CHAPTER VII
CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction
This chapter covers the summary of the research work, its results, conclusions, and the recommendations. The chapter also lists various areas, which can be taken up for further research. The summary of the research covers the method adopted, salient features, and tools and techniques used in the work. Further, the results of the survey and the case studies, and the inferences drawn from them along with the major learnings have been presented. Based on the results and the findings, conclusions have been drawn and recommendations have been made. The limitations along with the scope for future work are covered in the subsequent sections of the chapter.

7.2 Summary of the Research
The study has been conducted with an objective to assess the relative impact of new technology and sourcing practices on different flexibilities for the trade off associated with the strategic choice between different methods of achieving manufacturing flexibilities. The research has been carried out using flexible system methodology. The problem has been conceptualized as an S-A-P (Situation-Actor-Process) paradigm. Various phases of the study have been to: clarifying the context through a detailed review of the studies on flexibility, critique and taxonomy of manufacturing flexibilities, advanced manufacturing technology, sourcing practices and their relationships; understanding and assessing the situation by conducting a survey of various manufacturing organizations of north India, involved in achieving different manufacturing flexibilities using a peculiarly designed questionnaire through mail / personal visits and further analyzing the data collected through survey to establish the relationship between various independent and dependent constructs; assessing the actor’s capability by critically assessing the four case studies in the surveyed manufacturing organizations, to analyze the methods/techniques/approaches adopted for achieving manufacturing flexibilities, the success achieved and the modifications made in the future plans; synthesis of the learning issues of survey and case studies; developing a management process for managing the new technology and sourcing practices in
manufacturing industry; and finally recommending a systematic implementation plan for depicting the technology-sourcing-flexibility relationships and achieving tactical and strategic level manufacturing flexibility.

A simple, relevant and comprehensive questionnaire containing around 160 questions pertaining to the desired conceptual framework has been peculiarly designed, which seeks information on the status of different dimensions of manufacturing flexibility and various methods for achieving it in the Indian manufacturing industry. Special emphasis has been given to seek information related to business strategy and performance of the organizations, status of volume, modification delivery and manufacturing flexibility and the role of technology and sourcing practices in achieving different flexibilities. The questionnaire has been designed after extensive literature review and validated through peer review from academicians, consultants and practitioners from the industry. A 1–5 Likert-type scale has been employed for all item measures in the questionnaire. From the survey, the associations between various independent constructs and different manufacturing flexibility dimensions have been established using canonical correlation and multiple regression analysis. The primary interest in data analysis is to investigate the influence of sourcing practices and advanced manufacturing technology on manufacturing flexibilities and technology-sourcing associations.

The purpose of the case studies has been to validate the results achieved from descriptive and empirical analysis of the survey. For carrying out the case studies, the manufacturing organization should be the representative of the manufacturing industry, implementing various operations and process pertaining to the potential areas of technology and sourcing and forthcoming and co-operative in conducting the detailed case study.

Various factors related to new technology and sourcing practices as mentioned earlier have been studied through case studies. Only those factors, which were reflected as the potential factors have been taken up for detailed study. The case studies have been conducted in a phased manner starting from the evolution of the need for incorporating the manufacturing flexibility at the tactical level to the excellence at the strategic level by incorporating the new technology and sourcing practices as a competitive tool in different manufacturing enterprises. In each case study, the various aspects concerning purpose of study including; organization business strategy and initiatives, performance indicators, manufacturing capacity and capabilities, role of technology and sourcing practices, status of manufacturing flexibility, relative performance of technology and sourcing practices
and social and environment aspects have been analyzed for achieving manufacturing flexibilities. Further, the success achieved, the modifications made in the future plans have been compiled and analyzed in detail. The analyzed result of the case studies depicts the total industrial scenario about the achieved level of manufacturing flexibilities and assesses the relative impact of sourcing practices and new technology on different flexibilities for providing a basis for the trade off associated with the strategic choice between different methods of achieving manufacturing flexibilities.

For effectively managing the manufacturing flexibility in manufacturing industry, a management process has been developed in consultation with the experts from the industry. For this, various techniques of qualitative modeling like option field methodology, option profile methodology, analytical hierarchy process, and fuzzy set theory have been used.

