CHAPTER 3 DESIGN OF THE STUDY

This chapter highlights the overall design of the study, which includes limitations in the existing literature, objectives of the study, its scope, phases of research and methodology for carrying out the research work. The details of work carried out in each phase and tools, techniques, models etc. used in the dissertation have also been presented in this chapter.

3.1 LIMITATIONS IN THE EXISTING LITERATURE

The main limitations in the existing approaches are as follows:

1. There have been many studies indicating why certain organizations are more technologically advanced and competitive than others. These studies have tried to establish certain factors contributing to the technological innovation initiatives of the organizations, especially MSMEs. However, most of these findings focus on effect of one or two of these factors. There is a need of studies to provide holistic perspective on factors contributing to technological innovation comprehensively in an organizational setting.

2. There has been a lot of research indicating the effect of demographic factors related to entrepreneur to firm's technological growth. But very few studies have distinctively concentrated on effect of other factors like entrepreneur education, training, and work experience on technological innovation.

3. Further, there is dearth of empirical studies found in literature to support the theoretical findings. There are remote cases where the relative impact of technological innovation initiatives on performance improvements, especially in the Indian small scale manufacturing sector has been reported.

The present research work intends to bridge these gaps in literature.

3.2 OBJECTIVES OF THE STUDY

1. Identification of the challenges and opportunities that globalization raises for small scale industries as these are faced with pressures to reduce production costs, increase productivity and become more knowledge intensive.

2. Exploring the reasons for low performance in MSME sector and the major problems faced by small scale industrial units in course of continuous technological change.

3. Analyzing the technological innovation initiatives of small units as sources of
competitive advantage in MSMEs.

4. Presenting a business model to foster technological innovation initiatives as a basis of manufacturing performance enhancement.

3.3 ISSUES EXPLORED IN THE STUDY

The following issues have been taken up in the proposed research work:

1. Various factors affecting the performance of small manufacturing units in the region have been evaluated and rated.

2. The status of parameters (research constructs) comprising technological innovation initiatives and manufacturing performance parameters have been identified and evaluated.

3. The contribution of each input research construct in achieving performance parameters (i.e., assessing the impact of technological innovation initiatives to enhance manufacturing performance) has been evaluated.

4. A conceptual framework representing main elements of the technology innovation implementation program for small scale industrial sector has been developed.

3.4 SCOPE OF THE WORK

The scope of work have been limited to the small scale cutting tool, machine tool, hand tool, and auto component manufacturing units in North India.

3.5 METHODOLOGY USED

For accomplishing the objectives of this study, the following methodology has been followed:

1. A detailed literature review was carried out to identify the problems faced by MSMEs and technology innovation initiatives to enhance the performance of these firms.

2. A survey of various small scale units including cutting tool, hand tool, machine tool, and auto component manufacturing units was performed through a specially designed questionnaire for understanding and assessing the present situation.

3. Suitable qualitative and quantitative techniques were employed to correlate technology innovation initiatives and performance parameters.

4. Case studies in selected small scale units of north India were conducted to validate the findings of survey.

5. The results of survey and case studies were synthesized to come out with a suitable technology innovation implementation model.
3.6 PHASES OF RESEARCH

This section discusses overall design of the study and the methodology adopted for carrying out the present research work. It also provides details regarding the tools and techniques used in the dissertation work.

The present research work has been carried out using the overall framework of ‘flexible systems methodology’. This methodology involves use of an optimal mix of qualitative and quantitative techniques of system analysis and design (Sushil, 1993). Based on flexible systems methodology, the research work consists of four phases:

1. Clarifying the context
2. Understanding and assessing the situation
3. Assessing the actor’s capability
4. Evolving a management process

These phases are discussed as follows:

3.6.1 CLARIFYING THE CONTEXT

This phase reviews the literature on challenges and opportunities that globalization raises for MSMEs and also the reasons for low performance and major problems faced by small units. The literature on technology innovation initiatives of manufacturing industry with regards to investments in research function, policies, infrastructure facilities, and strategies adopted has also been explored. The tactical issues for managing innovations and strategies for bridging the technology innovation gap were assessed. After literature review, the gaps in existing approaches were identified. Thereafter, the objective of the proposed work and the various issues to be explored through the proposed research work were provided in this phase.

