CHAPTER 5
FACTOR ANALYSIS

5.1 INTRODUCTION

The descriptive statistics presented in chapter four shows that MSMEs are convincingly following the LMPs in their operations and benefited to sustainable performance. This chapter presents the results of the factor analysis on the variables used for measuring lean practices and sustainability performance.

Since lean practices are inter-reliant, analysing on single entity practices can be deceptive (Kim et al., 2012; Shah and Ward, 2003). The effect of the lean practices was studied by the various researchers based on the classification and examination as the sets of internally consistent groups of practices. There are various research works available in the literature which studied the impact of lean bundles rather than individual practices comprising each bundle (Agarwal et al., 2013; Bonavia and Marin-Garcia, 2011; Rahman et al., 2010; Shah and Ward, 2003). Although previous research works have conducted factor analysis and assigned bundles/variables to latent constructs of LMPs and sustainability performance, there have been non-uniformity in the definition of bundles and their inclusion in constructs.

In Indian context, attempts to define items and constructs of LMPs particularly in MSMEs have not been developed yet. Hence a factor analysis is to be conducted to identify the latent constructs and their composition of items in MSMEs. In this study, an Exploratory Factor Analysis (EFA) has been used to factorise the variables. Content/face validity, uni-dimensionality and reliability were assessed through factor analysis

The process of identification of underlying structures among the 19 indicator variables of LMPs and 12 indicator variables on sustainability performance, are presented in this chapter. The findings from these factor analyses will define the second order constructs of LMPs and sustainability performance for further analysis proposed using the ‘Structural Equation Modelling (SEM).

5.2 FACTOR ANALYSIS

Factor analysis is an interdependence technique, whose primary aim is to define the underlying structure among the variables in the analysis. This method analyses the interrelationship among a large number of variables and to group them accordingly to their common core dimensions as factors with minimal loss of information (Hair et al., 2013). Factors are formed by describing the variability among the observed and correlated variables into a potentially low number of unobserved variables. This method explores such joint variations in response to unobserved latent variables.

The observed variables are modelled as a linear combination of potential factors, plus error terms. By providing an empirical estimate of the structure of the variables considered, factor analysis becomes an objective basis for creating summated scale. The factor analysis is classified into two types as Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) (Byrne, 2010; Williams et al., 2010).

5.2.1 EXPLORATORY FACTOR ANALYSIS

EFA is an analysis of exploratory type and is used to identify the complex interrelationships among the variables, and group these variables as part of unified concepts. This method helps the researcher to draw the main dimensions of the area of interest to derive a theory or a model from the reasonably large set of variables. The groups formed from interrelated variables are called factors (Hair et al., 2013).

The distinctive feature of EFA is that the factors are derived from statistical results, not from theory (Hair et al., 2013). The EFA is performed without any prior idea of, which factors indeed subsist and which variables loads to each group formed. The researchers use the conventional procedure and rules to arrange and load the variables on factors and to fix the number of factors. The EFA explores the data and provides the researcher, the information about how many factors are needed to best represent it. The correlation between the variables and factors known as factor loading gives the nature of a particular factor.

5.2.2 CONFIRMATORY FACTOR ANALYSIS

This approach tests the hypotheses that the items are associated with specific factors. CFA uses Structural Equation Modeling (SEM) to test a measurement model whereby loading on the factors allows for evaluation of relationships between observed variables and unobserved variables. CFA is similar to EFA in some respect, but philosophically different.

In conducting CFA, the details such as the number of factors and the factors on which each variable load is to be specified for a given set of variables. Hypothesised models are tested against actual data, and the analysis would demonstrate loadings of observed variables on the factors, as well as the correlation between the latent variables. CFA is applied to test the extent to which researcher's a-priory, the theoretical pattern of the factor loading of pre-specified constructs representing the actual data.

5.3 STEPS IN EFA

An EFA consist of a series of procedures and steps to be followed in building clear decision pathways. First, it is required to define the objectives of the factor analysis concerned with the research problem. Figure 5.1, shows the systematic steps followed in EFA by the most of the researchers (Williams et al., 2010; Ogunbiyi, 2014).

