8.1 Introduction

Manufacturing is a fast-paced and ever-changing industry that has encountered numerous problems and challenges (Garbie, 2017) while establishing its performance, especially in emerging countries like India. The manufacturing industry has seen a tremendous change from the first industrial revolution to today's competitive environment. Since its inception, this industry has grown in all aspects, gaining technological breakthroughs along the way (Jain and Ajmera, 2020; Sanders *et al*., 2016). Subsequently, industrial revolution; Industry 5.0 is expected to be driven mostly by the use of robotics theory in the manufacturing context, which have a significant effect on the overall performance of the industry (Maddikunta,Pham, Prabadevi, Deepa, Dev, Gadekallu, Ruby and Liyanage, 2021). In comparison to 4.0, the goal of Industry 5.0 is to harness the human expert's creativity in combination with intelligent, efficient, and precise machinery solutions that are both resource-efficient and user-preferred (Sherburne, 2020). The technologies that support Industry 5.0, include digital twins, edge computing, collaborative robots, blockchain, and 6G etc. (Maddikunta *et al*., 2021; Sherburne, 2020). Textile manufacturing is a process and skill-based industry and is connected majorly with the operations management of the company. An unparalleled supply of raw material and production capabilities make India's textile sector the largest in the world (Garbie, 2017; IBEF, 2020). In 2019-20, after China, India is the second-largest manufacturer and exporter in the world and this sector accounted for 12 percent of India's export revenue. The country's textile industry employs over 4.5 million people, including 35.22 million handloom workers accounted for 2.3 percent of India's GDP. Five percent of the world's textile and clothing trade is accounted for by the country (IBEF, 2021). Textile companies in India, unlike those in developed countries, are not entirely mechanised and are still quite labour-intensive. Additionally, political environment and infrastructure bottlenecks are also disturbing the industry's capability (Annual Report, MoT, 2018-19). The policy formulation, development, regulation and export promotion of the textile sector in India comes under the ministry of textile (Annual Report, MoT, 2017-18)**.**

Haryana, previously agriculture based state, has transformed into a well-established industrial state in the contemporary age. HSIIDC is the leading industrial promotion agency in the state. It is responsible for ensuring that entrepreneurs investing in the state have access to reliable and efficient infrastructure. HSIIDC has built several industrial estates, industrial model townships, and specialized parks to facilitate the growth of industrial clusters. The state had seven export-oriented SEZs as of October 2020. The government of Haryana is creating, sector-specific, subsidies and theme park beside the Kundli-Manesar-Palwal expressway. The state government has earmarked Rs. 330 crore (US$ 45.56 million) for industries and the commerce department in its Budget 2021-22 (Haryana Textile Policy 2019). Although Haryana's textile industry has an excellent infrastructure (Darji and Dahiya, 2021), it faces several challenges every day to deal with the international environment (Medina *et al*., 2019; Raut, Gardas and Narkhede, 2019). This is because to attain the optimised and pioneering products in a price-driven market, including a scarcity of qualified workers, a dearth of research and development, the treatment of hazardous waste and materials, and a lack of financial and technological resources. In Haryana, districts including Faridabad Panipat, Hisar, Gurugram, and Sonepat have transformed into strong textiles centre. Haryana is one of the major exporters of readymade cotton garments. Although, a wide range of textiles are produced, including hand-spun and hand-woven goods and capital-intensive mills that use advanced machinery while on the other hand manual work, lack of organisation in the weaving sector, and uneven regional development are hampering the industry's ability. Additionally, state and central governments impose changes such as tax structure, interest rates, labour pay, and salaries which cause barriers for the industry. An organisation's ability to produce high-quality products at lower prices depends on its employees, processes, and products being continually improved (Digalwar *et al.*, 2017).

The proposed ISM model and MICMAC analysis help the policy makers in improving the performance of the textile industry in Haryana by reviewing the policies keeping the leading barriers in mind.

Table 8.1: related articles published on different databases are summarized below in the table

S.N.	Author	Year	Country	Techniques	Area	Publisher
1	Medina, *et al.*	2017	Spain	DEA	Textile company's Innovation	Wiley Online library
2	Kapse, *et al.*	2018	India	ISM	Textile entrepreneurial inclination	Tailor & Francis
3	Lu	2014	USA	CGE by GTAP	US Japan’s textile industry	Tailor & Francis
4	Truett and Truett	2016	Spain	TCF	Spanish Textile Industry	Tailor & Francis
5	Singh and Samuel	2018	India	ISM	Apparel Retailing	Emerald
6	Ananthanarayanan, *et al.*	2018	Fiji	ISM MCDA	Fiji manufacturing industry	John wiley and sons
7	Garbie	2017	Countries	ISM	Manufacturing enterprises	Emerald
8	Shukla, *et al.*	2018	World	ISM	Additive manufacturing	Tailor & Francis
9	Kaur, *et al.*	2017	Canada	DEMATEL	Green-supply chain management	Tailor & Francis
10	Thanki and Thakkar	2018	India	ISM and IRP	Lean green implementation challenges	Emerald
11	Azevedo and Cruz-Machado	2013	Portugal	ISM	Automotive supply Chain	Emerald
12	Movahedipour, *et al.*	2016	Iran	ISM	Supply chain management	Emerald
13	Bux, *et al.*	2019	Pakistan	Delphi &ISM	CSR in the Manufacturing industry	John wiley and sons
14	Ali, *et al.*	2018	World	ISM	Software outsourcing	John wiley and sons
15	Kaur, *et al.*	2019	India	Pareto Analysis	Green-supply chain management problems	Tailor & Francis
16	DeSanctis, *et al.*	2018	Spain	CFA	Moderating corporate problems	Tailor & Francis

As evidenced by the previous literature analysis, there is a lot of research is accessible in the Textile & Apparel sector that employs a variety of approaches and spans multiple economies. However, the researcher was unable to find any study that addresses problems specific to the textile industry in Haryana, India's northernmost state. The reason for selecting Haryana is that India is a country with diverse culture and significant divisions based on geography, religions, races, traditions, and values. Thus, it appears to be more appropriate to focus on a specific region of India (Haryana) rather than on the country as a whole, which may provide more relevant results because problems vary by region, even within countries such as India as mentioned in the introduction chapter of this thesis.

The following is the structure of this chapter: Section 2 describes the study's research methods. Section 3 is a detailed explanation of the most significant obstacles. Section 4 contains the findings of this study, as well as a discussion part and section 5 concludes the chapter.

8.2. Methodological Framework

8.2.1 Variable (Problems) selection and Data collection

To begin, a thorough assessment of the existing literature was done to identify the most significant problems being faced by textile manufacturing companies. After that, a final version of 30 key problems was compiled as mentioned below in Table 8.2 using the available research.