Finally, an implementation plan has been worked out to effectively manage the different manufacturing flexibilities in manufacturing industry. The order of implementing various strategies for successfully achieving the different manufacturing flexibilities at tactical and strategic level in Indian context has been highlighted.

7.3 Results and Major Learnings

The various results and learning issues have been derived on the basis of descriptive and empirical analyses of the primary data collected through the questionnaire survey and case studies. These learning issues have been listed below and will be synthesized in the qualitative modeling for developing the implementation plan.

7.3.1 Learnings from the Survey

The learning issues of the descriptive and empirical study of the survey have been synthesized and given below accordingly in pursuit of effectively managing the manufacturing flexibilities.

Concerning business strategy and initiatives

- ‘Customer focus and commitment’ has been considered as the highly important business initiative by majority of the organizations.
- The role of ‘manufacturing technology’ and ‘win-win situations with suppliers’ has been equally and significantly targeted by 81% of the organizations.
• Organizations have largely considered the importance of inducing flexibility in the manufacturing and design as an instrument for achieving competitiveness. However, majority of organizations have given the foremost priority to the achievement of quality conformance and reliability.
• Achievement of flexibility in manufacturing has been found to be a significantly important by 75% of the organizations.
• 77% of the organizations have given a significant importance to the attainment of adjustments in production capacity quickly. Further, flexibility in offering large degree of product features and variety has been considered significantly important by 65% and introduction of rapid design changes in the products have been felt considerably important by 50% of the organizations.
• 78% of the organizations have achieved the substantial improvement in their competitive position in the recent years of their business operations.

**Concerning technology adoption**

• The survey results depict the mixed response for the level of adoption of new technology by the organizations.
• 68% of the organizations have an agreement that manufacturing and design technologies played a significant role in their success.
• Increase in product quality in terms of performance and features have been found to be the fundamental factor for augmenting the adopting of new technology in 90% of the organizations.
• The need to improve the flexibility in the manufacturing system and fostering of next generation technology has been the main rationale for new technology adoption in 50% of the organization.
• Adoption of Infrastructural technologies has positively influenced the competitive position in 65% of the organizations.
• High cost of new technology has been considered as a main barrier for its adoption by 70% of the organizations.
• 60% of the organizations adopt new technology in order to reduce their dependency on external suppliers.
• The lack of information on new technology and customer non-responsiveness to new products has little to moderate effect for adopting the new technology in 23% of the organizations.
• Around 85% of the organizations have considerably increased the performance and features of their products by the adoption of new technology.

• ‘Speed of delivery’ and ‘number of customized product offerings’ has significantly increased as a result of new technology adoption in 79% of the organizations.

• Tactical and strategic level flexibilities have considerably increased in 69% of the organizations as an outcome of technology adoption.

• The cost of the existing and future product innovations have shown an upward trend, which can be resulted due to the high cost of technology acquisition in short term.

• 65% organizations have revealed a moderate improvement in the market share and net profit as a result of adopting new technology.

Concerning sourcing practices

• ‘Reduction in operating cost and risk of business’ has been considered as a significant factor in 85% of the organizations and followed by ‘adaptability to customer’s needs and requirement’ for adopting the various sourcing practices.

• 60% of the organizations have an agreement that the outsourcing of manufacturing facilities has played a moderate role in their business success.

• 61% of the organizations have an agreement that an involvement of supplier(s) in design and new product development process has played a moderate role in managing the market fluctuations.

• Ability to achieve volume and modification flexibility has been significantly improved in 86% of the organizations, due to the adoption of various sourcing practices.

• ‘Delivery of innovative and customized products’ has seen a moderate upside movement due to the adoption of sourcing practices in 55% of the organizations. In addition, 50% of the organizations have seen a moderate increase in the delivery speed and reliability.

• ‘Competitive scope of the supplier’ has been considered as most important factor in the supplier selection process by most of the organizations. An organization’s ability to produce the quality products at a reasonable cost and in a timely manner has been highly influenced by its suppliers’ capabilities.

• ‘Supplier technological competencies’ has emerged as the determining factor for the organization’s success. Further, most of the organizations have considerably focused on the supplier delivery competence in terms of consistency and speed.
- Majority of the organizations strive to establish a long-term strategically managed relationship with key suppliers, which in turn have a positive impact on their performance.

