3.1 Introduction

This chapter discusses the methodology for conducting research on the textile manufacturing industry in Haryana. A model structure has been developed based on the review of previous studies. The present thesis examines the performance of the textile manufacturing industry in Haryana at the micro-level. Every business's primary purpose is to optimise its performance to maximise wealth while minimising its inputs. Initially, a descriptive attempt has been made to identify the schemes and initiatives of central and state government for the textile industry. The researcher has examined and identified the benefits and shortcomings of the related schemes for the textile industry. Further, it is observed from the literature review that DEA and RTS techniques are the most appropriate measure for analysing the industrial unit's performance (Morita *et al.*, 2004; Paço and Pérez, 2013). DEA requires the unit level optimum input and output variables to analyse the performance (Darji and Dahiya, 2021). In addition to this, the literature review helped to choose the unit level input and output variables to analyse the industrial unit's operational and financial performance. The operational and financial variables' data (Profits and losses and balance sheets) for each business unit (Decision Making Unit - DMU) were collected from the Ministry of Corporate Affairs (MCA) and the prowess of CMIE's (Centre for Monitoring Indian Economies) database. The last objective of the thesis is to ascertain the major problems confronted by the textile manufacturing companies in Haryana. This may be a critical analysis for the state's textile industry since the problem acts as a virtual impediment to industrial performance. According to the existing literature, the ISM and MICMAC analyses were found to be the best models for determining the significant variable/variables (here problems) and their contextual relationships (among problems) (Panigrahi and Rao, 2018). Thus, by recognising the industry's significant/key problems and their contextual relationships, corrective measures can be taken to safeguard the industry, guiding it toward positive performance. The remainder part of this chapter is divided into 4 sections (Section 3.2 to Section 3.5).

Section 3.2 details the empirical research design of the thesis, which is divided into three sub-sections: 3.2.1 Study area; 3.2.2 Data collection sources; 3.2.2.1 Primary data collection; 3.2.2.2 Secondary data collection; 3.2.3 The Study's Sampling design. Section 3.3 concerned with the growth analysis- tool and techniques. It is divided into four sections 3.3.1 Correlation Analysis 3.3.2 Regression Analysis 3.4.3 Compound Annual Growth Rate 3.3.4 Coefficient of variation , section 3.4 presents the model structure of the Performance Analysis; This section is divided into three sub-sections; 3.4.1 shows the descriptive context of DEA efficiency measurement; 3.4.2 deals with the DEA Model with its input oriented CCR and BCC techniques; 3.4.3 explains Return to Scale analysis; 3.5. ISM and MICMAC analyses and establish the contextual association between the variables (here problems). It consists of six procedural phases, which are as follows: 3.5.1 Formulation of a matrix of structural self-interactions (SSIM); 3.5.2 Matrix of initial reachability; 3.5.3 Final Reachability Matrix; 3.5.4 Levels partition; 3.5.5 Conical Matrix; 3.5.6 The ISM and section 3.5.7 construct MICMAC analysis to establish the contextual relationships among problems.

3.2. Empirical Research Design

The present research study is exploratory cum descriptive in nature to analyse the performance of the textile manufacturing industry in Haryana. The descriptive study of schemes and initiatives for the textile industry has been undertaken to ascertain the benefits and shortcomings of these schemes to improve the performance of the textile industry in Haryana. Further, this study analyse the overall performance of the selected textile manufacturing units in Haryana and also the problems faced by them so that potential solution can be introduced timely to improve the performance of the textile industry in Haryana.

3.2.1 Area of the Study

The proposed research will be in Haryana, a northern state of India. Textile manufacturing units of Haryana state have been considered as a universe of study.

3.2.2. Sources and Instruments for Collection of data

The study will be conducted with the help of both primary and secondary data.

3.2.2.1. Collection of Primary data

The primary data has been collected, through a field survey with the help of a close-ended questionnaire on a five-point likert scale, from managerial personnel of selected textile manufacturing units in Haryana. The questionnaire has been developed under the guidance of experienced academicians and experts.

3.2.2.2. Collection of Secondary data

Secondary data has been collected through the Ministry of Corporate Affairs and Prowess database of CMIE.