Following that, a questionnaire (Appendix) was prepared for the data collection of the data on these barriers by the use of five-point Likert scale and to determine the severity of each problem. To reply to this questionnaire, requires highly qualified or experienced personnel. Thus, the respondents to the survey were the company's managerial personnel. The physical addresses of all 61 selected firms were accessed via both Prowess and the Ministry of Corporate Affairs.

Table 8.2: The Problems faced by textile manufacturing companies

Sr. N.	Problems	Researchers
1	The problem in optimization of fibre mixture selection (P1)	Banwet and Majumdar, (2014)
2	The problem of sorting techniques (like rotor spinning) and fibre separation processes	Muthu, (2017)
3	Improper design and optimization of fibre mixtures in cotton mills	Harpa, (2008)
4	Inaccurate Demand Forecasting	Kaur,Sidhu, Awasthi and Srivastava, (2019)
5	Obsolete plant & machinery selection	Muthu, (2017),
6	Non Availability/lack of skilled labour (P3)	Narayanan *et al*., 2019; Panigrahi and Rao, 2018; Thanki and Thakkar, 2018
7	Lack of raw material (P4)	Kaur *et al*., 2019; Singh and Samuel, 2018; Thanki and Thakkar, 2018
8	Lack of technological innovation, and new processes (P5)	Kaur *et al*., 2019; Majumdar and Sinha, 2018; Yang and Zhang, 2017
9	Insufficient attention on research and development (P6)	(Panigrahi and Rao, 2018; Rahman *et al*., 2020)
10	Lack of technical expertise	(Kaur *et al*., 2019; Khaba and Bhar, 2018; Panigrahi and Rao, 2018; Rahman *et al*., 2020; Yang and Zhang, 2017)
11	Lack of quality control	(Digalwar et al., 2017; A. Kumar et al., 2020)
12	High cost for disposing of hazardous wastes/waste minimization (P10)	(Kaur *et al*., 2019; Panigrahi and Rao, 2018)
13	Problem of design to reuse/recycle the product	(Garbie, 2017; Kaur et al., 2019; Muthu, 2017; A. E. Narayanan et al., 2019; T. Rahman et al., 2020)
14	The problem of production/ manufacturing in Eco-friendly apparel	Raut, *et al*., 2019; Kaur, *et al*., 2019; Muthu, 2017
15	Lack of employee training, capacity building, and development (P2)	Narayanan, *et al*., 2018; Thanki and Thakkar, 2018; Ananthanarayanan, *et al*., 2019; Kaur, *et al*., 2019; DeSanctis, *et al*., 2018
16	Problems in maintaining an appropriate level of inventory (P7)	(Azevedo *et al*., 2013)
17	Transportation barriers (P8)	(A. Kumar et al., 2020; Y. K. Sharma et al., 2019)
18	Lack of health and safety measures	(Digalwar *et al*., 2017; Panigrahi and Rao, 2018)

19	Lack of inter-departments cooperation	(Khaba and Bhar, 2018; Yang and Zhang, 2017)
20	Lack of top managerial performance and commitment (P9)	Narayanan, *et al*., 2018; Thanki and Thakkar, 2018; Majumdar and Sinha, 2018; Bux, *et al*., 2020
21	Resistance to change	Yang and Zhang, 2016; Khaba and Bhar, 2017; Kant, 2015; Bux, *et al*., 2020; Kapse, *et al*., 2018
22	Inadequate return on the investment	Panigrahi and Rao, 2018; Majumdar and Sinha, 2018; Garbie, 2017; Kaur, *et al*., 2019
23	Absence of financial planning (P11)	Thanki and Thakkar, 2018; Kant, 2015
24	Obstacle to bank finance	Yang and Zhang, 2016; Khaba and Bhar, 2017; Kaur, *et al*., 2019; Rahman, *et al*., 2019
25	Poor human resource planning (P12)	(Bux *et al*., 2019; Desanctis *et al*., 2018; Thanki and Thakkar, 2018)
26	Market competition and uncertainty (P13)	(Ananthanarayanan *et al*., 2019; Kaur *et al*., 2019; Kumar *et al*., 2020; Majumdar and Sinha, 2018)
27	Poor customer responsiveness	Digalwar, *et al*., 2017
28	Restrictive policies of the company towards product/process stewardship	Kaur, *et al*., 2019; Rahman, *et al*., 2019
29	Lack of supportive government policies	Yang and Zhang, 2016; Majumdar and Sinha, 2018; Narayanan, Sridharan and Kumar, 2018; Thanki and Thakkar, 2018; Kumar, *et al*., 2020
30	Political barriers (P14)	Bux, *et al*., 2020; Kaur, *et al*., 2019

Thus, the primary data was collected via physical visits to branches and face-to-face interaction. The questionnaire was dispersed to 412 stakeholders (top managerial personnel) from these companies. In total, 326 individuals in various roles responded to the questionnaire. These 326 respondents were asked to rate the observed 30 problems on the five-point Likert scale (1 to 5), with 1 being the lightest barrier and 5 representing the strongest barrier in textile manufacturing companies in Haryana. After validating the data, only 291 valid replies were retained for the study's final sample. Then, a panel of eight specialists was constituted for this research; five from textile manufacturing companies and three from academia. They advised that obstacles with an average value of 3.5 or greater be investigated for further analysis.

Table 8.3: Descriptive statistics of selected problems

Sr. N.	Problems	Average	S.D.	Minimum	Maximum
1	Problem in optimization of fiber mixture selection	**3.98**	0.96	1	5
2	Problem of sorting techniques (like rotor spinning) and fiber separation processes	2.14	1.22	1	5
3	Improper design and optimization of fiber mixtures in cotton mills	3.43	1.14	1	5
4	Inaccurate Demand Forecasting	2.18	1.22	1	5
5	Obsolete plant & machinery selection	3.39	1.33	1	5
6	Non Availability/lack of skilled labour	**3.8**	1.23	1	5
7	Lack of raw material	**3.76**	1.22	1	5
8	Lack of technological innovation, and new processes	**3.84**	1.19	1	5
9	Insufficient attention on research and development	**4.07**	0.94	1	5
10	Lack of technical expertise	3.31	1.35	1	5
11	Lack of quality control	3.21	1.38	1	5
12	High cost for disposing of hazardous wastes/waste minimization	**3.59**	1.22	1	5
13	Problem of design to reuse/recycle the product	2.45	1.29	1	5
14	Problem of production/ manufacturing in Eco-friendly apparel	2.13	1.18	1	5
15	Lack of employee training, capacity building and development	**3.66**	1.21	1	5
16	Problems in maintaining appropriate level of inventory	**3.88**	1.15	1	5
17	Transportation barriers	**3.78**	1.17	1	5
18	Lack of health and safety measures	2.59	1.39	1	5
19	Lack of inter-departments cooperation	2.69	1.38	1	5

20	Lack of top managerial performance and commitment	**3.66**	1.29	1	5
21	Resistance to change	2.63	1.36	1	5
22	Inadequate return on the investment	3.19	1.42	1	5
23	Absence of financial planning	**3.75**	1.25	1	5
24	Obstacle to bank finance	3.35	1.36	1	5
25	Poor human resource planning	**3.84**	1.22	1	5
26	Market competition and uncertainty	**3.77**	1.21	1	5
27	Poor customer responsiveness	2.2	1.04	1	5
28	Restrictive policies of the company towards product/process stewardship	2.6	1.39	1	5
29	Lack of supportive government policies	2.5	1.39	1	5
30	Political barriers	**3.8**	1.21	1	5

There were 14 key problems out of 30 that matched this requirement, denoted by the symbols P1, P2, P3....P14 (Table 8.4), while the remaining 16 that earned a score of less than 3.5 were omitted from the study. Then, the ISM model and MICMAC analysis were used.

