Chapter 7
Conclusions and Discussion

This chapter summarizes the work carried out as a part of this research study. Further, it lists significant research contributions and conclusions of the work following directions for future work for advancing the work presented here towards expansion of the productivity improvement strategy. The chapter ends with some concluding remarks on the productivity improvement methodology presented throughout this thesis.

7.1 Summary

This research work developed a set of approaches that can develop a managerial strategy for productivity improvement in manufacturing industries with consideration of various productivity attributes. Earlier in the productivity improvement process there is need of identification of various productivity attributes and grouping them in key productivity factors. The system dynamics (SD) productivity model estimates the productivity index (PI). It helps to find current productivity maturity level of manufacturing industry. If the targeted PI achievement period is too large, the managerial strategy can reduce the time by focusing on the key factors which have very low contribution. The attributes grouped under the key productivity factors can be considered for assessment and more attention.

The present research work studies the relevant existing research on productivity modeling techniques and approaches to create a comprehensive SD productivity model. It would help the organization to understand the impacts of various productivity attributes on the productivity improvement. It also aids in setting a better productivity improvement strategy. The SD productivity model includes identification of attributes affecting productivity, grouping them in five key productivity factors, developing questionnaire on productivity attributes, structural equation modeling for causal relationship among factors, causal loop modeling, detailed system dynamics (SD) modeling and analysis.

As the part of this research, a literature review on productivity is conducted to explore the contribution of researchers’ working on productivity improvement in various industrial sectors as discussed in chapter 2. Various research papers are analyzed and the attributes affecting
productivity are identified. It is found that the available literature on productivity is largely ignored to highlight the interactions among various productivity attributes. Unlike the previous approaches the study has grouped these attributes into five key productivity factors to help organize research work. Productivity improvement needs attention to be paid on using and manipulating productivity attributes which is often a challenging task. Understanding critical attributes of both positive and negative types help to set necessary steps to reduce project cost overrun and project completion delay which result into improved productivity and overall project performance. This work, therefore, will provide a platform for developing productivity model and measuring productivity index (PI) with the help of identified attributes to better understand the key productivity factors and plan for productivity enhancement in manufacturing industries.

Literature review reveals that the measuring tool for productivity attributes is largely ignored. To fill this gap the questionnaire on productivity attributes (QPA) based on five point rating scale is developed as discussed in chapter 3. The universal set of identified productivity attributes is used to develop QPA. The designed QPA is further used as a generalized measure to estimate widespread and organized productivity attributes. The generic scale used for developed measure justifies its use as it is easily administrable and helpful to compare various groups. By conducting various statistical analyses a five factor conceptual framework is designed. The developed measure for productivity attributes would be basis for formulating favorable productivity model showing interaction among key productivity factors.

The present research intends to provide a structural equation model of productivity showing causal relationship among key productivity factors for productivity improvement in manufacturing industries. It calculates the statistically significant relations for key productivity factors. The organizational culture factor plays a crucial role as a driver while remaining four factors including human resource management, management strategy, production methodology, and performance behave as system elements. The driver and system elements of framework help to achieve better results in terms of improved productivity through proper implementation.

The results presented in section 4.6 illustrate how the model works and gives mathematical representation of causal relation developed among key productivity factors. Further, the chapter presents managerial implications that discuss the role of key productivity
factors in association with productivity attributes. The mathematical relations derived among key productivity factors should be further used to develop the SD productivity model.

In the present study, a productivity system dynamics model is designed to help explain the supply and growth distribution dynamics as observed in the causal relations developed among key productivity factors. The SD model of the productivity index (PI) consists of three closed loops ‘driver loop’, ‘system loop’, and ‘PI loop’ as discussed in chapter 5. The model captures the interactions among the five constructs where the PI represents the sum of the ‘driver’ and the ‘system’ scores. This dynamics model reflects the assumption that the PI can be healthier provided that the organization focuses on improving the five constructs to achieve better results. The developed SD model proves that for any organization in its initial phase need to put attention in improving the attributes of key factors human resource management, organizational culture, and performance to achieve higher maturity levels within short period of time.

7.2 Contributions

This section discusses the significant research contributions of the work reported in this thesis.