3.2.3 Sampling and Variable selection

Both primary and secondary data have been systematically collected to analyse the overall performance of the textile manufacturing industry in Haryana. Initially, the five years' (2015-16 to 2019-20) secondary data (Profit & Loss and Balance sheet with their respective addresses) of all the textile manufacturing companies were collected through the website of MCA, New Delhi (India), and Prowess database of CMIE. At first, a report of 192 textile manufacturing companies including only Name, CIN (Company Identification Number) and addresses was extracted through MCA website. However, 139 of these companies have been striked-off and six were under liquidation. Hence, 145 companies have been removed from the list of 192 companies. Subsequently, complete data (Profit & Loss and Balance sheet) of the remaining 47 companies were extracted (one by one) through the MCA website. On the other hand, complete data of 35 companies (Profit & Loss and Balance sheet) was accessed through Prowess. Thus, after compiling both, 82 DMUs were left for analysis. Thereafter, outliers were removed and the final sample is left with 61 textile manufacturing companies. In the next step, major cost-effective variables; Labour (Gupta *et al*., 2019; Kumar and Arora, 2012; Kumar and Gulati, 2009; Mukherjee, 2007; Sahoo and Tone, 2009; Wu, 2016), the raw material (Leung and To, 1999; Rajeev and Mazumdar, 2009; Gambhir and Sharma, 2015b; Propa, Banwet and Goswami, 2018), operating expenses (Driessen, Lijesen and Mulder, 2006; Rajeev and Mazumdar, 2009; Ogayon, 2014; Gambhir and Sharma, 2015b, 2015a), Sales (Barros and Santos, 2006; Barros, 2004; Bhaskaran, 2013; Chandra *et al*., 1998; Joshi and Singh, 2010; Leung and To, 1999; Mani, 2007; Orzes *et al*., 2017) have been identified and selected carefully based on the available literature to analyse the operational performance of the selected textile manufacturing companies in Haryana by applying the DEA. On the other hand financial ratios; FATR, RATR, CR, DER, ROE, NPM have been calculated based on the financial data of balance sheet (Extracted from the website of MCA and Prowess) i.e. Net Sales, Total Assets, Current Assets, Current Liabilities, Total Debt, Equity, Profit after tax, Net Sales, Net sales, Non-current assets, Net Income, Shareholders equity. Afterward, the researcher applied the DEA technique to analyse the financial performance of the textile manufacturing units in Haryana.

Furthermore, 30 critical problems related to the textile/manufacturing industry were identified based on the available literature, and subsequently, 14 significant problems were shortlisted based on the respondents' average score of more than 3.5 on the five-point Likert scale. The responses of 291 senior personnel were collected from the selected 61 textile manufacturing companies. Then Interpretive ISM and MICMAC analysis has been applied to identify and analyse the contextual relationship among the above-selected problems faced by the textile manufacturing units in Haryana.

3.3 Analysis of the growth of Textile Units in Haryana

The following tools and techniques were applied to measure the growth of Textile Units in Haryana:

3.3.1 Regression Analysis

The intercept and coefficient of regression equation were calculated based on annual data of 10 years (2008-09 to 2017-18) of cotton production.

The regression equation is:

$y = -6.194 + 4.659 (x)$

Where,

-6.194 = Intercept

4.659 = Coefficient of x

y = Expected Production

x = Area of Cotton production

3.3.2. CAGR

It measures the compounded growth of any finite data over many years (Here, ten years of Haryana's textile industry data is calculated).

Formula to calculate CAGR; ((End value/First value) ^ (1/Period of study))-1

3.3.3. Coefficient of Variation (CV)

It is the multiplication of ‘Coefficient of S.D.’ by 100 that provides the percentage of the coefficient of S.D. to depict the variation percentage. It is the best measure of dispersion for comparing the homogeneity and heterogeneity of two or more distributions.

The coefficient of Standard deviation is as followed:

$$\text{Coefficient of S.D.} = \frac{SD\ of\ X}{Mean\ of\ X}$$

$$\text{Coefficient of Variation} = \frac{SD\ of\ X}{Mean\ of\ X} * 100$$

Where,

$$SD = \sqrt{\frac{\sum(\mathrm{X-mean})^2}{\mathrm{N}}}$$

3.4. Analysis of the operational and financial performance of Textile Units in Haryana

3.4.1. Background of DEA efficiency measurement

DEA is one of the non-parametric management science techniques to measure the relative technical efficiency by using various models and most appropriate input & output variables of a homogeneous group of companies (Charnes *et al*., 1978). DEA was initially proposed by Charnes *et al*. (1978). To measure the efficiency of DMUs, he developed a mathematical technique which was based on linear programming. The optimization method of mathematical programming is used in CCR to generalize single-output/input technical-efficiency measure of Farrell (1957) to the multiple-outputs/multiple-inputs case used by Charnes *et al*. (1994) by constructing a single "virtual" output to a single "virtual" input relative efficiency measure. The relative Technical Efficiency of any DMU is measured by framing the ratios of a weighted sum of outputs to the weighted sum of inputs. Weights of inputs and outputs are measured in a way that computes the Pareto efficiency measure of each DMU and no DMU has a score greater than unity (one) (Charnes *et al*., 1994). Further efficiency of each DMU is measured which shows the distance between the production frontier and relative efficiency of DMUs.

3.4.2 DEA: CCR and BCC Model

The input oriented models CCR and BCC have been used in the present study. These models were proposed by Charnes, Cooper, and Rhodes in 1978 and by Banker, Charnes, and Cooper in 1984. The CCR and BCC models help to obtain a scalar measure of OTE and PTE.