- Supplier’s integration in manufacturing has low to moderate impact on an organization performance in terms of loss of control and confidentiality dependency.

**Concerning manufacturing flexibility**

- The present status of manufacturing flexibility in the surveyed organizations is very good with an average score of 0.76 and standard deviation of 0.11 only. Status of manufacturing flexibility in 49% of the organizations is above the average value, 40% are in the fair range and poor in 11%. This can be attributed to the fact that most of the organizations have a considerable agreement to have achieved the manufacturing flexibility at the operational and tactical level but need to strengthen their capabilities at strategic level and a major improvement plan is urgently needed for effectively managing the manufacturing flexibilities.

- Most of the organizations have a capability to introduce process improvements in the manufacturing system. Further, 85% of the organizations have a capacity to produce large number of product categories in the manufacturing system.

- Around 72% of the organizations have a moderate to high capacity to handle volume changes in the manufacturing system in which 23% have a highest agreement to handle these demand fluctuations.

- 77% of the organizations believes that they can handle the different delivery sequences quickly and efficiently to satisfy customer demands and creating new markets. Around two third of the organizations can quickly changeover the manufacturing system to a different product mix.

- 60% of the organizations agree to the fact that the product configurations can be changed many times during the manufacturing process to accommodate customer preferences.

- The responsiveness of the organizations to the customer demands and operating efficiently at different levels of output has emerged as the most important, amongst flexibility-oriented tasks.

- The delivery of innovativeness in designing of new products has been an area of concern within the organizational competencies. Only 55% of the organizations have the capability to put new product design into production quickly.
• The sourcing practices are leading in flexibility, delivery and net profit aspects in contrast to new technology, which leads moderately for quality and market share.
• Cross-functional teams have been found to be the key area of interest for achieving manufacturing flexibility.

**Concerning volume flexibility**
• The current status of volume flexibility in the manufacturing organizations is very good with an average score of 0.76 and standard deviation of 0.10 only. Analysis of data revealed that 51.6% of the organizations are above the average value, out of which, 23.3% is in very good range and 28.3% of the organizations possess a good status.
• 79% of the organizations strongly agree that they can easily handle the demand for rapid increase in production volumes. Further, more than half of the respondent organizations have a capacity to handle the varied output volumes for the different products largely.
• In process improvement can be introduced in the manufacturing system without creating disturbances in 74% of the organizations.
• 46% of the organizations have moderate to significant impact on the profitability aspect as a result of operating at different production volumes.
• Technology investment in manufacturing infrastructure, explicitly the use of soft, administrative and intermediate technologies have resulted in strengthening the organization capabilities to handle rapid increase in production volumes and adjust the level of production quickly.
• Supplier involvement in modifying products has a significantly positive impact in managing the frequent volume fluctuations without sacrificing the quality of the different products. Also, the supplier ability to respond to order delivery changes has a positive relationship with volume flexibility.

**Concerning modification flexibility**
• The current status of modification flexibility in the manufacturing organizations is reasonably good with an average score of 0.74 and standard deviation of 0.10 only. 60% of the organizations are above the average value, out of which, only 15% are in very good range and 45% of the organizations possess a good status. Further, 23.3% of the organization are in fair range and possess a moderately important score.
• 81% of the organizations strongly agree that they are capable of producing minor alterations in product design to meet customization.
• 55% of the organizations have the ability to introduce a large number of new or modified parts and products frequently.
• The cost of the modified or new product and transition penalties in cost has been an area of concern for the organizations.
• Only 45% of the organizations have a reasonable facility to modify the product or product mix in a short span of time.
• The role of ‘supplier involvement in modifying products’, explicitly the supplier assistance in minor product and process design changes and managing the rapid changes in product variety have resulted in strengthening the organization capabilities to manage the modification flexibility.
• The strategic use of organizational infrastructural resources has shown a positive trend towards the attainment of modification flexibility.

