



**NATIONAL TECHNICAL UNIVERSITY COLLEGE OF  
MALAYSIA**

**Intelligent Part Recognition and Auto Storage  
Using Feature-Based Modelling Within CAD  
System**

Thesis submitted in accordance with the requirements of the National  
Technical University College of Malaysia for the Degree of Bachelor of  
Engineering (Honours) Manufacturing (Process)

By

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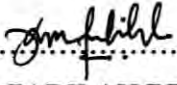
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## **ABSTRACT**

Feature-based modelling is one of a way of building a product model. One can start either with a more or less complete geometric model and defined form features on it, or one start sketching by combining form features from a standard library. The parametric representation of features provides a powerful way to change features with respect to their dimension. The programme is created and developed in SolidWorks and Visual Basic software to recognize the feature-based modelling and save them in part file storage. This programme is developed by studying the past research done on feature modelling fields, the Visual Basic programming language, and the SolidWorks software as well. The literature review and background study are done on the journals and books found in the internet or library. This project is important as it can enhance and simplify CAD user to recognize the feature-based modelling and save them in designated part files storage.

## **ACKNOWLEDGEMENTS**

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## **LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE**

API	-	Advanced Programming Interface
CAD	-	Computer-Aided Design
CAM	-	Computer-Aided Manufacturing
CAE	-	Computer-Aided Analysis
CADD	-	Computer-Aided Design and Drafting
CAID	-	Computer-Aided Industrial Design
CAAD	-	Computer-Aided Architectural Design
CATIA	-	Computer-Aided Three-Dimensional Interactive Applications
CAX	-	A summary term for various kinds of Computer-Aided technologies
COSMOS	-	Curvedness-Orientation-Shape Map on Sphere
DSL	-	Domain Specific Language
GUI	-	Graphical User Interface
LISP	-	List Processing
NX	-	UniGraphics
PDM	-	Product Data Management
PLM	-	Product Lifecycle Management
PTC	-	Parametric Technology Corporation
UGS	-	Unigraphics Solution Incorporated
VBA	-	Visual Basic Application



# **CHAPTER 1**

## **INTRODUCTION**

### **1.1 Introduction**

#### **1.1.1 The SolidWorks History**

#### **1.1.2 The Working Plan**

### **1.2 Problem Statements**

### **1.3 Objectives of The Project**

### **1.4 Scope of The Project**

## **1.1 Introduction**

### **1.1.1 The SolidWorks History**

SolidWorks Corporation was founded in December 1993. The headquarters are situated in Concord, Massachusetts. The ownership of this company was acquired in 1997 by *Dassault Systemes S.A.*, which is based in Suresnes, France. It is the leading global developer of “*product lifecycle management*” (PLM) solutions.

The mission of this company is to unleash the power of 3D for everyone in product development. SolidWorks serves customers in industrial, medical, scientific, consumer, educational, technology, and transportation markets.

With so many CAD based products in the market, SolidWorks still standing strong as it has very competitive product. Competitive differentiation of SolidWorks software is such as below.

- ❖ It is the number 1 supplier of 3D mechanical design software for the mainstream market.
- ❖ It is the mainstream 3D CAD market's leader in number of users in production, customer satisfaction, and revenue.
- ❖ It is the standard for mainstream 3D CAD software that blends all of the functionality that engineers need to create exact product designs and the ease of use that lets them complete those designs quickly.

- ❖ It has proven its adaptability to most engineering design needs. Customers have used it to design a broad range of products, including exploratory sub-sea, electric vehicles, Formula one race cars, and industrial machinery with tens of thousands of parts.
- ❖ It has more users worldwide than any other mainstream 3D CAD software with 400,000 designers and engineers using it at more than 66,000 locations in more than 100 countries.
- ❖ It has been endorsed and embraced by the world's top-ranked four and five-year engineering degree programs, worldwide. Over 4,500 academic institutions are using SolidWorks software to teach engineering technology and design.
- ❖ It has evolved with more product innovations and enhancements than any other 3D CAD product in the industry. This means SolidWorks has kept abreast of evolving customer needs and enhanced the technology to constantly meet those needs.
- ❖ It is the only 3D CAD software from a company that has been 100 percent focused on 3D product design since its beginning.

