CHAPTER 7 CONCLUSIONS, LIMITATIONS, AND SCOPE FOR FUTURE WORK

MSMEs are the fountain head of several innovations in manufacturing and service sectors and by promoting MSMEs into rural areas becoming India will be developed. The Indian market is rising rapidly and Indian entrepreneurs are building remarkable progress in various Industries such as Precision Engineering Design, Manufacturing, Food Processing, Textile and Garments, Retail, Pharmaceutical, IT, Agro and Service sector.

Although it has admirable contribution to the Nation's economy, MSME sector does not obtain the requisite support from the concerned Financial Institutions, Government departments, Banks and Corporate, which act as a handicap in becoming more competitive in the National as well as International Markets. MSMEs faces numerous problems such as limited capital and knowledge, absence of sufficient and timely banking finance, low production capacity, non–availability of suitable technology, constraints on modernization and expansions, ineffective marketing strategy, identification of new markets, non availability of skilled workforce at reasonably price, follow up with various government departments to resolve problems and so on.

Technological progressions have increased greatly the competition impelled by the globalization of the world economies. It is a remarkable, and in certain instances worrying situation because MSMEs play an important role in most economies, including in India, in that they comprise the largest business block and offer the bulk of employment. There have been several studies which highlighted certain factors contributing towards the technological innovation initiatives of the firms especially MSMEs. Further, only a few empirical studies have been found to support the theoretical findings. There are remote cases where the relative impact of technological innovation initiatives on performance enhancements, especially in the context of Indian small scale manufacturing sector has been reported.

With this backdrop, the present study has been made an effort to focus on empowering of the small firms. As argued earlier MSMEs are important contributors of economic development and it is therefore pertinent to study obstacles of small firm growth and identify technological innovation initiatives to enhance manufacturing performance of the selected class of industry.
7.1 CONCLUSIONS AND FINDINGS FROM THE RESEARCH

The study is aimed at identifying the problems faced by MSMEs in the era of globalization and prioritizing them according to their importance. The study also critically examine the factors affecting the manufacturing performance of small scale industry and then devise various critical success factors for overcoming the obstacles for successful implementation of technology innovation program in the Indian small scale industry. Moreover, the study illustrates how the synergistic relationship of TII s can be helpful for Indian small scale industry to have enhanced manufacturing performance, through a specially designed TI Questionnaire.

The major objective of this research is to examine, how effectiveness is the support of technology innovation in enhancing manufacturing performance of small firms. Finally, the research culminates with development of a strategic TI implementation model for Indian small scale manufacturing industry for sustained growth and competitiveness. The conclusions drawn from the research work have been highlighted and divided into following categories:

7.1.1 STATUS OF PROBLEMS AND TII s IN SMALL SCALE INDUSTRY

The research provides an insight into the problems faced by small scale industrial units and in addition provides an assessment of prevailing technology related issues of Indian small scale manufacturing industry like entrepreneur’s capability, technology infrastructure capability, organizational culture and climate and government initiatives.

a) The research reveals that most of the organization have scored quite high rating (present point score PPS) regarding major problems faced by them. The data shows that most of the organizations are affected by lack of cheap and reliable power supply (PPS= 86.11). Lack of appropriate raw material at reasonable price is another major problem faced by MSMEs (PPS=82.04). There is absence of large scale industrial sector (PPS= 81.85) and small scale industries are also lacking in allocating budget for R&D initiatives (PPS= 81.11).

b) The analysis of various problems reveals that most of organizations do not follow proper recruitment and selection practices (PPS= 80.19). At the same time, there is lack of good rail and road infrastructure (PPS= 79.26) in the region.

c) The data represents that there is lack of proper marketing to promote products (PPS= 77.96). The data of the survey also reveals that most of the organizations have
inappropriate organizational practices and policies (PPS= 77.41). Further, there is lack of cooperation between MSMEs and government agencies (PPS= 77.22).

d) The analysis of various issues related to entrepreneurial capability (EC) shows that most of the organizations have good education level of entrepreneur (PPS=75.19) and they have adequate knowledge regarding various government schemes for MSMEs (PPS = 71.11). They have the ability for strategic decision making in identifying right kind of business and market (PPS= 73.15) as well as the ability to make effective decisions pertaining to business activities (PPS = 68.33). They also strongly emphasize on R&D, technological leadership and innovative products.