**Concerning delivery flexibility**

• The present status of delivery flexibility in the manufacturing organizations is good with an average score of 0.714 and standard deviation of 0.13. Analysis of data depicts that 53.3% of the organizations are above the average value, out of which, only 13.3% is in very good range and 40% possess a good status.
• 62% organizations agree that they can handle rapid delivery of innovative products, while 47% shows their divergence to provide delivery differentiation profitably. Further, 32% of the organizations have shown a neutral response to the achievement of different item measures of delivery flexibility.
• Around 50% of the organizations have a moderate capacity to rapidly introduce the customized products for new market creation.
• The impact of supplier competencies has been found influential for the development of delivery flexibility in an organization. It has been found that the selection of supplier based on technology is important for the manufacturer whose focus is on delivery flexibility.
• The role of strategic sourcing is found to be statistically significant in developing the delivery flexibility. However, sourcing strategy for enhancing modification flexibility may have to be implemented in advance of similar actions to support the development of delivery flexibility.
Supplier involvement in managing minor product and process changes has played an imperative role as a prerequisite in developing delivery flexibility.

The impact of supplier competencies has been found influential for the development of delivery flexibility in an organization.

An organization with high level of delivery flexibility can operate more economically, if it has already achieved a high level of volume flexibility.

**Concerning learnings from Empirical Study**

- Delivery flexibility has a strong and significant association with other dependent variables i.e. volume flexibility \( (r=0.671, p=0.000) \) and modification flexibility \( (r=0.706, p=0.000) \).
- Volume flexibility has been found to have a strong positive association with the supplier involvement in volume changes requests, SIVCR\( (r=0.464, p=0.00) \), supplier involvement in modifying products, SIMP\( (r=0.483, p=0.00) \) and technology investment in manufacturing infrastructure, TIMS\( (r =0.532, p=0.00) \).
- Further, modification flexibility has established a significant positive association with SIVCR \( (r = 0.479, p = 0.00) \) and SIMP \( (r =0.435, p=0.01) \).
- Supplier competencies, SCOMP \( (r=0.550, p=0.000) \), SIVCR \( (r=0.468, p=0.000) \) and SIMP \( (r=0.451, p=0.00) \) has been found to be significantly associated with the delivery flexibility.
- SIMP has the highest cross-loading (0.511) among the independent variates for the set of dependent variates consisting of volume and delivery flexibility.
- SCOMP has come out to be second most significant factor affecting volume and delivery flexibility with cross loading of 0.503 and has the highest cross-loading (0.535) among the independent variates for the set of dependent variate consisting of modification and delivery flexibility.
- TMSYS and TIMS has a cross loadings of 0.334 and 0.338 respectively with a set of dependent variates consisting of modification and delivery flexibility.
- In multiple regression analyses, TIMS and SIMP have significantly influenced the achievement of volume flexibility. SIMP has found to be important for achieving modification flexibility and SCOMP and SIMP have played a major in achieving delivery flexibility.
7.3.2 **Learnings from the Case Studies**

The learnings from various case studies conducted in various manufacturing organizations have been synthesized as follows:

**Concerning business initiatives**

- Competitive excellence and commitment to quality remains the foremost business initiatives for the manufacturing organizations.
- Win-win situations with the suppliers, use of advanced manufacturing technology and flexibility in the manufacturing system are the important aspect to be looked upon in a competitive market environment.
- Cross-functional and cross-organizational teams wherever required has helped the organizations in achieving business competitiveness.
- Recognizing the potential of technology and innovation, the organizations can continuously harness the power of their knowledge capital.
- Seamlessly future proofing capital investments assures evolutionary capabilities of manufacturing infrastructure.
- Organizations have emphasized on VA/VE to cut down costs.
- For, survival, the organizations have been compelled to adopt cost cutting strategy in a big way so as to retain their profit margins. It is seen that there is a lot of scope for cost cutting through strategies like improving supply chain management, reducing inventory and making the vendors competitive.

**Concerning advanced manufacturing technology**

- The important factors for the implementation of AMT's includes the fostering of manufacturing flexibility, enhancing the design capabilities, improving the productivity and attain quality leadership in the market place.
- Use of IT enabled systems have largely helped the organizations to reduce the inventory level, promote E Sourcing, enhance various manufacturing flexibility, control waste and improve employee connect. Adoption of ERP system has further facilitated to perform better in the global market and manage manufacturing flexibility.
- The organizations are investing appreciable amount in new machinery and equipment and R&D to keep itself updated with the latest technology. In house R&D has helped
some of the organizations to indigenously develop robots that in course help significantly to achieve the tactical level flexibility.