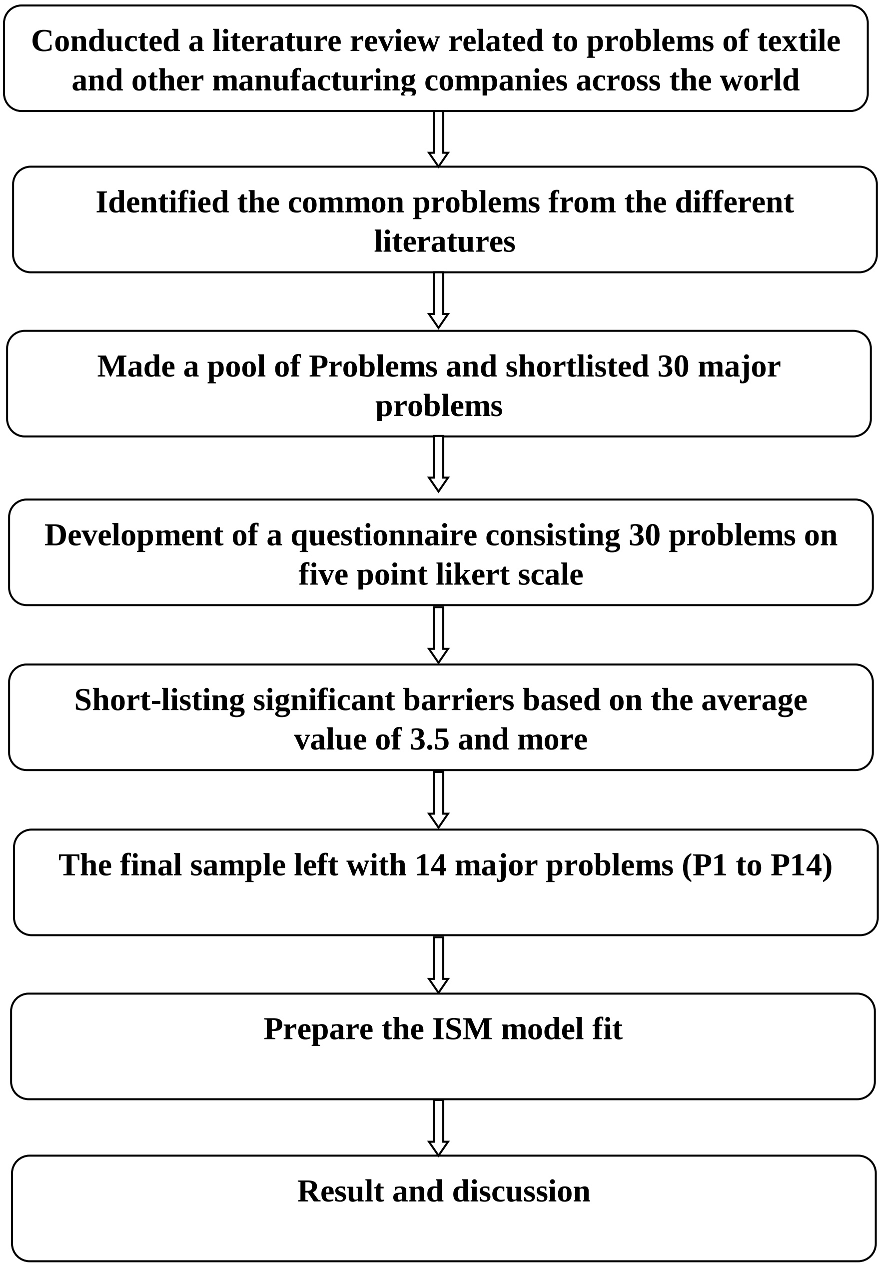
Table 8.4: Final sample of selected problems/barriers

Sr. N.	Problems Final	Problem's indicator
1	Problem in optimization of fibre mixture selection	P1
2	Lack of employee training, capacity building and development	P2
3	Non Availability/lack of skilled labour	P3
4	Lack of raw material	P4
5	Lack of technological innovation, and new processes	P5
6	Insufficient attention on research and development	P6
7	Problems in maintaining appropriate level of inventory	P7
8	Transportation barriers	P8
9	Lack of top managerial performance and commitment	P9
10	High cost for disposing of hazardous wastes/waste minimization	P10
11	Absence of financial planning	P11
12	Poor human resource planning	P12
13	Market competition and uncertainty	P13
14	Political barriers	P14

8.2.2 Interpretive structural modeling (ISM)

Warfield (1974) was the first to propose the technique of interpretive structural modelling (ISM). Numerous researchers have applied this technique to the industrial decision-making process and in the analysis of relationship complexity as discussed in the Research Methodology chapter of this thesis. Therefore, this technique has been used in the current thesis also to ascertain the link between different problems to some extent. The methodological procedure of current chapter is depicted in Figure 8.1.

Figure 8.1: Methodological framework of the study



8.3. The Model fit

8.3.1 Development of structural self-interaction matrix (SSIM).

The ISM model proposes the use of selected eight experts' judgments based on a variety of management approaches, such as group discussion, brain storming, and nominal procedure, to develop contextual relationships among the fourteen barriers in SSIM.

Table 8.5: Structural self-instructional matrix (SSIM)

Problems	P14	P13	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P 1
P1	O	O	O	O	O	A	O	O	A	A	O	A	A	X
P2	O	V	X	X	O	X	O	V	X	X	O	V	X	1
P3	A	X	O	A	O	O	O	O	A	O	O	X	0	
P4	A	X	O	A	O	O	A	V	A	O	X			
P5	O	V	A	A	V	X	O	V	A	X				
P6	O	V	A	A	V	X	V	V	X					
P7	O	O	A	A	O	A	A	X						
P8	A	X	A	A	O	X	X							
P9	O	V	X	X	V	X								
P10	A	O	O	O	X									
P11	O	V	X	X										
P12	O	V	X											
P13	A	X												
P14	X													

The contextual relationship has been established amongst the fourteen identified barriers using symbol V, A, X, O with the help of selected panel of eight experts using critical brainstorming and consultation. The subsequent part will use the following symbols in SSIM (Table 8.5).