7.2.1 Identification of Attributes Affecting Productivity

This research has presented new methodology to estimate the productivity index and current productivity maturity level of a manufacturing firm before the productivity strategy is finalized. Various productivity attributes are significant for cost-effective implications and contributes to total productivity. Confirming feasibility of productivity attributes in the current productivity improvement strategy before its implementation will eliminate the later need for expensive re-design efforts. The reasonable reflection of attributes aids option to the productivity improvement team in developing better strategies. The identified attributes also helps to modify a proposed productivity model or to compare alternatives in a set of it. The productivity attributes are identified on the basis of several researchers’ productivity improvement study. The literature review approach facilitates representation and analysis of research work authenticated by prominent global research journals. The existing research contribution serves as a reference
against which the productivity team can evaluate the new strategy. This study combines the various productivity attributes into a unique productivity evaluation system. The work groups the attributes into five major key productivity factors as: human resource management, management strategy, Organizational culture, production methodology, and performance. A new combination of various attributes is useful to design measuring tool which has ability to estimate productivity attributes which will be, in turn, helpful to evaluate optimal productivity improvement strategies.

7.2.2 Design and Development of Questionnaire on Productivity Attributes

The questionnaire on productivity attributes (QPA) is developed to estimate the productivity attributes. It is a generic questionnaire based on five point scale works as a survey tool. It collects data from respondents economically and quickly. It provides a mechanism to the productivity team for real-time analysis of the productivity attributes to confirm conceptual framework. Due to non availability of productivity attributes measuring tool, this research work has presented an approach based on a more realistic survey based data for estimating productivity attributes and conceptual framework. The designed QPA is acceptable since, various statistical analyses are conducted to check its construct validity and reliability. The optimal scale categorization is also used to convert ranking scale into ordinal scale. The descriptive infit and outfit mean square statistical measures are used to identify misfitting items. The exploratory factor analysis also confirmed the five factor conceptual framework.

The research effort tries to consider the various productivity attributes from manufacturing industries for design of QPA. It uses the survey data to confirm the five factor conceptual framework. The framework will provide a platform to develop various productivity models for productivity improvements.

7.2.3 Causal Relationship among Key Productivity Factors

This research have studied the conceptual framework and developed new productivity model to quantify the effects of five key productivity factors in a productivity improvement strategy. Initially, it created a structural equation model (SEM) for the relationships suggested by Malcom Baldrige national quality award (MBNQA) framework. As a result, the framework suggested the execution of driver and system elements for productivity improvement. Further; a
new model is developed giving strong relation coefficients among productivity factors by elimination of non significant relations.

The research study proposed a SEM for the productivity improvement. The model represents the relationships between the organizational culture playing a role of driver element and human resource management, management strategy, production methodology, and performance acting as system elements. It also represents intra-relations among system elements. This causal relationship is useful for studying dynamics behavior of these factors to set optimal strategy for productivity improvement in manufacturing industries.

7.2.4 System Dynamics Modeling to Measure Productivity Index

The research work studies and clearly presents how to measure the productivity index (PI) and current productivity maturity level of a manufacturing industry. Reducing productivity maturity level time results in economic benefits for the industry. This study supports the arguments for reducing productivity maturity level time. Relating productivity maturity level time to greater profitability is a difficult but important undertaking. No broad work for measurement of PI and productivity maturity level is previously existed. The casual relationship constructed through SEM is used to explain the supply and distribution growth dynamics observed for five factor conceptual framework. Productivity teams need to understand supply and growth behavior of driver and system elements associated with the generation of productivity index. It needs to evaluate each factor for identifying where to concentrate the efforts. The casual loop diagram presented in Section 5.5 is a novel attempt to understand the implications of various feedback loops to estimate the productivity index. Further, the stock-flow diagram developed in Chapter 5 to quantify the productivity index and time required to achieve targeted PI at various maturity levels. It also helps to understand the contribution of each productivity factor and the need to start more concentration to boost PI development.

7.3 Conclusions

The conclusions based on the current study as revealed by the collected data and proposed model are given as below:
1. A diverse literature available on productivity is exposed that there is a significant and supportive relationship between productivity attributes and productivity improvement strategy. It is managerially feasible and desirable to consider the impact of the attributes, and if implemented successfully, it would result in improved productivity. In this work identification of various productivity attributes has been completed successfully by finding the vital forty-five attributes.

2. An attempt is made to design the innovative questionnaire on productivity attributes (QPA) that satisfy need of widespread productivity attributes measurement. The surveyed data is analyzed which includes basic statistical measures (mean and standard deviation), descriptive statistics (infit and outfit mean square statistic measures), one way ANOVA, exploratory factor analysis (EFA). It is helped to identify fourteen misfitting items.

3. The rating scale model (RSM) developed for optimal scale categorization has proved that for the five points rating scale there is a separate location for each scale. It is also found that there is no disordered threshold for any subscale.