e) The close analysis of various issues related to technology infrastructure (TI) reveals that most of the organizations get appropriate raw material at reasonable prices (PPS = 78.33) and have technical knowledge and infrastructure to do business operations with information systems (e–purchasing, use of RFID and bar codes etc) as shown by the data (PPS = 75.19). Most of the organizations also have sufficient credit for meeting requirements of routine operations (PPS = 74.26).

f) The analysis of various issues related to Organization Culture and Climate issues (OCC) shows that only about half of the organization have skilled man power to increase competitiveness and suitable growths (PPS = 51.67) and at the same time, they provide training to transfer knowledge and skills that are of requisite quality (PPS = 51.48) to small extent. The extent of use of market and customer feedback into the innovation process is reasonable (PPS = 52.96) and most of the organization poor intensity of R&D personal (PPS = 45.93). The data shows that reasonable number of organization focus on employee empowerment (PPS = 65.56) and technological innovation initiatives are also supported by management (PPS = 67.41).

g) The close analysis of various issues related to government initiatives reveals that the government provides lab facilities for MSMEs to encourage them to speed up technological and new product development projects (PPS = 73.15). Government help MSMEs in acquiring latest technology, quality certification and marketing assistance (PPS = 56.67) and in a locating funds for R&D initiatives (PPS = 56.85) up to some extent. These firms are also provided with free or subsidized information regarding latest trends and technologies in relation to government regulations (PPS = 67.96).

h) The analysis of various issues related to performance parameters shows that market share of large number of organizations has been increased because of new products (PPS= 75.93) and there is improvement in product life cycle of products (PPS = 75.19)
as a result of TI initiatives. There is considerable improvement in sales due to new products as a percentage of total sales (PPS = 74.63). The TI initiatives have led to the increase in production of new products as a percentage of total products over the last 3–5 years (PPS= 67.78). The analysis of survey reveals that the implementation of TI initiatives improved the technical characteristics and features of existing product range (PPS= 67.59) as well as contributed in the implementation of new processes.

### 7.1.2 RESULTS OF EMPIRICAL ANALYSIS

The research has highlighted contribution of technology innovation initiatives (TIIs) in Indian MSMEs for enhanced manufacturing performance. The empirical analysis of survey reveals that TIIs have yielded considerable significant improvement in Indian MSMEs in terms of improved life cycle of products, reduction in cost of production, mean sales profitability, and increase in market shares.

a) It is evident from the survey that adoption of TIIs contributed to the sustained competitive advantage of several Indian MSMEs. The successful implementation of TIIs can led towards realization of strategic manufacturing performance improvements for competing in the highly dynamic global marketplace. These interrelationships can be used to understand the effect of various TII success factors towards realization of organization objectives of growth and sustainability.

b) The detailed interrelationship between various TIIs and manufacturing performance parameters indicate that Entrepreneurial Capability (I1) issues are considerably associated with the manufacturing performance parameters (O1– Product Performance (0.33*), O2– Innovation Performance (0.20*) and O3– Sales Performance (0.25*)). Also, Technology Infrastructure (I2) issues are found to be closely related to O1–Product Performance (0.43*) and O3– Sales Performance (0.30*). Government Initiatives (I2) issues are correlated with O1–Product Performance (0.31*) and O3– Sales Performance (0.44*).

c) The results of T–test (Table 4.21) reveals that various TIIs and MPPs are closely associated since the significant factor ‘p’ works out to be less than 0.05 in most of the cases. Moreover, the t (critical) value for confidence limits corresponding to n–2 (=133) degrees of freedom and significance level of 5 percent, from statistical t tables, works out to be 1.98, which is lower than the t values obtained for most of the input–output combinations as revealed in Table 4.21. This further validates the high correlation between various TIIs and manufacturing performance parameters.
d) The results through multiple regression analysis are presented in Table 4.22. The result implies that O1–Product Performance is significantly affected by I1–Entrepreneurial Capability (EC), I2–Technology Infrastructure Capability (TIC), I4–Government Initiatives (GI) issues. O2–Innovation Performance is significantly affected by I1–EC whereas O3–Sales Performance is affected by all TII s i.e. I1, I2, I3 and I4.