1 Data Suitability Tests for Factor Analysis

Suitability of the data depends on the assumptions underlying factor analysis, which is more conceptual than statistical (Hair et al., 2013). In factor analysis, sample size, factorability of the correlation matrix, Kaiser-Meyer- Olkin (KMO) measure of sampling adequacy, and Bartlett’s test of sphericity are the criterion to check the suitability of data for analysis. The requirement of minimum sample size is to be satisfied for conducting factor analysis.

The literature shows different opinions about the sample size. The minimum absolute sample size is 50 in general, and the recommended minimum number of observations is 100 or larger for conducting the factor analysis (Hair. et al., 2013, Sapnas and Zeller, 2002). In another aspect, the recommended minimum ratio of the number of observations to some variables to be analysed is 5:1 and the more appreciable sample size is up to 10:1. Similarly, for considering the data's suitability, correlations in the data matrix is also an important criterion to be considered. Sufficient correlations shall exist among the variables to consider in factor analysis. The thumb rules suggest that the values of correlation coefficients in correlation matrix above ±0. 30 can be considered as minimum, ±0. 40 is important, and ±0. 50 are practically significant for conducting factor analysis (Tabachnick and Fidell, 2007; Hair et al., 2013)

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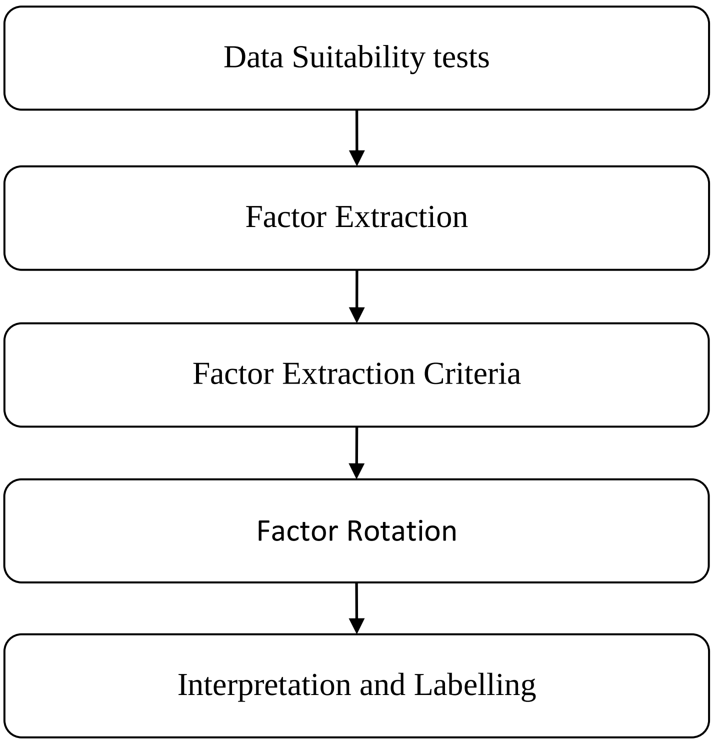

Figure 5.1 Steps in Factor Analysis

‘Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy’ and ‘Bartlett's Test of Sphericity’ are the two commonly adopted tests. If the ‘KMO measure of sample adequacy’ value is between 0.5 and 1.0 is the representation of the usefulness of factor analysis with the particular data. (Urban and Naidoo, 2012; Kaiser, 1974).

The ‘Bartlett’s Test of sphericity’ tests whether the correlation matrix is an identity matrix indicating the non-existence of correlation among the variables.

If the significance value is 0.05, this suggests that the factor analysis approach about the relevant data may be useful. (Hair et al., 2013).

2 Factor Extraction

This is the process of extracting the best linear combinations of variables explaining variance in the data than any other linear combination (Hair et al., 2013). The ‘Principal component analysis’ (PCA), ‘Principal axis factoring’ (PAF) are the common methods employed for factor extraction (Pett et al., 2003; Thompson, 2004).

Various criteria are used to assist the factor extraction. The ‘Kaiser‘s criteria’ based on ‘Eigenvalues’ (Kaiser, 1974), the ‘Scree test’ (Cattell, 1966), and the ‘cumulative percentage of variance extracted’ are the commonly used criteria for factor extraction. Factors are extracted with the rules of Eigenvalues either greater than one or by fixing the number factors to be a fixed one, based on prior expectations. The Scree plots are the graphical representation of Scree tests by drawing a straight line through the smaller Eigenvalues, at which the above conditions are fixed. The total variance explained in social science, and management researchers are acceptable for a minimum value from 50-60 percentages (Pett et al. 2003, Hair et al. 1995).