- Capabilities strengthened in benchmarking and design optimization has further improved and upgraded the value of the product.
- The organizations have adopted the technology from its alliance partners to reduce the lead-time to new product introduction.
- The organizations are building core capabilities in some critical area and exploiting these to the maximum extent.
- The majority of the organizations does extensive analyses based on the trends of the past years before going in for new technology and also goes for economic viability study for adopting new technology.
- The organizations have a capacity to assess and select cost effective technology solutions.

**Concerning sourcing practices**

- A participative and collaborative approach with the suppliers has emerged as a key factor for the growth of any manufacturing organization.
- ‘Speed of capacity changeover’ and ‘adaptability to customer needs and requirement’ in the manufacturing system has emerged as important factors for adopting the sourcing practices.
- ‘Supplier technological competences’, ‘improvement in product variety’ and ‘low delivery time’ have been the important factors for adopting different sourcing practices.
- Organizations rely on small but high quality suppliers and strive to establish long-term relationship with suppliers.
- Early involvement of suppliers triggers innovations at the designing stage itself. This will further lead to achieve cost target approach at design stage itself.
- The tier-1 organizations have penetrated their facilities to become a system supplier to OEM’s apart from manufacturing aspects only.
- Organizations have witnessed the marginal decrease in product cost and substantial increase in net profit as a result of adopting and developing sourcing practices.
- Supplier flexibility, technological capability and financial condition play a significant role in supplier selection criteria.
• Cross-functional and cross-organization efforts to increase flexibility and eliminate uncertainties have created the level of performance needed to create competitive advantage.
• Suppliers are being trained to evolve as innovation drivers by engaging them at new product designing stage and achieve various business parameters more efficiently and effectively.
• Some of the companies have identified a group of suppliers for implementing an ERP solution enabling seamless sharing of information and promoting e business, and flexibility as a measure for vendor consolidation.
• Longstanding strategic partnerships with key technology providers, allows the organizations to access new technologies. New technology from alliance partners helped the companies to reduce the lead-time to new product introduction and further localize it to suit market conditions within house R&D efforts.

**Concerning manufacturing flexibility**

• The organizations moderately rely on adoption, adaptation and further development of manufacturing technology and infrastructure in house to achieve various tactical and strategic level flexibilities.
• The significant use of design technology and strategic sourcing has helped the organizations to achieve delivery flexibility, in course leads to the introduction of new products with minimal lead-time.
• The augmentation of facilities with manufacturing technology and strategic sourcing has considerably helped the companies to achieve the modification flexibility.
• Significant investment in infrastructural technology and the involvement of vendors in providing capacity support has helped the organizations in achieving volume flexibility.
• Early involvement of suppliers for design and development and supplier competencies has impacted the achievement of delivery flexibility moderately.
• The significant use of technological and sourcing aspects helps the organizations to achieve the delivery flexibility leading to the introduction of new products with minimal lead-time.
7.3.3 Summary of Developing a Management Process

To achieve the projected requirements of managing manufacturing flexibility, a management process has been developed in consultation with the experts from the industry. For developing the management process, a qualitative modeling using option field methodology, option profile methodology, analytic hierarchy process, and fuzzy set theory has been used. The modeling began with listing of various options to manage new technology in manufacturing industry for achieving manufacturing flexibilities. These options have been derived from the synthesized learning issues of this study. Option field methodology and option profile methodology have been used as a basis for this purpose. The options have been then put into various categories and these categories have been considered as the dimensions of the design. The dimensions have been then put into broader categories called clusters. The clusters have been put into sequence based on the importance of an area. The sequencing of dimensions within the clusters has been then carried out. Various profiles for course of actions planned for new technology and sourcing practices have been finalized. These profiles are: manufacturing technology based approach, design technology based approach, infrastructural technology based approach, outsourcing based approach and strategic sourcing based approach. After deciding the profiles, the objectives of the study have been taken from the results of the survey conducted. These are: volume flexibility, modification flexibility and delivery flexibility. To find out their degree of importance, these objectives have been compared pair-wise using AHP. Following this, quantitative contribution of each profile to each objective has been determined, and position matrices have been made. From the position matrices, weighted position matrices have been determined by multiplying weight of criteria by the value of each position of position matrices. The weighted position matrices have been aggregated in three ways, i.e. optimistic, average and pessimistic aggregation. Dominance matrices have been also prepared to display dominance structure between all possible pairs of options. Based on these matrices, the ranks of options have been decided for the manufacturing industry. Different approaches have been suggested for achieving various manufacturing flexibilities at tactical and strategic level.