e) The results of canonical correlation analysis between TII s and MPPs are shown in table 4.23 and indicate strong and significant canonical correlation function (r= 0.750 at F statistics probability of 0.00) between the predictor set of TI implementation dimensions and the criterion set of MPP. The multivariate test statistics have been observed to be statistically significant (p < 0.001). The redundancy indices were 0.283 and 0.248 for the dependent and independent canonical variates respectively. The redundancy index indicates the amount of variance in a canonical variate explained by the other canonical variate in the canonical function. The canonical loadings for predictor set of various TII s (I1, I2, I3 and I4) on the dependent variate ranges from 0.396 to 0.701. The criterion set of Manufacturing Performance Parameter variates (O1, O2 and O3) have also been found to be loaded upto 0.690 on the dependent variate.

7.1.3 CASE STUDY FINDINGS

Further, detailed multiple–descriptive case study has been conducted in selected small scale manufacturing organizations across the country in the Northern region that has made serious interventions regarding TI implementation and has reaped significant manufacturing performance enhancements as a result of successful adaptation of these initiatives. The following key issues have been highlighted through the case studies:

a) The case studies have indicated that organization has adopted proactive TI principals for meeting the competition thereby affecting significant production system improvements, improving cost effectiveness of production, improving sales performance, aligning the workforce with organizational growth and development objectives, improving employee competencies and realizing improved workplace environment.

b) The Manufacturing organizations have been successful in creating a congenial atmosphere for implementation of these initiatives. Also, small firms India could overcome various obstacles by demonstrating its endeavour to adopt TI program through successful implementation of TII s such as entrepreneurial capability, technology infrastructure capability and government initiatives for improving manufacturing performance.
7.1.4 RESULTS OF QUALITATIVE MODELING

a) The research has been extended to prove the synergistic suitability of TIIIs using Fuzzy based Model Simulation. For the study, the most relevant factors affecting these drives like Product Performance and Sales Performance have been considered as most important issues to be cared for and data given by experts in simulation uses Fuzzy Logic Tool Box of MATLAB. It also provides the steps for designing Fuzzy interface system and Simulink block for analyzing designing and simulating system based on Fuzzy Logic. A continuum of Fuzzy solutions for TI implementation equation is presented using the rule viewer of fuzzy tool box of MATLAB. The Rule Viewer displays a roadmap of the whole fuzzy inference process and it is based on the fuzzy inference diagram. The Rule Viewer allows interpreting the entire fuzzy inference process at once. It also shows how the shape of certain membership functions influences the overall result as it plots every part of every rule. Each rule is a row of plots, and each column is a variable. The rule numbers are displayed on the left of each row. By clicking on a rule number, the rule in the status line can be viewed. The two inputs can be set within the upper and lower specification limits and the output response is calculated as a score that can be translated into linguistic terms. In this instance the order output of 8.52 indicates “Acceptable system” linguistically from Table 6.8. The Rule Viewer shows in detail one calculation at a time and in this sense, it presents a sort of micro view of the fuzzy inference system. The results show that if TI measures are used efficiently, their synergistic effect can improve manufacturing performance of an organization.

b) For validating the Fuzzy study empirically, the SEM has been done. This study uses the confirmatory factor analysis approach using SEM in AMOs 22.0 software to imply the inter–relationship among TII and MPP variables in the study. Model Fit summary of SEM_TI model after doing the Modification Indices represents that the value of RMR decrease to 0.064, which is less as compared to RMR value before doing the modification indices as depicted in Table 6.10. Similarly, the value of GFI increased to 0.584 which is close to 1. This indicates that the model after modifications does provide a better fit w.r.t. NFI which is equal to 0.686. Thus, SEM study confirms and validate TI Fuzzy model which justifies the previous study.

c) Further, the justification of TI implementation in Indian MSMEs has been made using AHP by calculating consistency ratio (CR), which is a comparison between consistency index (CI) and random index (RI). For the study, the value of CR (0.0670) is coming less than 0.1 (10%) as shown in Table 6.18, which means the judgment considered for the
study is consistent and acceptable. Further, Table 6.19 represents that success rate of using TI in the organizations is 72% whereas failure rate is 28%.

d) Finally, a conceptual framework representing main elements of the technology innovation implementation program for small scale industrial sector has been developed. The framework has been developed based on relevant literature, sample based survey, case studies and qualitative modeling presented in this study. The four independent variables known as TIIs: entrepreneurial capability, technology infrastructure capability, organizational culture and climate and government initiatives are aligned to the three dependent variables known as manufacturing performance parameters (MPPs): product performance, innovation performance and sales performance as represented in the framework. These MPPs collectively lead to enhance manufacturing performance.

