A STUDY OF THE EFFECTIVENESS OF ADAPTING FUSED DEPOSITION MODELLING (FDM) IN INDUSTRIAL DESIGN PROCESS

FIRDAUS BIN ZAWAWI

MA

April 2005
A STUDY OF THE EFFECTIVENESS OF ADAPTING FUSED DEPOSITION MODELLING (FDM) IN INDUSTRIAL DESIGN PROCESS

FIRDAUS BIN ZAWAWI

Thesis submitted in fulfilment of the requirements for the degree of Master of Art

Faculty of Art & Design

April 2005
ACKNOWLEDGEMENTS

Thanks are due to a number of people from whom I have received a great deal of assistance, encouragement and support. I am greatly indebted to my research supervisor, Assoc. Prof. Dr. Marzuki Hj. Ibrahim for his invaluable guidance and constructive criticism without which this thesis would not have come to fruition. I owe him a great deal of gratitude for his time and his continuous efforts to guide my research and challenge my patience beyond preconceived limits.

I am also especially thankful to the people in the organisations which took part in the case studies, TNB Research (TNBR) in Bangi, Selangor, Universiti Islam Antarabangsa Malaysia (UIAM) in Gombak and Technology Park Malaysia (TPM) in Bukit Jalil. Without their time, interest and information, the collection of data and research findings presented here would not have been possible. I am also very indebted to the TNBR for its support and providing an opportunity for me to work in the amazing field of Fused Deposition Modelling. This support is gratefully acknowledged.

My family and close friends have provided continuous support. My wife has been incredibly supportive and patient while I was completing this research. For that I am forever thankful.

I would like to express my thanks to Ma for always being proud of me and my accomplishments. I can never repay all she has done.
TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Contents</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>ii</td>
</tr>
<tr>
<td>TABLE OF CONTENTS</td>
<td>iii</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>viii</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>ix</td>
</tr>
<tr>
<td>LIST OF ABBREVIATIONS</td>
<td>xi</td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>xii</td>
</tr>
</tbody>
</table>

CHAPTER 1: INTRODUCTION

1.1 Introduction                        1
1.2 Rationale for the Study            3
1.3 Research Objectives                4
1.4 Order of Presentation              5

CHAPTER 2: INDUSTRIAL DESIGN

2.1 Design                               7
  2.1.1 Definitions of Design            7
  2.1.2 The Importance of Design         10
2.2 Industrial Design                   12
  2.2.1 Definitions of Industrial Design 12
  2.2.2 The Importance of Industrial Design 14
  2.2.3 The Industrial Designer         16
2.3 Industrial Design Process           19
  2.3.1 The Importance of Industrial Design Process 19
  2.3.2 Industrial Design Process       22
  2.3.3 Model of the Industrial Design Process 22
    2.3.3 (a) Conceptual Design          24
    2.3.3 (b) Embodiment Design          24
    2.3.3 (c) Detail Design              25
    2.3.3 (d) Design for Manufacture     25
    2.3.3 (e) Task Clarification Phase   28
ABSTRACT

The principal objective of this study is to assist Industrial Designers to improve the quality of prototype and design process through the recommendation of guidelines from an industrial design perspective. The approach adopted in this research was a study of the process of producing prototypes using different FDM machines by three selected organisations. Two phases of data collection were employed in this study: literature search and review (Phase One) and case study (Phase Two). Case studies included semi-structured interviews with senior staff directly involve in industrial design process. With this, a set of detailed descriptions of effectiveness of adapting FDM in industrial design process were obtained. FDM machines were chosen for comparison because at present it is one of the successful technologies to produce a prototype, representing with non-toxic materials, easy to process, simple, accurate and fast. The case studies focus on six important factors derived from Peschges (1999) research: 1) Preciseness, 2) Surface Quality, 3) Cost Corridor, 4) Time, 5) Suitability for Geometry and 6) Practical Features. The findings showed that they produced durable prototype, which are smooth surfaced and complete layer, thin layer, with cost savings and reduce build time, as well as wide suitability for geometry, practical features achieved by improving surface quality through sanding, polishing and painting the prototype. This thesis concludes that FDM machine model Quantum is the best machine to fulfil the requirements of quality prototype produced. Finally, it is hoped that this research will benefit any individuals or organizations involved in industrial design process.