V: Problem i leads problem j;

A: Problem j leads Problem i;

X: Problem i and j both leads each other; and

O: Problem i and j are not related to each other.

8.3.2 Initial reachability matrix

The initial reachability matrix was constructed by converting SSIM into a binary matrix through substituting V, A, X, and O with 0 and 1.

Table 8.6: Initial Reachability Matrix

Problems	P14	P13	P12	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1
P1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
P2	0	1	1	1	0	1	0	1	1	1	0	1	1	
P3	0	1	0	0	0	0	0	0	0	0	0	1		
P4	0	1	0	0	0	0	0	1	0	0	1			
P5	0	1	0	0	1	1	0	1	0	1				
P6	0	1	0	0	1	1	1	1	1					
P7	0	0	0	0	0	0	0	1						
P8	0	1	0	0	0	1	1							
P9	0	1	1	1	1	1								
P10	0	0	0	0	1									
P11	0	1	1	1										
P12	0	1	1											
P13	0	1												
P14	1													

Initial reachability rules are stated in table 8.6:

1. If an entry in the position (i, j) of the SSIM is V, then position (i, j) entry becomes 1 and position (j, i) entry becomes 0 in the initial reachability matrix;
2. If an entry in the position (i, j) of the SSIM is A, then position (i, j) entry becomes 0 and position (j, i) entry becomes 1 in the initial reachability matrix;
3. If an entry in the position (i, j) of the SSIM is X, then position (i, j) entry becomes 1 and position (j, i) entry also becomes 1 in the initial reachability matrix;
4. If an entry in the position (i, j) of the SSIM is O, then position (i, j) entry becomes 0 and position (j, i) entry also becomes 0 in the initial reachability matrix.

8.3.3 Final reachability matrix

The transitivity rule has been incorporated in the final reachability matrix to close the gap created by the responses acquired throughout the SSIM's creation.

Table 8.7: Final reachability matrix

Problems	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14
P1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
P2	1	1	1	1*	1	1	1	1*	1	1*	1	1	1	0
P3	1	0	1	1*	0	0	0	1*	0	0	0	0	1	0
P4	0	0	1*	1	0	0	1	1*	0	0	0	0	1	0
P5	1	1	1*	1*	1	1*	1	1*	1	1	1*	1*	1	0
P6	1	1	1	1	1	1	1	1	1	1	1*	1*	1	0
P7	0	0	0	0	0	0	1	0	0	0	0	0	0	0
P8	1*	1*	1*	1	1*	1*	1	1	1	1*	1*	1*	1	0
P9	1	1	1*	1*	1	1	1	1	1	1	1	1	1	0
P10	0	0	0	0	0	0	0	0	0	1	0	0	0	0
P11	1*	1	1	1	1	1	1	1	1	1*	1	1	1	0
P12	1*	1	1*	1*	1	1	1	1	1	1*	1	1	1	0
P13	1*	0	1	1	0	0	1*	1	1*	0	0	0	1	0
P14	1*	0	1	1	0	0	1*	1	1*	1	0	0	1	1

The transitivity is the basic assumption of ISM and maintained for the conceptual consistency (Dubey,Sushil and Singh, 2015). The transitivity rule defines, if "X" is related to "Y" and "Y" related to "Z", then ultimately "X" related to "Z" and X-Z entry in the matrix table renewed to '1' instead of '0' (Majumdar and Sinha, 2018; Thanki and Thakkar, 2018); the resultant matrix is named as the final reachability matrix is shown in Table 8.7.

8.4. Results and Discussion

8.4.1 Level partitions

The final reachability matrix has been used to identify the reachability set and antecedent set. The reachability set includes both the element itself and other elements it may affect, the antecedent set includes both the element itself and any other elements that may influence it. Additionally, the intersection of all the sets of reachability and antecedent is determined for all the elements, and their levels are assigned.

Table 8.8: Level partitions in 4 Iterations

Iteration 1

Barriers/ Problems	Reachability	Antecedent	Intersection	Level
P1	1	1,2,3,5,6,8,9,11,12,13,14	1	1
P2	1,2,3,4,5,6,7,8,9,10, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P3	1,3,4,8,13	2,3,4,5,6,8,9,11,12,13,14	3,4,8,13	
P4	3,4,7,8,13	2,3,4,5,6,8,9,11,12,13,14	3,4,8,13	
P5	1,2,3,4,5,6,7,8,9,10, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P6	1,2,3,4,5,6,7,8,9,10, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P7	7	2,4,5,6,7,8,9,11,12,13,14	7	1
P8	1,2,3,4,5,6,7,8,9,10, 11,12,13	2,3,4,5,6,8,9,11,12,13,14	2,3,4,5,6,8,9,11,12,13	
P9	1,2,3,4,5,6,7,8,9,10, 11,12,13	2,5,6,8,9,11,12,13,14	2,5,6,8,9,11,12,13	
P10	10	2,5,6,8,9,10,11,12,14	10	1
P11	1,2,3,4,5,6,7,8,9,10, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P12	1,2,3,4,5,6,7,8,9,10, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P13	1,3,4,7,8,9,13	2,3,4,5,6,8,9,11,12,13,14	3,4,8,9,13	
P14	1,3,4,7,8,9,10, 13,14	14	14	

Iteration2

Barriers/Problems	Reachability	Antecedent	Intersection	Level
P2	2,3,4,5,6,8,9,11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P3	3,4,8,13	2,3,4,5,6,8,9,11,12,13,14	3,4,8,13	2
P4	3,4,8,13	2,3,4,5,6,8,9,11,12,13,14	3,4,8,13	2
P5	2,3,4,5,6,8,9, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P6	2,3,4,5,6,8,9, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P8	2,3,4,5,6,8,9, 11,12,13	2,3,4,5,6,8,9,11,12,13,14	2,3,4,5,6,8,9,11,12,13	2
P9	2,3,4,5,6,8,9, 11,12,13	2,5,6,8,9,11,12,13,14	2,5,6,8,9,11,12,13	
P11	2,3,4,5,6,8,9, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P12	2,3,4,5,6,8,9, 11,12,13	2,5,6,8,9,11,12	2,5,6,8,9,11,12	
P13	3,4,8,9,13	2,3,4,5,6,8,9,11,12,13,14	3,4,8,9,13	2
P14	3,4,8,9, 13,14	14	14	

Iteration 3

Barriers/Problems	Reachability	Antecedent	Intersection	Level
P2	2,5,6,9,11,12,	2,5,6,9,11,12	2,5,6,9,11,12	3
P5	2,5,6,9, 11,12	2,5,6,9,11,12	2,5,6,9,11,12	3
P6	2,5,6,9, 11,12,	2,5,6,9,11,12	2,5,6,9,11,12	3
P9	2,5,6,9, 11,12	2,5,6,9,11,12,14	2,5,6,9,11,12,	3
P11	2,5,6,9, 11,12	2,5,6,9,11,12	2,5,6,9,11,12	3
P12	2,5,6,9, 11,12	2,5,6,9,11,12	2,5,6,9,11,12	3
P14	9, 14	14	14	

Iteration 4

Barriers/Problems	Reachability	Antecedent	Intersection	Level
P14	14	14	14	4

When an element's intersection sets and reachability are identical, the element is given the highest level in the ISM model. After determining the top-level element, it is deleted and the same technique is used to determine the elements for the subsequent level. This procedure is repeated until each element's level is established. The levels produce a digraph, that is then transformed in the ISM model. Table 8.9 shows the different levels and figure 8.2 shows the ISM. The procedure of level identification of problems was done in four iterations provided in Table 8.8, it indicates that the political barrier occupies the fourth level, and so, will be placed at the last step of the ISM presented in Figure 8.2.