7.1.5 MAJOR FINDINGS OF THE STUDY

It can be concluded that, in a highly competitive scenario, implementation of technology innovation program has proven to be the most significant initiative that leads the organizations to scale new levels of achievement. Accordingly, the following major findings have been drawn out of the elaborative study:

1) Entrepreneurial capability, technology infrastructure capability and government initiatives have emerged as significant contributors towards enhanced manufacturing performance in the organisations.

2) Entrepreneurial Capability is strongly associated with all the manufacturing performance parameters i.e. Product Performance, Innovation Performance and Sales Performance and demonstrated as the most successful factor for implementing technology innovation.

3) Technology Infrastructure Capability has proven to be an important contributor in improving Product Performance and Sales Performance hence enhancing the manufacturing performance of the organizations.

4) Government Initiatives are significantly linked with Product Performance and Sales Performance in the selected class of industry as government assistance for MSMEs provides potential benefits in creating employment opportunities and improving innovation and competitiveness.

5) Organizational Culture and Climate is closely associated with Sales Performance in the organizations which confirm that culture directly affects employee’s ability to
work effectively and efficiently and therefore determines the productivity of the firm.

6) The technology innovation-strategy model developed shall prove to be a ready to use tool for enhancing manufacturing performance of Indian MSMEs in fierce competitive environment.

7.2 LIMITATIONS OF THE STUDY

The research limitations of the present work provide suggestions for future studies. This study has number of limitations in generalizing the findings across MSME sector in Indian economy which include:

- The present research is limited to only cutting tool, machine tool, hand tool and auto components industry of North India. Factors may vary according to the products of manufacturing industry like material handling equipments, farm and agri–machinery, bicycle industry, two–wheeler and car parts manufacturing units.

- The present research is carried out in small scale manufacturing units situated in North India only; significance of issues could differ in other regions of the economy.

- In this research, only four significant technology innovation factors (Entrepreneurial Capability, Technology Infrastructure Capability, Organizational Culture and Climate and Government Initiatives) are studied, whereas other factors (Collaborative Networks, Workforce Management, Resource Management and External Knowledge Inflows) might also affect firm performance.

- The research suggests a generalized implementation of TI approach for Indian small scale industry as a whole and all manufacturing organizations in the study have been treated alike, irrespective of the specific requirements of various small firms. Thus, minor changes have to be incorporated to effectively adopt this program.

- As such no mathematical models or quantitative relationship has been derived to calculate the contribution of various factors in achieving enhanced manufacturing performance.

7.3 SCOPE FOR FUTURE WORK

While carrying out the study and trying to list its scope, a number of areas has come to focus, where detailed research can be taken up. Such areas demanding attention, further exploration, and analysis through research work are mentioned below.
• The study can be extended to examine the role of other prominent factors like Collaborative Networks, Workforce Management, Resource Management and External Knowledge Inflows on manufacturing performance of organizations.

• Scope of the study is limited to cutting tool, machine tool, hand tool and auto components industry. Further research can be carried by taking into consideration the different kind of products manufactured by various industrial units such as material handling equipments, farm and agriculture–machinery, bicycle industry, two–wheeler and car parts manufacturing units.

• All manufacturing organizations have been treated alike, irrespective of the specific requirements of various small firms. Minor changes might have to be incorporated for effectively managing technology innovation in varying situations. Thus, sectors wise analysis can also be conducted for appropriately dealing with varying requirements of different sectors.

• The study is aimed at implementing strategic TI methodology in Indian small scale manufacturing units situated in Northern region only. Another direction for future research is developing these programs for small firms in other regions of the country.

• A qualitative technology innovation–strategy model has been developed. In future research a mathematical model for technology innovation strategy could be developed.