ABSTRACT

Manufacturing is defined as the transformation of material and information into goods for the satisfaction of human needs, and is one of the primary wealth generating activities for any nation and contributes significantly to the employment. The advancements of technology in manufacturing sector lead to gradual reduction in the work force employed in manufacturing industries and lead to the world wide productivity. One of the most important indicators reflecting the industrial and technological development of the country is the growth of the machine tools in the manufacturing sector.

These observations show the importance of manufacturing with the overall economic development of the nation and also the need for research and development in the manufacturing field. Thus, the study of the issues related to manufacturing becomes increasingly important not only to the industry but also to the academic community, which is often challenged with finding solutions to the problems relevant to the industry.

Decisions regarding manufacturing process and system require technical understanding and expertise as well as the ability to satisfy certain business objectives. Thus, combination of engineering and management disciplines are required to provide a decision making framework for
manufacturing. Decision making depends on particular problems, specific objectives, goals and criteria. The four main attributes/factors in manufacturing are cost, time, quality and flexibility, but all these manufacturing attributes are not relevant to every manufacturing decision. Each class of attributes arises in specific form in specific problem. In manufacturing, decision making which is basically selection of values of certain variables relates to the manufacturing operation or system. It is not possible to optimize all attributes simultaneously. The overall outcome of manufacturing decision is rather governed by trade off between attributes.

In order to optimize the systems/processes, various analyses are required. These analyses of manufacturing system can be conceptualized as the mapping from the performance requirements of manufacturing system onto suitable values of decision variables, which describe the physical design of system. The performance measures are either benefit measures (higher the better) or cost measures (lower the better). The performance measure differs from one system to another. The design of the manufacturing system or process is the process of deciding the values of the decision variables of the manufacturing or deciding a suitable process from the alternatives. The methods and tools for the analysis of manufacturing systems/processes fall into many broad alternatives.

--Mathematical programming
Because of the scenario that drastically changes the requirements of the manufacturing system from time to time, the design is approved to the first part produced, when the analysis of systems/processes becomes more important. There is no single tool which can provide the complete satisfaction for analyzing the process or system. Hence, the proposed system/process design is rarely implemented entirely. Even though more tools and techniques are available, new tools are required.

This thesis provides an integrated approach called graph theory matrix approach for the evaluation of manufacturing system or process. Since 1960, the graph theory and matrix approach find wider application in the field of game theory, chemistry and computer networks. Now it is applied to solve the traveling salesman problem and problems in supply chain management. Agrawal.V.P [1989], O.P.Gandhi [1992] and Venkatasamy [1996] have shown the possibilities to solve the problems in manufacturing area by using graph theory, specifically digraph and matrix approach. This thesis further explores the capability of digraph and matrix approach to analyze and evaluate the manufacturing systems/processes. This approach provides an index, which shows the performance of the systems/processes. A software has been developed to find the universal evaluation index from the universal attributes characteristic permanent function. Two case studies which have been
considered in this research work for the justification of employing the graph theory and matrix approach in the manufacturing process/system applications. They are the evaluation of jig for flange coupling and the evaluation and selection of the best design for a motor bike kicker from the defined two alternatives based on design aspects. In this research work, the milling machine selection problem has also been considered in which the AHP, ANP and graph theory and matrix approach have been employed and subsequently the comparison of the results implies that graph theory and matrix approach has more effectiveness than that of the AHP and ANP.