3 Factor Rotation

The rotation of factors used to get more interpretable and simplified solutions from the factor extraction results. The ‘Orthogonal rotation’ and ‘oblique rotation’ are the two commonly used techniques for factor rotation. There are several options for both rotation techniques. The orthogonal rotation could be Varimax or Quartimax, while oblique rotation could be Olbimin or Promax. The Orthogonal Varimax rotation was first developed by Thompson (2004), and it is the most common rotational technique used in factor analysis, which is capable of producing factor structures that are not correlated (Costello and Osborne, 2005). In contrast, Oblique rotation produces factors that are correlated. This is often seen as more accurate for research involving human behaviours, or when data do not meet prior assumptions (Costello and Osborne, 2005).

4 Interpretation and Labelling

In the interpretation stage, the factors are generated, and attributed variables are examined to identify the common property to name the variables (Williams et al., 2010). In general, at least two variables must load on the factor, so it can be given a meaningful interpretation (Henson and Roberts, 2006). The labelling of factors is a subjective, logical, and inductive process (Pett et al. 2003). The meaningfulness of latent factors is ultimately dependent on the logical definition raised by the researcher (Henson and Roberts, 2006).

5.4 EFA OF LEAN MANUFACTURING PRACTICES

The EFA was conducted using the principal component method with the condition of Eigenvalues greater than 1.0. Normality, linearity, homoscedasticity and homogeneity of the sample are assumed for performing the factor analysis as alike to similar researches (Mitra and Datta 2014). Sample adequacy for LMPs was tested by the KMO measure of sample adequacy and Bartelett's test for sphericity. Details of the KMO test and Bartlett's tests are shown in Table.5.1. KMO measure of sampling adequacy test for lean manufacturing practices gives a KMO value of 0.877, which go above the suggested threshold value of 0.6. Bartelett's test for sphericity gives a chi-square value of 1723.568 with a degree of freedom (d.f) of 171. A significant p values ($p < 0.05$) reject the null hypothesis of 'correlation matrix is an identity matrix' indicates the suitability of the data for factor analysis.

Table 5.1 K-M-O and Bartlett's Test Results of LMPs

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy		0.877
Bartlett's Test of Sphericity	Approx. Chi-Square	1723.108
	df	171.0
	Sig.	0.000

The communality plays a significant role in factor analysis procedure. Communality is defined as the total amount of variance a variable has in common with the constructs upon which it loads (Byrne, 2010. The minimum threshold value for the communality is accepted at 0.5 (Hair et al., 2013). In common practice, if a variable loaded on a factor with a value less than 0.4 or significantly loaded on more than one factor, that variable is deleted from the further analysis (Hair et al, 2013).

Indicators with low communality values (< 0.5) are deleted and recalculated for new communalities. In the first iteration, factor analysis gives a cumulative variance explained as 56.96 percent with 4 factors. The Table. 5.2 gives the initial and extracted communalities obtained from the initial analysis with 19 variables. On further analysis, the variables loaded greater than 0.40 on more than one constructs or loaded into a factor that did not match with the theory or logic were avoided

Table 5.2 Initial Communality Values of LMPs

Lean Manufacturing Practices variables	**Initial**	**Extraction**
LMP01	1.000	0.667
LMP02	1.000	0.743
LMP03	1.000	0.521
LMP04	1.000	0.684
LMP05	1.000	0.571
LMP06	1.000	0.588
LMP07	1.000	**0.277**
LMP08	1.000	0.576
LMP09	1.000	0.636
LMP10	1.000	0.589
LMP11	1.000	0.606
LMP12	1.000	0.601
LMP13	1.000	0.532
LMP14	1.000	0.558
LMP15	1.000	0.671
LMP16	1.000	0.646
LMP17	1.000	**0.406**
LMP18	1.000	0.562
LMP19	1.000	0.588

Variables with low communality LMP07 (0.277) and LMP17 (0.406) are deleted from the variable list and was conducted factor analysis again. The initial and extraction communalities values from this test are shown in the Table 5.3. From Table 5.3, it is observed that all the communalities values are above the threshold value equal to 0.5.