4. The exploratory factor analysis performed by using the method of principle component analysis with Varimax rotation is resulted into five factor conceptual framework.

5. The questionnaire and five factor conceptual framework is validated for their construct validity by calculating coefficient of Cronbach’s alpha value which in turn increased the internal reliability of framework.

6. The questionnaire and five factor conceptual framework are also validated for their discriminant validity by conducting confirmative factor analysis.

7. From structural equation model, it is shown that five factor conceptual framework is significant and all five factors are interrelated with each other. It is also noted that the factor organizational culture behaves as the driver element showing strong coefficient relations with remaining four system elements including human resource management, management strategy, production methodology, and performance.

8. The result analysis of mathematical model has demonstrated as how causal relationships have become more efficient with an integrated key productivity platform.

9. In this work, the innovative way for the productivity improvement strategy is applied by using system dynamics model.

10. Simulated results of system dynamics model are used to measure productivity index, enabling to find the existing productivity maturity level of an organization.
11. For any organization in its initial phase, the proposed SD model shows that there is need to put attention for improving the productivity attributes grouped under the factors of human resource management (HRM), organizational culture (OC), and performance (PER) for higher maturity levels within short time span.

12. Time span of achieving productivity maturity levels can be reduced by four years with the application of proposed SD model.

13. The study also revealed that the lack of attention on improvement of factors HRM, OC, and PER is resulted into budgeted cost overruns, execution time overruns and unsuccessful change management.

14. A case study is ascertained that productivity improvement strategy is useful to organizations. Yet many organizations fail to implement it effectively. Hence such organizations do not achieve the full benefits out of its implementation as they do not appreciate the various dimensions of its implementation. Lack of identification of various productivity attributes and insufficient understanding of key productivity factors implementation contribute to the failure of productivity improvement strategy.

7.4 Future Scope

Productivity for any manufacturing industry is essentially a function of a set of indiscriminate variables. Such variables are the identification of various attributes affecting productivity and the contribution of efforts for coordination among them.

In this work, the researcher has set goals and objectives for the study purpose and studied accordingly. To study every aspect concern with the productivity improvement will take long duration. Since there are more aspects need to cover horizontally and vertically associated with different types of productivity attributes. The scope of the future study can be further expanded as follow:

1. This work has presented quantitative causal relation to develop system dynamics productivity model for measurement of the productivity index to estimate current maturity level of productivity. It helps to set managerial strategy for productivity improvement program being processed in the small to medium scale manufacturing industries. However, this work can also
be extended to large scale industry. There is need of implementation of proposed productivity improvement strategy yet to be tested at large scale industrial level.

2. Similarly, the work has been restricted to 311 respondents due to limitation of time in obtaining data from employees working in manufacturing industries. However, further research can be undertaken by increasing the sample size to obtain more refined results.

7.5 Concluding Remarks

Productivity is one of the factors which affect overall performance of any organization. The productivity improvement managerial strategy leads to process improvement, thereby causing better utilization of resources as well as getting higher quality levels. This study shows an attempt to achieve the objective of improving productivity within less duration of time. In an order to satisfy the objective the study adopted a methodology as described in figure 1.1. The proposed study resulted into development of a system dynamics model that suggests the better managerial strategy for productivity improvement.

Identifying key productivity factors would involve suitably decomposing these factors into productivity attributes and developing productivity architectures. The system dynamics (SD) model with five factor conceptualized framework is useful to measure productivity index (PI) which in turn helps to find current productivity maturity level of manufacturing organization. The SD productivity model should be beneficial to variety of manufacturing organizations. The execution of SD productivity model will vary depending on the recommended attribute assessment gaps encountered for the manufacturing organizations.

The managerial strategy based on the SD model must be designed on basis of the specific manufacturing organization. This in turn requires understanding of specified productivity attributes utilized in the model. The team concerned with productivity improvement must identify how different attributes affect the productivity and to what extent. In this study, it is found that the attributes categorized under the factors organizational culture, human resource management, and performance are found to be more influencing to enhance the productivity which is ascertained by a case study conducted. Hence, it is needed to be focused on the attributes categorized under these factors.
The methodology adopted can also be useful for developing SD model of any organization. The SD model must also take into account the various productivity attributes implemented in the organization. The effort should be taken to collect data on the attributes and involved in making that data accessible to the development team. It must be remembered, however, that the final goal for the productivity improvement team is to set a profitable managerial strategy.