Table 8.9: Final list of Level partition

The final list of level partition		
Levels/ Iterations	**Problem Code**	**Problem**
1	P1, P7, P10	Problem in optimization of fibre mixture selection, Problems in maintaining appropriate level of inventory, High cost for disposing of hazardous wastes/waste minimization
2	P3, P4, P8, P13	Non Availability/lack of skilled labour, Lack of raw material, Transportation barriers, Market competition and uncertainty
3	P2,P5,P6,P9,P11,P12	Lack of employee training, capacity building and development, Lack of technological innovation, and new processes, Insufficient attention on research and development, Lack of top managerial performance and commitment, Absence of financial planning, Poor human resource planning
4	P14	Political barriers

8.4.2 Conical matrix

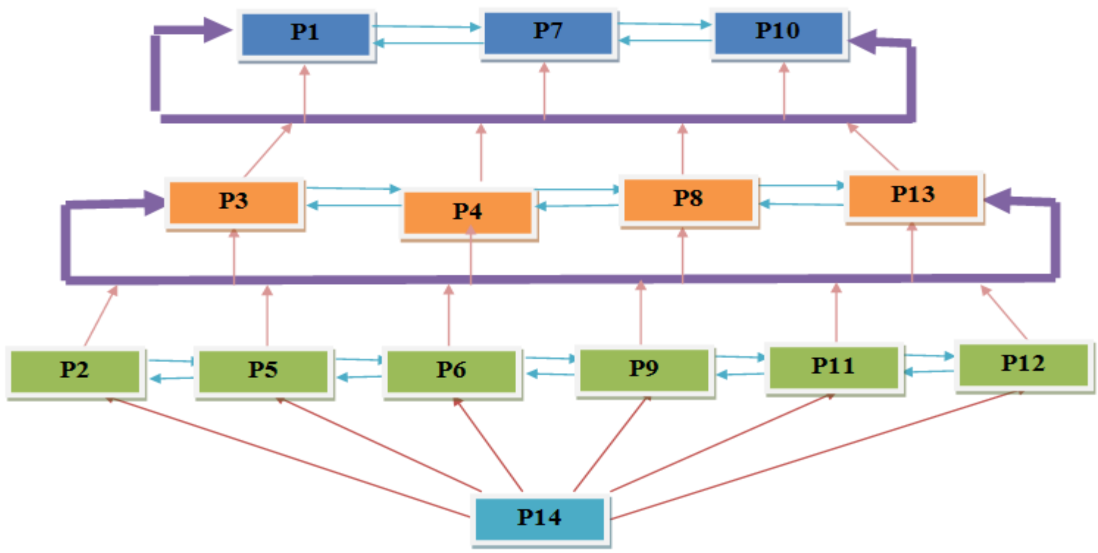
Table 8.10: Conical Matrix

Problems	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	Driving Power
P1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	**1**
P7	0	0	0	0	0	0	1	0	0	0	0	0	0	0	**1**
P10	0	0	0	0	0	0	0	0	0	1	0	0	0	0	**1**
P3	1	0	1	1	0	0	0	1	0	0	0	0	1	0	**5**
P4	0	0	1	1	0	0	1	1	0	0	0	0	1	0	**5**
P13	1	0	1	1	0	0	1	1	1	0	0	0	1	0	**7**
P14	1	0	1	1	0	0	1	1	1	1	0	0	1	1	**9**
P2	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**13**
P5	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**13**
P6	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**13**
P8	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**13**
P9	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**13**
P11	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**13**
P12	1	1	1	1	1	1	1	1	1	1	1	1	1	0	**13**
Dependence power	**11**	**7**	**11**	**11**	**7**	**7**	**11**	**11**	**9**	**9**	**7**	**7**	**11**	**1**	**120/120**

Table 8.10 shows how to make a conical matrix by placing the maximum digit 1 below the diagonal and zero above the diagonal. The entire value of each attribute's dependent power is presented in the last row, while the total driving power is shown in the last column of Table 8.10 (conical matrix). In the MIC-MAC analysis, these values will be employed.

8.4.3 The ISM

Figure 8.2: The ISM Model



8.5 MICMAC analysis (Matrice d'Impacts croises-multiplication appliqu¨e an classment)

The goal of the MICMAC analysis is to distinguish items (barriers) on the basis of their driving and dependence power. MICMAC is a cross-impact matrix multiplication method for classification that makes use of matrices' multiplication properties (Panigrahi and Rao, 2018; Phogat and Gupta, 2018). It's a graphical approach of categorising items (problems) in four groups: linkage, autonomous, independent, and dependent. This is done to explore the system's key problems in several areas. Problems have been split into four groups on the basis of dependence and driving power in this scenario (Digalwar *et al.*, 2017; Thanki and Thakkar, 2018):

(1) Autonomous problems: These are the elements with a low driving power and a low dependency power. They remain cut off from the system, with which they have just a few tenuous ties. These elements (here problems) are situated in Quadrant 1 (Q1).

(2) Dependent problems: These are the problems which have a low driving power but a high dependent power, and they are placed in Quadrant 2 (Q2).