Table 5.3 Communality Values after Dropping the Low Communality Values of LMPs

Lean Manufacturing Practices	Initial	Extraction
LMP01	1.000	0.687
LMP02	1.000	0.751
LMP03	1.000	0.544
LMP04	1.000	0.694
LMP05	1.000	0.598
LMP06	1.000	0.587
LMP08	1.000	0.589
LMP09	1.000	0.667
LMP10	1.000	0.630
LMP11	1.000	0.611
LMP12	1.000	0.602
LMP13	1.000	0.536
LMP14	1.000	0.582
LMP15	1.000	0.688
LMP16	1.000	0.636
LMP18	1.000	0.562
LMP19	1.000	0.586

As the communalities values are above 0.5, varimax rotation is conducted with a condition ‘Eigen value greater than one’. The initial rotated component matrix obtained from the analysis is shown in Table 5.4. This results show that four factors are extracted. However, the variable LMP13 is not showing a significant loading and the variable LMP19 is cross loaded with two factors. Hence, these variables may be eliminated, but according Hair et al. (2013), this is a problem situation for researcher in which variables with sufficient communality values show cross loading or absence of significant loading. As a remedy, Hair et al. (2013) have also suggested that, without eliminating these variables the factor model may be respecified by changing the condition of extraction, to get a factor structure with empirical and conceptual support.

Table 5.4 Initial Rotated Component Matrix of LMPs

Lean Manufacturing Practices	**Component**			
	1	**2**	**3**	**4**
LMP03		0.598		
LMP14		0.641		
LMP16		0.778		
LMP15		0.827		
LMP01				0.798
LMP02				0.827
LMP06				0.693
LMP13				
LMP19		**0.412**	**0.524**	
LMP18		0.521		
LMP09			0.772	
LMP08			0.761	
LMP10			0.772	
LMP12	0.756			
LMP05	0.729			
LMP11	0.745			
LMP04	0.799			

Hence, in the next stage, without deleting the variables LMP13 and LMP19, the factor analysis was again conducted by changing the condition of 'Eigen value greater than one' to a condition specifying a fixed number of factors. Thus, an analysis was conducted, by fixing the number of factors to be extracted to the next higher value equal to '5' than the previous number of factors extracted.

The new rotating component matrix obtained is shown in Table 5.5. This result suggests five factors to represent all the lean manufacturing practices. During this iteration, the cross loading of the variable were eliminated. The Scree plot obtained from the output results is shown in Figure 5.2. In this diagram, the Eigenvalue of fifth factor is very close to unity (0.980) and thus confirms the choice of the five factors in the solution.

Table 5.5 Final Rotated Component Matrix of LMPs

Lean Manufacturing Practices	**Components**				
	1	**2**	**3**	**4**	**5**
LMP03		0.582			
LMP14		0.568			
LMP16		0.779			
LMP15		0.861			
LMP01			0.805		
LMP02			0.821		
LMP06			0.686		
LMP13					0.831
LMP19					0.574
LMP18					0.707
LMP09				0.801	
LMP08				0.749	
LMP10				0.785	
LMP12	0.723				
LMP05	0.741				
LMP11	0.744				
LMP04	0.817				