3.6.2 UNDERSTANDING AND ASSESSING THE SITUATION

The various stages involved in this phase are as follows:

Questionnaire Development: For effectively conducting the survey, the first task was to design a questionnaire. A relevant and detailed questionnaire containing objective type questions with multiple choice answers pertaining to the desired conceptual framework was designed. Scale items were used in analysis, since the research interest was to examine the effects of independent variables on dependent variables.
Questionnaire Validation and Pre–testing: The questionnaire was validated through peer review from practitioners and academicians. To ensure the effectiveness and relevance of the questions to the selected class of manufacturing industry, the questionnaire was pre–tested on a representative sample. The suggestions received from peers, academic experts, and senior executives from industries were incorporated. Further, Cronbach’s Alpha coefficient was evaluated for each scale item and the item–to–total correlation for empirical analysis.

Sampling and Data Collection: The survey instrument (along with a postpaid reply envelope) was mailed to all the manufacturing organizations in the sample frame. The survey was conducted primarily through mail but personal visits were also undertaken to the extent possible.

3.6.3 ANALYSIS OF RESPONSE
The analysis of response of the survey was divided into two broad categories: (i) Descriptive Analysis and, (ii) Empirical Analysis.

Descriptive Analysis: The descriptive analysis for various research parameters was carried out to assess their status in the manufacturing organizations. The status of each research component was evaluated and discussed for the manufacturing sector. Further, the overall standing of different organizations in various research components was presented.

Empirical Analysis: The empirical analysis was also carried out to evaluate the contributions of technological innovation initiatives towards achieving manufacturing performance improvements. For this, independent and dependent constructs (variables) were formulated based on literature review and the objectives of research.

3.6.4 STATISTICAL TOOLS
Several statistical tools and techniques were employed using SPSS software to predict the results.

Cronbach’s Alpha Coefficient: This parameter was used for convergent validity to assess the degree to which measures of the same concept (construct) are correlated. Correlation among items was assessed which make up the scale or instrument measuring the construct (internal consistency validity).
Pearson’s Correlation and t–Test Analysis: To find the relationship between key inputs and key outputs, Pearson’s correlation coefficient values (r values) between various issues of input and output parameters were calculated. The correlation values obtained were validated using t–test. Pearson’s correlation values and t–values (obtained from t–test) were worked out to ascertain significant issues and factors contributing to the success of technological innovation implementation program in industry.

3.6.5 ASSESSING THE ACTOR’S CAPABILITY
The survey was followed by case studies in four different manufacturing units that are ‘actors’ in the present context. The purpose of case studies was to analyze those aspects of the research problem which were reflected as potential areas requiring further investigation. The case studies focused upon the step–by–step implementation procedure adopted by organizations towards achieving global competitiveness through management of innovation in research initiatives. The main tools used for data analysis in case studies were SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis, SAP (Situation–Actor–Process) analysis and LAP (Learning– Actions–Performance) synthesis.

3.6.6 EVOLVING A MANAGEMENT PROCESS
This phase presents a synthesis of learning issues and outcomes of survey and case studies for their utilization through a qualitative model to evolve a technological innovation program for small scale industry in the region. Qualitative modeling was used in the present study. It involves deriving expert opinion and using this along with findings of previous phases (survey and case studies) in a structured manner. Two main techniques for modeling of the research problem were used in the present work. These included Fuzzy Set Theory (FST), Structural Equation Modelling (SEM) and Analytic Hierarchy Process (AHP).

Finally, a conceptual framework was developed to represent the linkage between essential components of ‘Technological Innovation Implementation Program’ elaborating on their relative contribution in meeting the overall research objective.