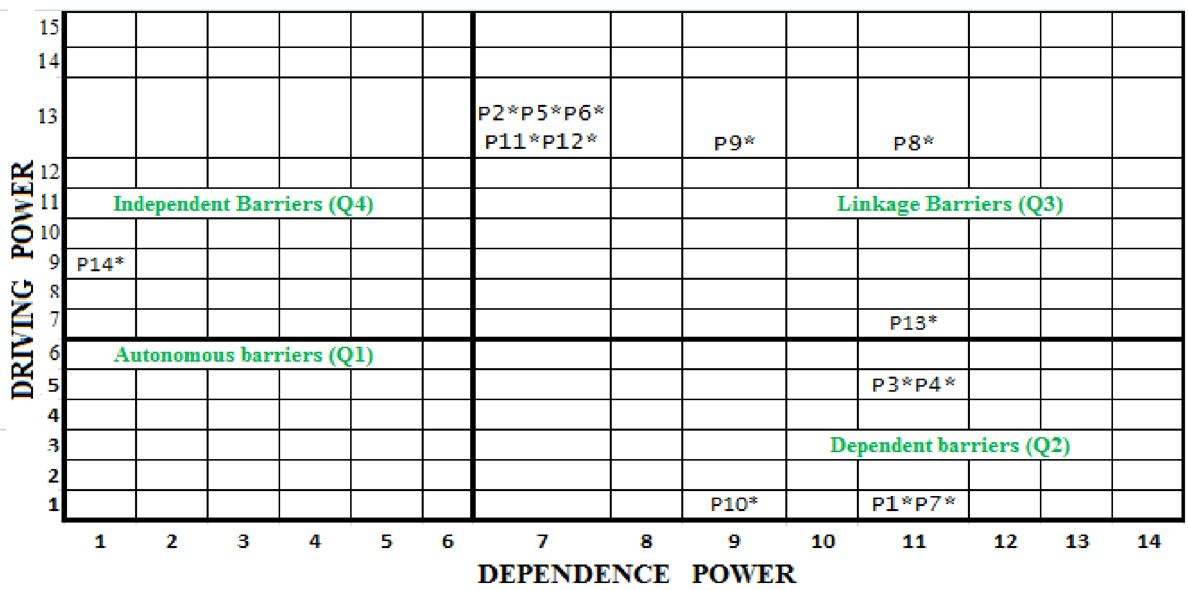
(3) Linkage problems: They are the problems that have a high driving power and a high dependence power and these are placed in Quadrant 3 (Q3). These are, however, not stable, and their actions do not have any bearing on the other elements. Additionally, it has a feedback impact on them.

(4) Independent problems: These are the problems that have a high driving power but a low dependent power. These can be found in Quadrant 4 (Q4). When an element possesses a high driving power, it is referred to as a critical element and belongs to the independent or linkage cluster. Table 8.10 summarises the driving and dependence powers of each of these barriers. Figure 8.3 illustrates the relationship between driving power and dependency power.

Q1: Autonomous barriers – Nil; Q2: Dependence barriers – P1, P3, P4, P7, P10

Q3: Linkage barriers – P2, P5, P6, P8, P9, P11, P12, P13; Q4: Independent barriers – P14

Figure 8.3: Relationship between driving and dependence power



The aim of this section is to study the contextual association among the problems affecting textile manufacturing units in Haryana. Figures 8.2 and 8.3 illustrate the study's findings visually. The ISM for 14 barriers is summarised in Figure 8.2 at four levels. The driving and dependency power levels in the conical matrix; Table 8.10 yielded a MICMAC analysis that sheds light on the 14 barriers in figure 8.3.

The results of the current chapter can be interpreted in the manner:

1. There are no autonomous problems in Quadrant 1, implying that all problems considered and analysed are relevant in Haryana's textile manufacturing units.
2. Quadrant (Q2) comprises of problems which have low driving power and high dependence power. The six problems are P1,P3,P4,P7,P10; Problem in optimization of fibre mixture selection (P1), Non Availability/lack of skilled labour (P3), Lack of raw material (P4), Problems in maintaining adequate level of inventory (P7), High cost for disposing of hazardous wastes/waste reduction (P10). P1 and P7 have a dependence power of 11 and a driving power of 1, which means that firms are encountering optimization problems in fibre mixture selection and maintaining an adequate level of inventory. P10 has dependence power 7 and driving power 1 it demonstrates that the textile business in Haryana is carrying high costs of disposing the hazardous waste because it is a process industry and a huge waste is out from the companies is worth noting here. These problems (P1, P7, P10) occur at the highest level in the ISM. P4 and P3 (at level 2 in the ISM) have a dependence power of 7 and 11 respectively and driving power of 5 for each, indicating that raw material and skilled labour concerns are considerably lighter.
3. Eight barriers numbered P2, P5, P6, P8, P9, P11, P12, P13, are falling in Quadrant (Q3) which have robust dependence and driving power. P8 and P13 are in level two and the rest of the problems (P2, P5, P6, P9, P11, P12) in Q3 are in level 3. These are

highly unstable. Any action on these variables will affect the others in the system and also themselves, as they have a feedback effect on them (Panigrahi and rao, 2018).

4. P14 (at level 4), "Political problem" is a self-contained barrier located in Quadrant IV and at the bottom of the ISM hierarchy, implying that it should be given priority due to its capacity to impact other barriers. It might be considered as the major problems of the textile industry in Haryana.

8.6 Conclusion

The primary aim of this chapter is to identify and assess the significant problems confronted by Haryana's textile manufacturing industry. Thus, this study will help the stakeholders in eliminating the company's key problems which hinder the company's overall efficiency. The present study reveals fourteen major critical problems based on replies from the top management of the selected 61 companies. The contextual relationship has been established among the critical problems using the ISM technique. Also, the transitivity study was carried out to establish a more direct relationship between these problems. Three problems were identified at the top level (First), namely "issues with optimizing fibre mixture selection", "problem with maintaining an appropriate level of inventory", and "high costs associated with hazardous waste disposal/waste minimization" in the ISM, whereas "political barriers" were identified at the lowest level of the four. At the third level, six problems are interconnected and revolve around human resource management, namely employee training, capacity building, research and development, human resource management, financial difficulties, and a lack of top management commitment. The second level consists of four problems i.e. Non Availability/lack of skilled labour, Lack of raw material, Transportation barriers, Market competition and uncertainty in the ISM. Following that, MICMAC analysis discloses the problems in all four groups, namely linking, autonomous, dependent, and independent. The linking group contains the maximum number of problems (8); whereas the remaining three groups contain three distinct problems: no autonomous, five dependent, and one independent problem.

The performance of the textile industry has improved significantly during the last ten years, but it is still facing many challenges and is less compatible with the global market. After phasing out of MFA, the Indian textile industry has come up in the global market to compete with Bangladesh, Vietnam, and Cambodia. The present thesis demonstrates the performance of Haryana’s textile industry (a north Indian state). The basic infrastructural facilities are much stronger in the state and it is also a leading cotton producer state in India (Haryana Textile Policy, 2019). Cotton is the primary raw material for producing 'fibre' that is further used for making clothes in textile companies. It has been a 78% increase in cotton production in Haryana, from 14 lakh bales in 2008-09 to 25 lakh bales (provisional) in 2017-18, which was 35% of the entire north Indian cotton production (MoT, 2018, referenced from Cotton Advisory Board of India, as per CAB meeting dated 12-12-2017). This thesis is an attempt towards the overall performance measurement of the textile manufacturing industry in Haryana. At the very first step, various schemes initiated by the central and state government for the textile industry were studied. Their findings, shortcomings, and benefits have been highlighted descriptively. Second, the study has analysed the growth of cotton production in Haryana for a decade (2008-09 to 2017-18) over a specified area. At the third step, the study analysed the company-level operational performance based on the five years data (2015-16 to 2019-20). The study has revealed the operationally efficient and inefficient companies across Haryana at the fourth step. This information will be useful for the top managers of the company in decision making. At the fifth step, the financial performance of the textile industry has been analysed using the DEA technique with various financial ratios based on the company-level data from 2015-16 to 2019-20. It highlighted the financially efficient, inefficient, and benchmark companies across Haryana. At last, the researcher analyses the important issues being confronted by Haryana's textile industry using the ISM and MICMAC analysis. In line with it the thesis evaluates crucial problems and their contextual relationships that obstruct the industry's performance. By consolidating all the above six steps, the overall performance status of the textile industry is achieved and highlighted. The results show that textile companies are inefficient operationally and financially up to a great extent and there is a huge scope of improvement to achieve the appropriate level of efficiency. Although, the trend of cotton production is increasing over the covered area but the companies are performing poorly at their operations and finance. The major problems confronted by Haryana's textile industry have been discovered in the thesis using ISM and MICMAC analysis based on the questionnaire survey. The remainder of this chapter has been separated into 3 sections. The conclusion of the study has been discussed in section 9.1. In section 9.2, policy recommendations have been proposed and the final chapter 9.3 deliberates the future scope of the study.