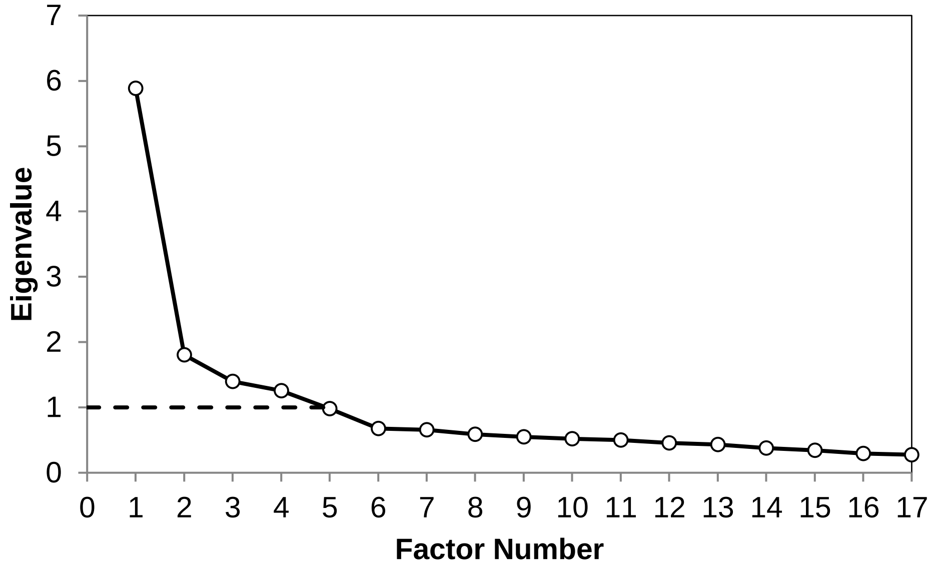

Figure 5.2 Scree Plot of Factor Rotation of LMPs.

The total variance explained by these generated factors is shown in Table 5.6. From this table, the five factors selected have a rotation sum of squared loadings equal to 66.48 percentages, which indicates the percentage of the total variance explained by these five factors. This range of percentage as total variance explained is acceptable as per the previous researchers in this type (Hair et al., 2013; Rahman et al., 2010).

Table 5.6 Total Variance Explained by the Factors of LMPs

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	**Variance %**	**Cumulative %**	**Total**	**Variance %**	**Cumulative %**	**Total**	**Variance %**	**Cumulative %**
1	5.886	34.624	34.624	5.886	34.624	34.624	2.750	16.175	16.175
2	1.807	10.630	45.254	1.807	10.630	45.254	2.351	13.827	30.002
3	1.400	8.235	53.488	1.400	8.235	53.488	2.173	12.784	42.786
4	1.257	7.395	60.884	1.257	7.395	60.884	2.124	12.493	55.278
5	0.980	5.764	**66.648**	0.980	5.764	66.648	1.933	11.369	66.648
6	0.675	3.970	70.618						
7	0.658	3.869	74.486						
8	0.588	3.458	77.944						
9	0.548	3.221	81.166						
10	0.521	3.066	84.231						
11	0.502	2.953	87.185						
12	0.456	2.680	89.864						
13	0.432	2.543	92.407						
14	0.379	2.229	94.636						
15	0.343	2.018	96.654						
16	0.293	1.724	98.378						
17	0.276	1.622	100.000						

5.5 EFA OF LMPS - RESULTS

The EFA of LMPs generated five factors. The name and definitions of these factors are given in Table 5.7. The first factor includes four variables (LMP12, LMP05, LMP11, and LMP04). These variables are the lean practices related to employees and workforce, and hence this factor is named as Workforce management practices (W). This factor contributes the highest portion of variation in the total variance explained by all the five factors. The second factor formed by variables (LMP03, LMP14, LMP16, and LMP15) is related to flow management and hence this factor is termed as Flow management practices (F). Similarly, the third factor with three variables (LMP01, LMP02, and LMP06) which are related to manufacturing processes and hence known as Process management practices (P).

Table 5.7 Lean manufacturing practice Constructs-Definitions

Sl.No.	Constructs	Definition	Supporting literature
1	Workforce Management Practices (W)	Practices for the involvement of workers in continuous quality improvement programs, expansion of their autonomy and responsibility. Concentrated on the reduction of wastes due to underutilized people, waiting, and unnecessary Motion	Shah and Ward (2003, 2007); Al-tahat and Jalham (2015)
2	Flow management practices (F)	A set of interrelated practices for managing production flow concentrated on the reduction of waste due to excess inventory, over production and unnecessary delays on flow time.	Shah and Ward (2003), Swink et al. (2005)
3	Process Management Practices (P)	Practices to sustain the quality standards of processes. Mainly concentrated on waste reduction due to unnecessary motion, over processing and waiting.	Panizzolo et al. (2012)
4	Supplier Management Practices (S)	Practices that focus on managing the relationships between the manufacturing firm and its suppliers. Concentrated on the reduction of waste due to inventory and waiting.	Shah and Ward (2003, 2007); Al-tahat and Jalham (2015); Panizzolo et al.(2012)
5	Customer Focus Practices (C)	Practices that are directly related to customers, for establishing links between customer satisfaction and their needs. Mainly concentrated on the reduction of wastes due to defect, transportation and waiting.	Al-tahat and Jalham (2015); Panizzolo et al.(2012)

The fourth factor with three variables (LMP09, LMP08, and LMP10) are the practices related to suppliers and hence termed as Supplier management practices (S). The fifth factor includes three variables (LMP13, LMP19, and LMP18) which are related to customer management and hence termed as Customer management practices (C). In short, the construct LMPs in MSMEs can be represented as five factors, namely, 'Workforce management practices', 'Flow management practices', 'Process management practices', 'Supplier management practices', and 'Customer management practices'. These findings are in line with the similar researchers (Khanchanapong et al., 2014). These five factors listed in Table 5.7 will represent all variables of LMPs in the further analysis of this research.

