufacturing and economic sustainability performance significantly supports H1.This outcome is consistent with the extant literature (Fullerton and Wempe, 2009; Shaw and Ward, 2003).

The hypothesis H3, LMPs on social sustainability performances is also accepted. The proposed relationship between LMPs and social sustainability performance is supported with an estimated coefficient of $\beta = 0.313$ ($t = 3.053$, $p < 0.05$).

The estimated coefficient of $\beta = 0.444$ ($t = 4.261$, $p < 0.01$) for the relationship between environmental sustainability and economic sustainability performances is significant representing a strong support for hypothesis H4. This finding is similar to prior works. Similarly, the proposed relationship (H5) between environmental sustainability and social sustainability performance is supported by an estimated coefficient of $\beta = 0.431$ ($t = 4.068$, $p < 0.01$). However, the structural equation results show that the proposed relationship between economic sustainability and social sustainability performance is insignificant with an estimate coefficients $\beta = 0.057$ ($t = 0.539$, $p > 0.10$).

6.8 CONCLUSION

The study explains whether LMPs influence sustainability performances in MSMEs or not. The findings reveal significant positive effects of LMPs on three dimensions of sustainability benefits – economic, environmental, and social sustainability performances (H1-H3). These results give the evidence that LMPs are valuable resources for achieving the sustainability. The study also agrees with the vast majority of the literature, which indicated a positive relationship between the agreement of LMPs and performances of the organisations (Chugani et al., 2017; King and Lenox, 2001; Ball, 2015; Longoni et al., 2013).

The positive relationship of LMPs and economic and environmental performances are already established from the previous works (Rothenberg et al., 2001; Ng et al., 2015; Fullerton and Wempe, 2009; Ball, 2015; Yang et al., 2011), which this study further confirms in MSMEs. The findings acquire greater significance, as India is one of the developing countries in which MSMEs are playing a crucial role, and government authorities are promoting LMPs. The findings in this research work are crucial and relevant than the earlier works conducted in this field precisely because LMPs also have a positive link toward the social benefits.

The LMPs focus on the "people" in addition to "profit" and "planet" with particular attention given to the welfare of workers including safety and health, labour relationship, and customer satisfaction. Hence, adopting LMPs in the manufacturing MSMEs and thus becoming leaner in its operations is one of the ways to achieve business sustainability. This finding is in line with the recommendations of Thomas et al. (2012).

The interrelationship between the 3BL sustainability performances and their linking with each other were also tested (H4-H6). Consequently, significant positive effects on environmental sustainability to economic and social sustainability performances (H4 and H5) are established from this study which is in line with the findings of the previous study by Vinodh and Joy (2012). Further, this study shows that there is no a significant relationship between economic and social sustainability performances (H6). This finding becomes significant as the attainment of the economic sustainability may not guaranty the social sustainability.

Moreover, this result is a clear indication of the conflict of interest of organizations (Wong and Wong, 2014) that have been existing among the entities of sustainability, giving more emphasis on profit without much consideration to people. MSMEs often lag behind on the implementation of best practice including LMPs and sustainability practices (Panizzolo et al., 2012; Thomas et al., 2012; Zhou, 2012; Urban and Naidoo, 2012; Upadhye et al., 2013). MSMEs have different reasons for this situation which are resource constraints, managements inability to adapt to changes, and unwillingness to make the necessary investments for the lean implementation (Zhou, 2012; Theyal and Hofmann, 2012; Panizzolo et al., 2012). The findings of this study corroborate the necessity of adoption of LMPs within the MSMEs, targeting their sustainable growth.