9.1 Conclusion and findings of the study

- The present thesis first unveils the institutional changes relating to the textile industry in such as all India handloom board, national jute board, national textile policy, NIFT, CSB, etc. Then, several major schemes and initiatives taken by the central and state government towards the growth of the textile industry have been identified and analysed in the study. Financial assistance, technology up-gradation, employment generation, infrastructure development, and export have been the major concerns of the government policies and schemes for the textile sector in India. The cumbersome documentation and approval process creates difficulty for entrepreneurs to get the full benefit of government schemes. Now, the government has started an easy online process for approval of loans and subsidies, with very lesser documentation formalities, to mitigate the challenges of the tedious approval process. The online training and dissemination of information through online apps make it easier for entrepreneurs to deal with the complex business environment. ATUFS scheme provides financial assistance to textile manufacturing units, enabling them to produce qualitative products by using upgraded technology. The CPCDS scheme provides infrastructure assistance and other benefits such as the latest technology, adequate training, Human Resource Development (HRD) inputs, and appropriate market linkages to the cluster. The project ICARE, enhanced the quality and productivity of Jute by line sowing using seed drills, weed management by using nail-weeders, wheel-hoeing, distribution of certified quality seeds, etc. The SITP has significantly supported the living standard of workers of textile units and provided a good infrastructure base for these units. The HSN classification of codes for the technical textile sector has increased the consumption of various sub-products of technical textile in foreign & domestic markets. The CoEs of technical textiles develop skilled and technically fit entrepreneurs and workforce by providing training, industry-based information, and testing support. The government has taken a step to eliminate thigh reeling by distributing Buniyad reeling machines to tribal reeler women. A Mobile app, e-cocoon, is being used for quality certification and supports entrepreneurs much in getting the authentication proof of silk product. The CSB has provided help in the production of bivoltine silk (An upgraded quality of silk that can sustain in summer and winter equally) in India. The Catalytic Development Program of the government has improved the quality of silk, efficiency in the delivery system, and up-scaled the sericulture activities. The anti-dumping duty initiative of the Indian government has increased the demand for indigenous jute in the domestic market and generated employment opportunities. The MSP scheme provides certain remunerative prices to the cotton farmers of Kapas every year. The introduction of an innovative technique of retting (Removal of fibre from the woody tissue by partial rotting) has increased the farmers' income and quality of raw jute. The Powertex India scheme provides interest-free corpus funds up to two crores to SPV (Subsidiary company/association). These SPVs purchase yarn at wholesale price and provide yarn to small weavers at a reasonable price to avoid brokerage charges and middlemen.

- Subsequently, the trend of Cotton production over the defined area was analysed in the thesis and the comparison of cotton production and productivity between Haryana and northern India (Haryana + Punjab + Rajasthan) was made. Haryana was found to be the best performer (productivity-wise) state across northern India. The trend of cotton production (over the area) in Haryana is increasing. A downfall in cotton production has been found in the year 2015-16 and 2016-17 because of the whitefly pest attack and leaf curl virus in Haryana and north India. The CAGR of cotton production and productivity (Lakh bale production over per lakh hectare area) in Haryana was observed higher each year. Export performance was selected as another variable to measure the growth of the textile sector in Haryana. The year-wise increasing trend and absolute growth of handloom, handicraft, and cotton export have also been observed in the study. It can be inferred from the results that Haryana is growing well in terms of cotton production and productivity but the textile manufacturing companies are not performing well and there is a huge scope for improvement in efficiency.
- Thereafter, the findings show that the operational performance of the textile industry in Haryana may vary according to different variables, industry, country as well as years. It was observed that the textile units in Haryana are underperformed with an average consolidated technical efficiency score of only 0.25 for five years. The selected textile companies with respective scores of 0.2, 0.18, 0.18, 0.4, and 0.28 are technically efficient from 2015-16 to 2019-20 respectively. Only, 5.8 companies (average of five years) are operating at CRS, 10.2 companies (average of five years)

are operating at IRS, and the rest 45 companies (average of five years) are operating at DRS. The seventy-five percent of the operational inefficiency can be eliminated through company-level input optimization combined with increased managerial efficiency. There is a need to increase the input scale by those companies which are operating at an increasing return to scale while those have to lower their input scale which are operating at a decreasing return to scale to enhance their efficiency. According to descriptive statistics of raw data (operational variables) demonstrated in chapter 6 shows the huge variation in range and SDs. It can be concluded that some companies are very big and some are very small. In addition to this, the majority of the companies are operating at the DRS (As per table 6.13) which means they have to lower their input size in order to reach the level of efficiency equal to one (1). Hence, small companies need to improve their internal sustainability (Shahi *et al.*, 2020) like financial matters, and efficiency in management to improve their performance.

- Then, the financial performance of the textile units in Haryana was analysed. It was found that the textile industry in Haryana is financially underperformed with an average five years (2015-16 to 2019-20) consolidated OTE, PTE and SE score of 0.34, 0.51 and 0.63 respectively. The average efficiency scores of selected textile companies for five years in chronological manner is; OTE scores 0.18, 0.17, 0.50, 0.48, 0.39; PTE score 0.33, 0.29, 0.65, 0.72, 0.56; SE scores 0.55, 0.58, 0.71, 0.62, 0.71. Additionally, average 10.6 companies are operating at CRS, average 20.8 companies are operating at IRS and rest 29.6 companies are operating at DRS for five years. Thereby, they needs to increase their input scale which are operating at an increasing return to scale while those have to lower their input scale which are operating at a decreasing return to scale to enhance their efficiency. The present study clearly shows that textile industry in Haryana is financially inefficient and unstable.