5.6 EFA OF SUSTAINABILITY PERFORMANCE

As similar to the EFA of LMPs, the EFA of Sustainability performances are conducted using the principal component method with the condition of Eigenvalues greater than 1.0. Normality, linearity, homoscedasticity and homogeneity of the sample are assumed for conducting the factor analysis (Mitra and Datta 2014).

Details of the 'KMO test' and 'Bartlett's tests' are shown in Table 5.8. 'KMO measure of sampling adequacy' test for sustainability performance indicators give a KMO value of 0.871, which go above the suggested threshold value of 0.6. 'Bartelett's test for sphericity' gives a chi-square value of 1129.78 with a degree of freedom (d.f) of 66. A significant p values ($p < 0.05$) reject the null hypothesis the 'correlation matrix is an identity matrix' and indicates the suitability of the data for factor analysis.

Table 5.8 K-M-O and Bartlett's Test Results of Sustainability Performance.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.871
Bartlett's Test of Sphericity	Approx. Chi-Square	1129.778
	d.f	66
	Sig.	0.000

The rotated component matrix using the principal component method with the condition of 'Eigen values greater than 1.0', suggests three constructs in the first iteration to represent all the 12 sustainability performances. These three factors explain

62.36 percentage of total variance in the first iteration. Table.5.9 gives the initial and extracted communalities obtained from the initial analysis with 12 variables.

Table 5.9 Initial Communality Values of Sustainability Performance

Sustainability performance Variables	Initial	Extraction
SP01	1.000	0.565
SP02	1.000	0.648
SP03	1.000	0.712
SP04	1.000	0.588
SP05	1.000	0.707
SP06	1.000	0.624
SP07	1.000	0.708
SP08	1.000	0.733
SP09	1.000	0.561
SP10	1.000	0.571
SP11	1.000	0.637
SP12	1.000	0.429

Indicator SP12 (Technology improvement) with low communality value equal to 0.408 (< 0.5) is deleted and recalculated for new communalities. The communalities values in the second iteration are shown in the Table. 5.10.

Table 5.10 Communality Values After Dropping the Low Communality Values of Sustainability Performances

Sustainability performance Variables	Initial	Extraction
SP01	1.000	0.601
SP02	1.000	0.661
SP03	1.000	0.722
SP04	1.000	0.585
SP05	1.000	0.699
SP06	1.000	0.630
SP07	1.000	0.709
SP08	1.000	0.734
SP09	1.000	0.577
SP10	1.000	0.565
SP11	1.000	0.644

As the communalities values are above 0.5 with all variables, the factor rotation was conducted using varimax rotation. The rotated component matrix is shown in Table 5.11. Three factors are extracted, and the corresponding Scree plot is shown in Figure 5.3. The Scree plot confirms the choice of three factors in the solution with respect to the criteria of 'Eigen value greater than one'.

Table 5.11 Final Rotated Matrix for Sustainability Performances

Sustainability performance Variables	**Component**		
	1	**2**	**3**
SP01			0.721
SP02			0.782
SP03			0.819
SP04		0.552	
SP05		0.775	
SP06		0.761	
SP07		0.790	
SP08	0.814		
SP09	0.724		
SP10	0.711		
SP11	0.744		

