EXPERT SYSTEM APPROACH
TO
INTEGRATION OF DESIGN WITH MANUFACTURE

D. JANAKI RAM

THESIS SUBMITTED IN FULFILMENT
OF THE DEGREE OF DOCTOR OF PHILOSOPHY

Department of Mechanical Engineering
Indian Institute of Technology, Delhi
New Delhi - 110 016
INDIA
December, 1989

CERTIFICATE

This is to certify that the thesis entitled **"EXPERT SYSTEM APPROACH TO DESIGN-MANUFACTURE INTEGRATION"** being submitted by Mr.D. Janaki Ram to the Indian Institute of Technology, New Delhi, India for the award of the degree "DOCTOR OF PHILOSOPHY " is a record of bonafide research work carried out by him under our guidance and supervision.

To the best of our knowledge the thesis has reached the requisite standard. The material presented in this thesis has not been submitted in part or full to any other University or Institution for award of any degree or diploma.

11-12-1989

Dr. U.R.K. RAO,
Professor,
Mechanical Engg. Dept.,
I I T DELHI,
NEW DELHI- 110 016

L V Prasad

Mr. L.V. Prasad,
Asst. Professor,
Mechanical Engg. Dept.,
I I T DELHI,
NEW DELHI- 110 016

ACKNOWLEDGEMENTS

At the outset, I would like to express my deep sense of gratitude to Prof. U.R.K.Rao and to Prof. L.V.Prasad for their invaluable guidance and help in the completion of this thesis. The many discussions that we had and the useful suggestions that were made, helped me in not only determining the directions and contours of the present work but also helped me to finish it in reasonable amount of time. Needless to say, the thesis would not be in the present shape, without their constant and unwavering attention and help.

My father and my mother are a source of constant inspiration to me. Without their touching care and love, and moral support, it could not have been possible for me to complete this course of study.

I have the support, affection and guidance of my brother and sister all through. Their contribution to the work, though invisible, is invaluable to me.

Finally, I would like to express my sincere gratitude to "elder" Raju, Sarat, KRK, Srinivas, Rao, and Mahesh, who have helped me a lot in the preparation of the manuscript.

ABSTRACT

Many problems relating to the manufacture of a product can be traced back to the inappropriate design decisions. However, it is not realistic to expect the designer to anticipate all the manufacture-related problems and constraints while taking design decisions. The advent of intelligent CAD systems based on expert systems offers much scope for helping the designer in this respect. The thesis concerns the development of an expert system for bringing effective integration between design and manufacturing aspects in the process of designing.

The different classes of design activity have been examined and a "Design Process" has been formulated to encompass routine designing of specialized products such as gear-boxes.The basic issues relating design-manufacture interaction have been identified. These are material selection for component design, tolerance allocation, design for manufacture, and design for assembly. These issues have been considered in the development of the expert system EXDEM (Expert System for Design and Manufacture).

Methodologies for material selection and tolerance allocation have been formulated and implemented on EXDEM. The process of checking the design from a check-list of rules and tailoring the designs for automatic assembly have also been implemented on the system.

A gearing design problem has been solved to exemplify the working of the expert system EXDEM.

CONTENTS