The average level of efficiency in each year is very less. The high value of SD shows the extent of variation across all the companies as some companies are getting very good score near to one but some are at very low efficiency, this depicts an unfavorable financial position of textile industry in Haryana. Although, maximum efficiency in each year is one (1) but very few companies are efficient in the study period viz. 6 companies are efficient in 2015-16, four companies are efficient in 2016-17, fifteen companies in 2017-18, twelve companies are efficient in 2018-19 and sixteen companies are efficient in 2019-20 out of the final sample of 61 DMUs. It is worth noting that, although efficiency level of OTE found 0.50 in 2017-18, PTE 0.72 in 2018-19 and SE found 0.71 in 2017-18 and 2019-20 (which are highest scores across all the five years of the study period) still there is a considerable scope for improvement to achieve financial efficiency in the textile industry in Haryana. As per Table 7.14, the improved efficiency has been observed in the financial operations over the five years (2015-16 to 2019-20) but there is a need to minimize the input scale and management underperformance to get the higher level of efficiency in each DMU of the textile industry in Haryana. Hence, it can be concluded that financial performance may vary according to the number of different variables, industry, country, years and even case. It is also observed from the descriptive statistics that some companies are very big and some are very small, so the small companies always fight in the market in term of finance, technology and other important sources. Mselmi, Lahiani and Hamza, (2017), have supported this finding that smaller companies have higher levels of debt, are less profitable and have lower repayment capacity, so they reflect lesser efficiency. In practical scenario, capital structure theory has an adverse effect on small businesses. The capital structure theories are best suited for established or large enterprises because debt is typically available for them at a lesser cost. Thus, huge businesses always preserve the quantity of debt higher to a certain amount, and this also happens to be more profitable compared to funds held by the company. Hence, small companies need to improve internal sustainability (Shahi *et al*., 2020) like financial matters, and efficiency in management to improve their performance. Whereas, large scale companies can easily raise fund from the market, so it is easier for them to employ the quality material and skilled labour. Around seventy five percent of the financial inefficiency observed in Haryana's textile industry can be eliminated through company-level input optimization combined with increased managerial efficiency. The improved financial performance results in better financial disclosure for different stakeholders in decision making (Quayes and Hasan, 2014).

- At last, the significant problems being confronted by Haryana's textile manufacturing industry were identified and assessed. It will help to educate the stakeholders about the company's problems, which may be avoided by implementing corrective steps to increase the company's overall efficiency. The critical problems were chosen using a decisive method. Fourteen major problems have been identified for further investigation based on replies from the top management of the selected 61 companies. The contextual relationship has been established among the critical problems using the ISM technique. The transitivity study was conducted in order to establish a more direct relationship between these problems. Three problems were identified at the top level (First), namely “issues with optimizing fibre mixture selection”, “problem with maintaining an appropriate level of inventory”, and “high costs associated with hazardous waste disposal/waste minimization” in the ISM, whereas “political barriers” were identified at the lowest level of the four. At the third level, six problems are interconnected and revolve around human resource management, namely employee training, capacity building, research and development, human resource management, financial difficulties, and a lack of top management commitment. Second level consist four problems in ISM. Following that, MICMAC analysis revealed problems in all four groups, namely autonomous, dependent, independent, and linking. The linking group contains the larger number of problems i.e. Lack of employee training, capacity building and development, Lack of technological innovation and new processes, Insufficient attention on research and development, Transportation barriers, Lack of top managerial performance and commitment, Absence of financial planning, Poor human resource planning, Market competition and uncertainty. The remaining three groups contain distinct problems including no autonomous, five dependent; Problem in optimization of fibre mixture selection, Non Availability/lack of skilled labour, Lack of raw material, Problems in maintaining appropriate level of inventory, High cost for disposing of hazardous wastes/waste minimization, and one independent i.e. Political barriers.

9.2 Policy implications

The findings of the present thesis have some policy implications which can be helpful in improving the performance of the textile industry in Haryana.

- Government should focus on rural, tribal, and less developed areas of the country, which have several artisans and weavers: they put in unique art and craft in making different textile products. Particularly, there is also a need to concentrate more on women workers belonging to each part of the country, especially for rural and tribal areas, as the women workforce is the largest contributing workforce of the textile industry.
- Government should spread awareness about different schemes and initiatives. Many of the aspirants (entrepreneurs) don't have awareness about these potential schemes of government which can be an important opportunity for them.

- The Research & Development facilities should be improved to produce the of better quality products at low cost. It will improve the overall performance of the textile industry in Haryana.
- The thesis found an increasing trend in production and export in the textile sector of Haryana. The Government needs to make policies to protect handloom and Handicraft segments of the textile as these sectors face competition from powerloom. Moreover, the Government should monitor and create an adequate textile industry database for policy formation, and review process. Continuous awareness and improvement should be initiated over time to improve credit delivery to entrepreneurs. The Government should focus on the necessary quality parameters to sustain the industry in the global market.
- The textile business demands highly skilled workers. Thereby, companies must have enough finances to attract highly trained workers and should use updated technology to get the maximum outputs from the available inputs. Additionally, the government should establish textile parks equipped with modern infrastructure. To promote textile and apparel expansion in the state, the government should upgrade existing textile parks and special clusters. The government should establish a panel of talented designers with the assistance of KVIC and design institutes such as NIFT in order to produce high-quality designer clothing. Thereby the operational and financial performance of the textile units can be enhanced.
- Textile companies should wisely select the cost effective input combinations to prevent the company from OTIE. Also the textile companies should evaluate their managerial performance to prevent them from PTIE because PTIE is caused by the managerial underperformance. In addition to this, the companies should establish and maintain internal financial controls based on financial reporting criteria.

- The companies should focus on planning and management to minimise the improper utilisation of the operating expenses like electricity, water and fuel to enhance the operational performance. Apart from this the company should pay attention to reduction in consumption of energy by following the appropriate energy saving measures.
- This study helps in analysing and prioritising the important issues being faced by Haryana's textile industry. This study makes a preliminary attempt by evaluating crucial problems and their contextual relationships that obstruct the industry's performance. The senior personnel of the companies will become aware of these critical problems and their severity and can take corrective action to improve the industry's performance.

9.3 **Limitations and future research**

As discussed in the earlier chapters, the textile industry of Haryana is underperforming and there is a huge scope for improvement. The limitations and future research scope is discussed herewith below;

- Non-availability or lesser availability of state specific-data on the textile industry like Haryana was the major constraint faced during the study. Limited data on cotton production, handloom and handicraft export is available. ARIMA model could have been applied with time-series data for more than 50 years for better prediction.
- It is possible to add some more variables such as size of operations that also influence the operational success of a company while analyzing the operational performance of the industry. Additionally, the study is confined in the state of Haryana (A northern part of India) only. If the sample of the companies represents the entire country (India) or any other country in the globe, the study's findings may be different.

- It is possible that some macroeconomic factors may also influence the financial success of a company while performing the analysis of the financial performance of the industry.
- Although ISM theory gives the good contextual link among elements (here Problems) yet opinions of the experts may be inaccurate occasionally may drive it towards weak decisions. There are only 14 problems observed as the primary difficulty in Haryana whereas it may variate by changing the area and country.