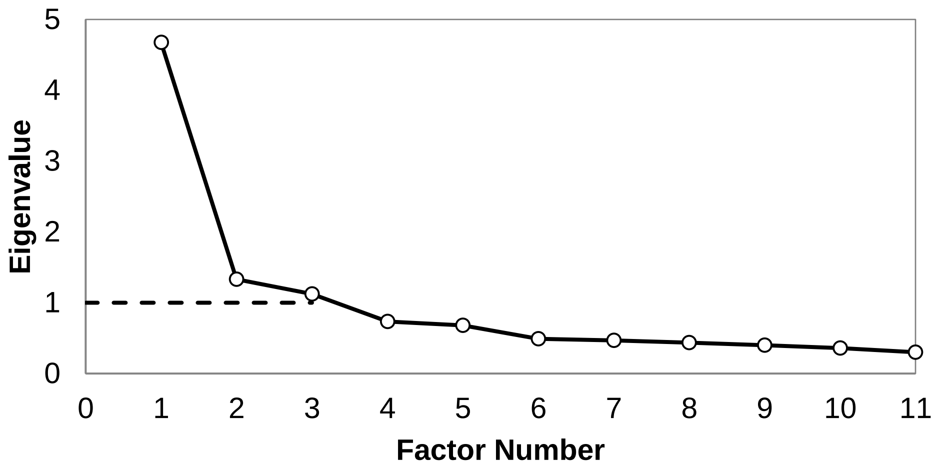

Figure 5.3 Scree Plot of Factor Rotation for Sustainability Performance Variable

The total variance explained by these generated factors is shown in Table 5.12. From this table, the three factors selected have a rotation sum of squared loadings equal to 64.799 percentages, which indicates 64.80 percentage of the total variance is explained by these three factors. This range of percentage as total variance explained is acceptable as per the researches in this type (Hair et al., 2013; Rahman et al., 2010).

Table 5.12 Total Variance Explained by Factors of Sustainability Performance

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	**Variance %**	**Cumulative %**	**Total**	**Variance %**	**Cumulative %**	**Total**	**Variance %**	**Cumulative %**
1	4.674	42.488	42.488	4.674	42.488	42.488	2.545	23.132	23.132
2	1.330	12.087	54.575	1.330	12.087	54.575	2.375	21.591	44.723
3	1.125	10.225	64.799	1.125	10.225	64.799	2.208	20.077	64.799
4	0.733	6.666	71.465						
5	0.680	6.183	77.648						
6	0.492	4.469	82.118						
7	0.468	4.258	86.375						
8	0.436	3.960	90.336						
9	0.400	3.640	93.976						
10	0.361	3.284	97.260						
11	0.301	2.740	100.000						

5.7 EFA OF SUSTAINABILITY PERFORMANCE - RESULTS

Three factors are generated in the EFA of sustainability performances. The four variables (SP8, SP9, SP10 and SP11) included in the first factor are employee safety and health, labour relationship, training and customer satisfaction. These performances have a common feature of social value, and hence this factor is named as social sustainability performances. From Table 5.12, this factor contributes to the highest portion of variation among the total variance explained by all the factors. The four variables (SP04, SP05, SP06 and SP07) in the second factor are the reduction in environmental business wastage, reduction in emission/ unit of production, and reduction in material usage/ unit of production and reduction in energy were the performances in environmental aspects. This factor was named as Environmental sustainability performance. The three variables in third factor, are SP01, SP02 and SP03 representing a reduction in operational cost, growth in profit and market performance are related to economic performances. So, the third factor is named as economic sustainability performance.

Hence, the sustainability performances of MSMEs are grouped into three constructs such as social sustainability performances, environmental sustainability performances and economic sustainability performances. The definitions of constructs in terms that can incorporate from the sustainability principles and previously related literature are shown in Table 5.13.

Table 5.13 Sustainability Performances Constructs - Definitions

Constructs	Definition	Supporting literature
Social Sustainability Performance	Focuses on useful and fair practices to the workers, customers, local community and region in which firm do business	Wang et al., 2015; Shah and Ward, 2007; Lozano and Huishingh, 2011
Environmental Sustainability Performance	Focuses on any harm caused to the environment by addressing the use of materials, energy management and reduction of pollution and waste.	Wang et al.,2015; Azevedo et al.,2012; Martínez-Jurado and Moyano-Fuentes, 2014;
Economic sustainability performances	Focuses on short-and long-range profitability and economic viability	Wang et al., 2015; Martínez-Jurado and Moyano-Fuentes, 2014