7.3.4 Summary of Implementation Plan

After developing the management process for managing the new technology and sourcing practices in manufacturing industry for achieving various tactical and strategic manufacturing flexibilities, a systematic implementation plan has been developed for its
effective and smooth implementation. Different strategies to be followed in this regard have been discussed in Indian context. The implications of these strategies have also been pointed out.

The results of various analyses as well as the developed management process have brought out the prime importance for ‘strategic sourcing based approach’ as the key strategy, to be followed for managing manufacturing flexibility at tactical and strategic level. Further ‘manufacturing technology based approach’, and ‘Infrastructural technology and outsourcing based approaches’, are the need of the hour in this dynamic and highly competitive market environment. The manufacturing organizations in the region have to follow these three strategies logically and sincerely for the accomplishment of various business objectives related to flexibility aspect.

7.4 Conclusions and Major Recommendations

This section points out conclusions, in a digest form, in light of research objective and various issues and as a result of the detailed study carried out through survey, case studies and qualitative modeling. The following conclusions have been drawn:

- Manufacturing flexibility has been viewed as a multi-level and multi-dimensional concept rather than as an independent variable. The same has been defined along with its dimensions in light of the existing literature (Chap. 2, pp. 22, 31-32, and 38).

- Large and systematic investments in advanced manufacturing technologies and sourcing practices have positively influenced the management of manufacturing flexibilities at tactical and strategic level. The findings suggest that the sourcing practices are leading in flexibility, delivery and net profit aspects in contrast to new technology, which leads moderately in quality and market share (Chap. 4, pp. 109-112).

- The following flexible approaches have been identified in the qualitative model developed during this study for managing manufacturing flexibilities broadly at tactical and strategic level: outsourcing based approach, strategic sourcing based approach, infrastructural technology based approach, manufacturing technology based approach, and design technology based approach (Chap. 6, pp. 273-274). Further, a systematic plan for technology – sourcing – flexibility relationship has been developed for managing manufacturing flexibilities (Chap. 6, pp. 288).
Based on a conceptual framework developed during this research work and subsequent study, the following inferences have been crystallized for the strategic choice between different methods of achieving manufacturing flexibilities in the manufacturing organizations (outcome of synthesis of learning issues of survey and case studies in the domain of qualitative modeling, Chap. 6):

- Strategic sourcing (including joined knowledge contribution, creation of synergy and integrative interface with system suppliers) and manufacturing technology competence has significantly influenced the achievement of manufacturing flexibility at tactical and strategic level.
- Outsourcing of manufacturing and adoption of infrastructural technologies have enhanced the capabilities of the organizations to achieve volume flexibility.
- The systematic investment in manufacturing technology and employment of strategic sourcing has positively influenced the attainment of modification flexibility.
- Strategic sourcing and adoption of design and manufacturing technologies have considerably ensured a higher level of delivery flexibility.

- The organizations should enlarge their technological competencies before widely adopting the supplier based sourcing practices for effectively managing the manufacturing flexibilities. The organizations should build core capabilities in some critical area and develop these to the maximum extent (Chap. 5, pp. 249-251).
  - Use of IT enabled systems and adoption of infrastructural technology has helped the organizations to promote E sourcing and manage the manufacturing flexibilities needs effectively.
  - In house research and development efforts have facilitated the organizations to indigenously develop manufacturing competencies, which in course improve the manufacturing flexibilities, reduce cost and control waste.