3.7 FRAMEWORK OF RESEARCH
The research framework developed and employed in the present study is represented in the form of a block diagram in Figure 3.1. The study was carried out in small scale sector in the
north India to identify the challenges that globalization raises for small scale sector and to analyze the technology innovation initiatives as a source of manufacturing performance enhancements. The main objective was to explain the relationships between technology innovation initiatives and performance parameters for small units, which significantly contribute towards improvement in manufacturing performance.

In this study, a reasonably large number of manufacturing units were extensively surveyed through a specifically designed questionnaire to understand and assess the prevailing situation. The present approach was aimed at justifying the support of Technology Innovation initiatives (TIIs) in improving manufacturing performance.

The TI questionnaire was designed through an extensive literature review for effectively conducting the survey (McEvoy, 1984; Scott et al., 1986; Kim 1991; Frenkel, 2001; Swain and Pratihar, 2002; Rogers, 2004; Collinson and Houlden, 2005; Subrahmanya, 2005; Wang et al., 2007; Das, 2008; Abereijo et al. 2009; Radas and Bozic, 2009; Nath and Singh, 2010; Oluleye and Oyetayo, 2010; Kache et al., 2011; Munster, 2011; Subrahmanya, 2012; Tirkey and Badugu, 2012; Fatimah, 2013; Nkualh et al., 2013; James et al., 2014) and validated through peer review from consultants and academicians. The questions framed were based on a four point Likert scale ranging from 1 to 4. The various sections involved in the questionnaire have been presented in Appendix–I, based on which the ‘Technology

Figure 3.1: Block diagram of the Methodology

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Innovation Questionnaire’ has been generated. Detailed description of ‘Technology Innovation Questionnaire’ has been presented in Appendix–II. Also, the letters of support from various organizations are listed in Appendix–III.

The small scale manufacturing units across the northern region of the country were first screened and an industrial database was created to mail the “Technology Innovation Questionnaire”. The questionnaires were mailed to the selected units and the industries were subsequently contacted through various communication means such as: postal mail, telephonic interviews, E-mail, besides personal interviews through visits to various manufacturing units to explain importance of the research work, its significance and to clarify any queries/doubts to facilitate complete and clear-cut responses to the ‘Technology Innovation Questionnaire’.

The finalized ‘Technology Innovation Questionnaire’ was sent to around 380 industrial units which belonged to cutting tool, machine tool, hand tool and auto component sector. More than 100 telephonic calls and several emails calls were sent to contact persons in industry. Besides this, various interviews with the resource persons were conducted personally and clarifications were provided. The responses thus received were compiled and analyzed critically to ascertain the performance of units. Most of the respondents to ‘Technology Innovation Questionnaire’ belonged to the management executives that included Entrepreneurs, patrons, managers and supervisors. As a result, 135 filled questionnaires were received yielding a response rate of 35.5%.

In order to determine the benefits realized by an effective competitive approach, it becomes necessary that different technology innovation initiatives and manufacturing performance parameters be examined carefully. In the present study, four key technology innovation factors were analyzed for their impact on three performance parameters so as to improve manufacturing performance of small firms.

Considering the literature review, and the results and findings of questionnaire survey and case studies, a ‘Technology Innovation Implementation Program’ for north Indian manufacturing industry was developed showing the synergistic effect of technology innovation initiatives on manufacturing performance. A summary of the research undertakings was highlighted and finally, limitations of the research were presented and recommendations for future research were suggested.
3.8 CONCLUDING REMARKS
In this chapter, a step–by–step approach employed for the dissertation was elaborated. The tools and techniques employed for analysis of various areas and activities for development of implementation plan were described briefly. A detailed survey and case studies were carried out for the study of research propositions. In the next chapter, the details of the survey, responses obtained, and correlations obtained between various variables have been illustrated, while case studies have been presented in the forthcoming chapters.