5.8 VALIDITY AND THE RELIABILITY OF EFA

Table 5.14 gives the list of constructs with corresponding variables as given in the questionnaire. Variable codes were modified for further analysis, based on their corresponding constructs in which it was loaded, is also given in the table 5.14 against their question codes.Internal consistency reliability of all constructs can be assessed by calculating the value of Cronbach’s alpha. The Cronbach's alpha values if exceeded 0.7 is typically considered adequate (Cronbach, 1951; Nunnally. 1978) and acceptable if atleast 0.6 (Chen and Paulraj, 2004). The Table 5.14, gives the values of Cronbach's alpha of each construct with corresponding variables of LMPs and sustainability performance. Table 5.14 shows that values of all Cronbach's alphas are between 0.6 and 0.9 and are in the acceptable range, which demonstrates satisfactory internal consistency reliability of all dimensions.

Table 5.14 List of Constructs and Indicators with Question Code and New Variable Code with Cronbach's Alpha

Construct	Question Code	Variable Code	Variable	Cronbach's Alpha
Workforce Management Practices **(W)**	LMP12	W1	During problem-solving sessions, we make an effort to get all team members' opinions and ideas before making a decision	0.804
	LMP05	W2	Many equipment problems have been solving through small group sessions	
	LMP11	W3	We form teams capable to do their daily work without formal leadership.	
	LMP04	W4	Workers carry out routine maintenance on all equipments (eg: Cleaning, lubrication or small repairs) following standard procedures	
Flow Management Practices **(F)**	LMP03	F1	We focus to reduce process set up time—the time required to prepare or refit equipment, workstations etc.	0.773
	LMP14	F2	We usually complete our daily schedule as planned	
	LMP16	F3	The layout of the shop floor facilitates low inventories and fast throughput	
	LMP15	F4	We have a small amount of work-in-process inventory	
Process Management Practices **(P)**	LMP01	P1	Our plant emphasise putting all tools and fixtures in their proper place	0.752
	LMP02	P2	We use standardized and documented processes which are well instructed to our employees	
	LMP06	P3	Our plant following either preventive/predictive maintenance	
Supplier Management Practices **(S)**	LMP09	S1	We have built close, long-term relationships with our suppliers	0.731
	LMP08	S2	We can depend on time delivery of our suppliers	
	LMP10	S3	We have high levels of information transparency or information sharing with our suppliers	
Customer Management Practices **(C)**	LMP13	C1	We systematically and regularly measure customer satisfaction	0.769
	LMP19	C2	Customer needs and expectations are effectively disseminated and understood throughout the workforce	
	LMP18	C3	We have an effective process for resolving customers' complaints	

Construct	Question Code	Variable Code	Variable	Cronbach's Alpha
Economic Sustainability Performance **(ECP)**	SP01	ECP1	Low Operational cost	0.752
	SP02	ECP2	Growth in Market Value	
	SP03	ECP3	Growth in Profit	
Environmental Sustainability Performance **(ENP)**	SP04	ENP1	Reduction in Environmental Business wastage (ie Non Value added activities)	0.802
	SP05	ENP2	Reduction in Emission /unit of Production	
	SP06	ENP3	Reduction in Material Usage/ Output	
	SP07	ENP4	Reduction in Energy/ Fuel usage	
Social Sustainability Performance **(SOP)**	SP08	SOP1	Safety and Health	0.787
	SP09	SOP2	Labour relationship	
	SP10	SOP3	Training and Education	
	SP11	SOP4	Decrease in Rate of consumer complaints	

5.9 CONCLUSION

This chapter focussed on the exploratory factor analysis of the variables of Lean manufacturing practices and sustainability performance. In both cases, the KMO test and Bartlett's test for sphericity are conducted on the data to test the suitability of data to conduct factor analysis. The results of factor analysis show that LMPs can be grouped into five significant and meaningful constructs in MSMEs. These five constructs of Lean manufacturing practices are categorized as 'workforce management practices', 'flow management practices', 'process management practices', 'supplier management practices' and 'customer management practices'. These five factors explaining 66.65 percentage of the total variance explained. These findings are comparable with similar studies conducted earlier.

Similarly, factor analysis conducted shows that sustainability performances in MSMEs can be grouped into three meaningful and significant constructs. These three constructs of sustainability performances are categorised as 'economic sustainability performance', 'environmental sustainability performance', and 'social sustainability performance'. These three factors explaining 64.78 percentage of the total variance explained. These results are in line with the 3BL concept of sustainability.