The findings suggest that sourcing practices have positively influenced the manufacturing organizations trying to attain the flexibility competence. Organizations can deploy specific sourcing practice designed to achieve specific flexibility objectives (Outcome of survey, Chap.4 and case studies, Chap. 5 learning issues).
  - Organizations that place an emphasis on the use of stringent selection criteria for choosing their suppliers based on their quality, consistency, flexibility, delivery and relationship, performed better in their respective industries.
Organization must rely on small but high quality suppliers and strives to establish long-term relationship with them.

Cross-functional and cross-organization efforts to increase flexibility and eliminate uncertainties have created the level of performance needed to create competitive advantage and further helped the organizations in achieving business competitiveness.

Another outcome of managerial interest is the association of different manufacturing flexibilities with one another and the role of organizations to acquire certain flexibilities as a pre-requisite for developing others. The role of delivery flexibility has been found to be the largely important, followed by modification and volume flexibility (Chap. 6, pp.274). This could be attributed to the fact that the organizations now a day are focused towards the delivery of new or customized products quickly for achieving competitive excellence in the dynamic business environment. However, the volume and modification flexibility must be achieved prior to delivery flexibility amongst manufacturing flexibility-oriented tasks.

Organizations should conduct business that achieves a balance of integration of economic, environmental and social imperatives while at the same time should come up to the customers’ expectation (Chap.5, pp.249).

7.5 Limitations of the Study

The main limitations of this study are as follows:

- The study has been limited to large and medium scale manufacturing organizations in the northern region of the India.
- The manufacturing organizations in the study have been treated alike, irrespective of the specific requirements of various sectors.
- The study has been limited to explore and explicate the impact of new technology and sourcing practices in achieving various tactical and strategic level flexibilities only.
- As such no mathematical models or quantitative relationship has been derived to calculate the contribution of various factors in achieving different flexibilities.

7.6 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 here.
The study presents the macro–analysis for examining the impact of new technology and sourcing practices on different manufacturing flexibilities. However, similar studies can also be carried out for analyzing the impact of these practices on other competitive priorities like quality and cost individually.

The study can be extended to examine the role of other prominent factors like human resource, work force management practices- the relationship-oriented practices and participative leadership and delegation practices, demand management through effective manufacturing – marketing schedule sharing and forecasting efficiencies on the different manufacturing flexibilities.

The study can be extended from manufacturing to entire value chain for effectively managing the supply chain flexibility.

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

The item measures identified for various constructs have been considered to be equally important in the study, however in real life situations, some item measure may be more important than the others. The study can be extended by attaching appropriate weights to these item measures through qualitative techniques.

The present study has taken into consideration the manufacturing industry only and can be extended to other categories of industry also.

7.7 Concluding Remarks

Manufacturing flexibility is widely recognized as a critical component for achieving a competitive advantage in the marketplace. The role of technology and sourcing in managing the manufacturing flexibility at tactical and strategic level in manufacturing industry has been imperative and inseparable. However, sourcing practices lead in cost and delivery aspect in contrast to technology, which leads in quality and performance. Further, the organizations must enhance their technological competencies before going into the sourcing partnerships.

A manufacturing revolution has been well underway in the Indian economy, spurred on by the increasing presence of multinationals, scaling up of operations by the domestic
companies and expanding domestic market. The sector has been averaging 9 per cent in the last four years (2004-08), with a record 12.3 per cent in 2006-07. The growing economy and industrial growth in the recent years helps the manufacturing industry to invest in new technology, facilitating the increase in flexibility, quality and delivery level and product and process design capabilities. However, still due to the persistence of organizational and infrastructural barriers, the role of research and development and investment in design engineering is limited to large scale manufacturing organizations and research institutes. Additionally, Indian companies are also becoming renowned for their adherence to global quality standards and on the path of continuously increasing its productivity levels.

The role of strategic sourcing in managing varying demands of manufacturing flexibility has emerged as a key solution for the Indian manufacturing industry in addition to outsourcing of manufacturing facilities. Optimization of the value chain, joined knowledge contribution, creation of synergy, integrative interface and joined innovative capability with the key suppliers have largely helped the manufacturing organizations for effectively managing manufacturing flexibility.

It is concluded that in a dynamic business environment, new technology and sourcing practices individually and relatively put a vital impact in managing manufacturing flexibility. The effective selection and implementation of these practices are required for not only surviving but also thriving in the technology-intensive industrial environment around the globe.