CHAPTER 7

SUMMARY AND CONCLUSION

7.1 FINDINGS FROM THE RESEARCH

The research has been comprehensive keeping in trend the current and future needs of excellence in the selection of Non-Traditional Machining Processes (NTMPs). The result of this exhaustive research work has brought out the application of web technology to the emerging machining needs. The salient details of the research findings are as follows:

1. 12 common NTMPs of industrial importance are incorporated in the proposed web enabled knowledge base system.

2. Separate user module for selection and expert module for knowledge up gradation of NTMPs are developed.

3. Process capabilities and other process parameters of NTMPs are graded based on their industrial relevance.

4. More than 25 case studies are dealt with in order to validate the developed web-enabled knowledge base system.

7.2 CONTRIBUTIONS

The abundance of available and emerging selection procedures for NTMPs has confused the design engineers in selecting the appropriate NTMPs. The need to select the appropriate NTMP has become inevitable for survival of the manufacturing companies dealing with NTMPs. This is needed
to evolve an exhaustive methodology to select an NTMP and to suit the requirements of a design engineer for a given part. This research study has given a holistic approach to select the appropriate NTMPS for excellence in process selection. The major contributions, which probably, the first of its kind, are as follows:

1. Helping the design engineers in selecting a suitable NTMP for the problem at hand through ‘Selection module’,
2. Dealing with very large data and responding quickly using ‘Expert module’,
3. Standardising the conclusion for a given set of data related to NTMPs,
4. Capturing the scarce expertise on NTMPs and making it available for effective use,
5. Multi-attribute SQL based queries with knowledge base,
6. Expert Module to update process knowledge, and
7. Interactive selection of process parameters.

All the aforementioned have been adequately substantiated with current and live data. The software by helping the design engineer will show its impact on the excellence in selection of NTMPs. This software is also made versatile for global application.

**7.3 LIMITATIONS**

Research and development in this area is cumbersome. Identifying various NTMPs parameters used in different companies and algorithms for excellence in selection of NTMPs takes a lot of time and large-scale effort.
Effective operation of such computer systems therefore requires not only use of logic but also of appropriate inference, intuition and experience.

The limitation of the present study is that the available knowledge base. Only 12 common NTMPs of industrial importance are incorporated into the system. Accurate and exact selection can be made by adding more number of NTMPs. Another limitation of the study is expert knowledge. This is a common problem when collecting data from different countries the expert knowledge differs thoroughly. The selection of NTMPs made for one country may not be suitable for another country because of varying input requirements.

7.4 SCOPE FOR FURTHER RESEARCH

The same selection system can be adopted for any type of manufacturing processes practised by small, medium, and large-scale industries. The research attempt to cross-process innovations and their selection can be a topic for further research. There could be research on selection of NTMPs with same input requirement between two different countries as there exists many changes in process capabilities and performance.

A similar research can also be done by mapping the manufacturing processes such as casting, welding, forming, and machining instead of keeping selection of NTMPs alone.

The present research can be extended to selection of hybrid non-traditional machining processes as well. The expert system used can be upgraded to hybrid expert system so that process characteristic curves can also be fed as input to the system and selection can be made.
To keep the knowledge base up-to-date and to meet the technological development across the globe, a separate expert module can be introduced into the web enabled knowledge base system so that experts who are physically separated but geographically well connected through internet can share their knowledge and update the common knowledge bank thereby up-to-date and accurate selection of NTMPs can be made possible.

The NTMPs can be modeled based on Metal Removal Rate (MRR) and surface finish using neural network approach and accurate selection can be done using the developed models.

The present research can be extended by including certain important selection parameters such as machining time, machining cost, metal removal rate, and environmental factors of NTMPs in the selection procedure so that a more realistic selection of NTMPs can be made.

The web enabled knowledge base system can be used as a guiding tool for the young entrepreneurs, engineers and technocrats involved in decision making process. The developed web enabled knowledge base system has tremendous potential to make it a commercial package.

7.5 CONCLUSION

This research work presents a web enabled knowledge base system for selecting the appropriate NTMPs to meet specific input requirements for a given part. This thesis outlines the method, incorporating simple steps, which have been treated with caution and human judgement relating to the conclusions. The software takes into consideration all the vital process parameters such as material, shape applications, process capability, and process economy.
It is observed that the developed web enabled knowledge base system works satisfactorily and yields acceptable results, as well as makes accurate decisions. It is simple to note from the output of the expert system for each of the NTMPs, that the material application and shape application dominates the selection process.

The developed approach surely eases the decision maker's task of choosing the quantitative weights and making further calculations and, thereby, renders the decision maker(s) less susceptible to human error. Moreover, this approach does not require the decision maker(s) to have any in-depth technical knowledge regarding the available NTMPs and their capabilities.

The data related to NTMPs can be centralized with the approach described in this research work. The data can be stored in one of the web server, which allows the user to access through internet. This means it is accessible throughout the world. The bulky data hand books need not be carried all over the place. The NTMPs related data can be stored and maintained at any one site by some standard organizations. Users can access the most up-to-date data easily throughout the world and even benefit from any minor change in the data. Another important feature is platform independence. The client side can be of any platform to access the server information.

The applicability of the approach is illustrated by introducing a large number of case studies. For case studies, the selection and ranking of NTMPs obtained from the developed approach are consistent with the literature and the application solutions in industry. Identifying relevant attributes, determining their relative importance in the selection process, combining them to obtain a single ranking score require extensive discussion, brainstorming sessions, accumulation of expertise, and knowledge within the
manufacturing organization. Once properly introduced and implemented in the selection process, the proposed web enabled knowledge base system should improve the NTMP selection process and consequently contribute to the efficiency and profitability of manufacturing organizations.

The thesis also suggests that before making any commitment to install the recommended software, the user should carefully read the software description, and if possible consult with other design engineers who are using the recommended software.