Linear Programming Problem (LPP) for Input-oriented CCR model as follows:

$$TE_k = Minimize\theta_k$$

$$Subjectto: \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta_k x_{ik}$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} \geq y_{rk}$$

$$\lambda_j \geq 0$$

LPP for BCC model as

$TE_k = Minimize\theta_k$

$$Subjectto: \sum_{j=1}^{n} \lambda_j x_{ij} \leq \theta_k x_{ik}$$

$$\sum_{j=1}^{N} \lambda_j y_{rj} \geq y_{rk}$$

$$\lambda_j \geq 0$$

$$\sum_{j=1}^{n} \lambda_j = 1$$

Here:

λ is a $(n \times 1)$ column vector.

$\theta$is a scalar and is the efficiency score of DMU ki.e. the Overall Technical Efficiency (OTE) based on CRS assumption.

$i = 1,2, \ldots\ldots, m$ represent the inputs.

$r = 1,2, \ldots\ldots, s$ represents the outputs.

$j = 1,2, \ldots\ldots, n$ represents the companies.

x_{ij} = amount of input i used by DMU j.

y_{rj} = amount of output r produced by DMUj.

In the Input-oriented BCC model, one additional constraint is added given as follows:

$$\sum_{j\in 1}^{n} \lambda_j = 1$$

Where,

$$\sum_{j=1}^{n} \lambda_j = 1 = \lambda_{1+}\lambda_{2+\dots} + \lambda_n$$

The LPP using one additional constraint given above provides us with the measure of Pure Technical Efficiency (PTE), which is based on the VRS assumption. PTE is also called managerial efficiency.

From the above, a measure of scale efficiency (SE) as a ratio of OTE to PTE is given as:

$$SE = {}^{OTE}/_{PTE}$$

The firms getting OTE =1 are called as 'globally technical efficient' and firms obtaining PTE=1 but OTE ≠1 is called 'locally technical efficient'. The results of BCC model give us PTE measures that are without of scale effect. The inefficiency reflected through PTE scores is attributed to poor management of resources or managerial sub-performance.

3.4.3 Return to Scale (RTS)

RTS analysis can be calculated by obtaining the total of Lambda values of different DMUs based on the OTE scores. If $\sum \lambda$=1, it means the DMU is operating at Constant Return to Scale (CRS), in case of $\sum \lambda$>1 then DMU is operating at the Decreasing return to Scale (DRS) and when $\sum \lambda$<1 then DMU is operating at the Increasing Return to Scale (IRS). In DRS and IRS, a DMU is operating at a sub-optimal level and there is a need to minimise or maximise the inputs to get the Most Productive Scale Size whereas in CRS a DMU is operating at the optimal level and there is no need to improve in inputs size or process.

The conditions of RTS (Chandra *et al*., 1998) are:

If $\sum_{j=1}^{n} \lambda_j * = 1$ DMU is operating at CRS.

If $\sum_{j=1}^{n} \lambda_j * > 1$ DMU is operating at DRS.

If $\sum_{j=1}^{n} \lambda_j * < 1$ DMU is operating at IRS.

3.5. Analysis of the problems faced by Textile Units in Haryana

The present thesis is using ISM and MICMAC techniques to study the problems faced by Textile units in Haryana. Warfield, (1974) was the first to propose the technique of ISM. Numerous researchers have applied this method for the decision-making in different industries and the analysis of relationship complexity. The ISM process makes judgments based on the opinions of experts from business and academics, using a brainstorming technique to construct a contextual relationship between the components (barriers) (Panigrahi and Rao, 2018; Phogat and Gupta, 2018). So, the team of eight experts was engaged to ascertain the contextual linkages between barriers in this study. ISM has been widely applied across the globe in a variety of contexts, including textile entrepreneurial inclination models (Kapse *et al*., 2018), apparel retailing strength factors (Singh and Samuel, 2018), manufacturing enterprises toward implementing sustainability (Garbie, 2017), additive manufacturing for mass customisation and barriers (Shukla *et al*., 2018), lean green implementation challenges (Thanki and Thakkar, 2018), supply chain management (Movahedipour *et al*., 2017) and CSR in manufacturing industry (Bux *et al*., 2019). The technique is also used in the current investigation to ascertain the link between different problems in some extant. The following are steps of ISM and MICMAC analysis:

3.5.1 Development of structural self-interaction matrix (SSIM)

3.5.2 Initial reachability matrix

3.5.3 Final reachability matrix

3.5.4 Level partitions

3.5.5 Conical Matrix

3.5.6 The ISM

3.5.7 MICMAC analysis

These above mentioned steps of ISM and MICMAC analysis are described in detail in chapter 8 of the thesis while framing the model fit.