(<http://www.solidworks.com/pages/company/companyprofile.html>)

### 1.1.2 The Working Plan

For this project, it is required to design a program, which is to recognize the feature-based modeling part and save them in part files storage. This program is developed by studying the past research done on feature modelling fields, the Visual Basic programming language, and the SolidWorks software as well.

Initially, the related topics from journals and websites have been searched in the internet in order to gain more knowledge and understanding about the project title. The journals includes about the SolidWorks, UniGraphics, ProEngineer, CATIA, and Visual Basic Application.

Some exercises in the SolidWorks and Visual Basic Application have been worked out as well. This is important as it can enhance more skills and understanding in designing a program.

To understand more about the programming, the Computer Programming Using MVC++ subject have been revised back, which was taken on the first year. This subject had introduced to the computer and its functions, the components and the software, the programming language, how the computer runs the program, and general form of C++ programming. This subject had helped a lot for this project.

Lastly, the flowchart and the pseudo-codes for the program have been designed. From this flowchart and pseudo-codes, the fully program for this project can be built, which is implemented in *Projek Sarjana Muda 2 (PSM 2)*.



## **1.2 Problem Statements**

The problem of the project is how to develop a program in SolidWorks and Visual Basic software in order to recognize the feature and save the part files into designated storage folders saved on feature-based modelling analysis. To overcome this problem, several topics related found out and understand how the programming could work. They are AutoCAD, CATIA, SolidWork, UniGraphics, ProEngineer, CAD/CAM, Visual Basic, and SolidEdge.

## **1.3 Objectives of The Project**

The objectives of this project are as below:

- (i) To understand feature based modelling concept.
- (ii) To apply feature based modelling concept within CAD models.
- (iii) To create an intelligent CAD files storage system based on feature based modelling.

## **1.4 Scope of The Project**

The scopes of this project are as follow:

- (i) Feature Based Modelling.
- (ii) Visual Basic Programming Language.
- (iii) CAD System.
- (iv) Programming.
- (v) Case Study.

## **CHAPTER 2**

### **LITERATURE REVIEW**

#### **2.1 CAD**

##### **2.1.1 CAD System**

##### **2.1.2 Types of CAD Applications**

###### **2.1.2.1 CATIA**

###### **2.1.2.2 SolidWorks**

###### **2.1.2.2.1 The SolidWorks Approach**

###### **2.1.2.2.1.1 Parts**

###### **2.1.2.2.1.2 Assemblies**

###### **2.1.2.2.1.3 Drawings**

**2.1.2.3 Pro/Engineer**

**2.1.2.4 UniGraphics**

**2.1.2.5 SolidEdge**

## **2.2 Programming in CAD**

### **2.2.1 Advanced Programming Interface (API)**

#### **2.2.1.1 Visual Basic Application (VBA)**

## **2.3 Feature-Based Modeling**

### **2.3.1 Introduction**

### **2.3.2 Design by Feature**

### **2.3.3 Interactive Feature Definition / Feature Identification**

### **2.3.4 Feature Models**

### **2.3.5 Feature Model & Domain Specific Language**

## **2.1 CAD**

### **2.1.1 CAD System**

Engineers, architects and other design professionals use Computer-aided design (CAD), which is the wide range of computer-based tools that assist them in their design activities. Within the Product Lifecycle Management process, it is the main geometry authoring tool and involves both software and sometimes special-purpose hardware.

CAD is sometimes translated as "computer-assisted", "computer-aided drafting", or a similar phrase. Related acronyms are CADD, which stands for "computer-aided design and drafting", CAID for Computer-aided Industrial Design and CAAD, for "computer-aided architectural design". There are some subtle differences in meaning and application, though all these terms are essentially synonymous.

Some of the capabilities of modern CAD systems include:

- Wireframe geometry creation.
- 3D parametric feature based modelling.
- Solid modelling.
- Freeform surface modelling.
- Automated design of assemblies, which are collections of parts and/or other assemblies.
- Create engineering drawings from the solid models.
- Reuse of design components.
- Ease of modification of designs and the production of multiple versions.
- Automatic generation of standard components of the design.
- Simulation of designs without building a physical prototype.



Below, as shown in Figure 2.1, is the CAD standard development process flowchart.

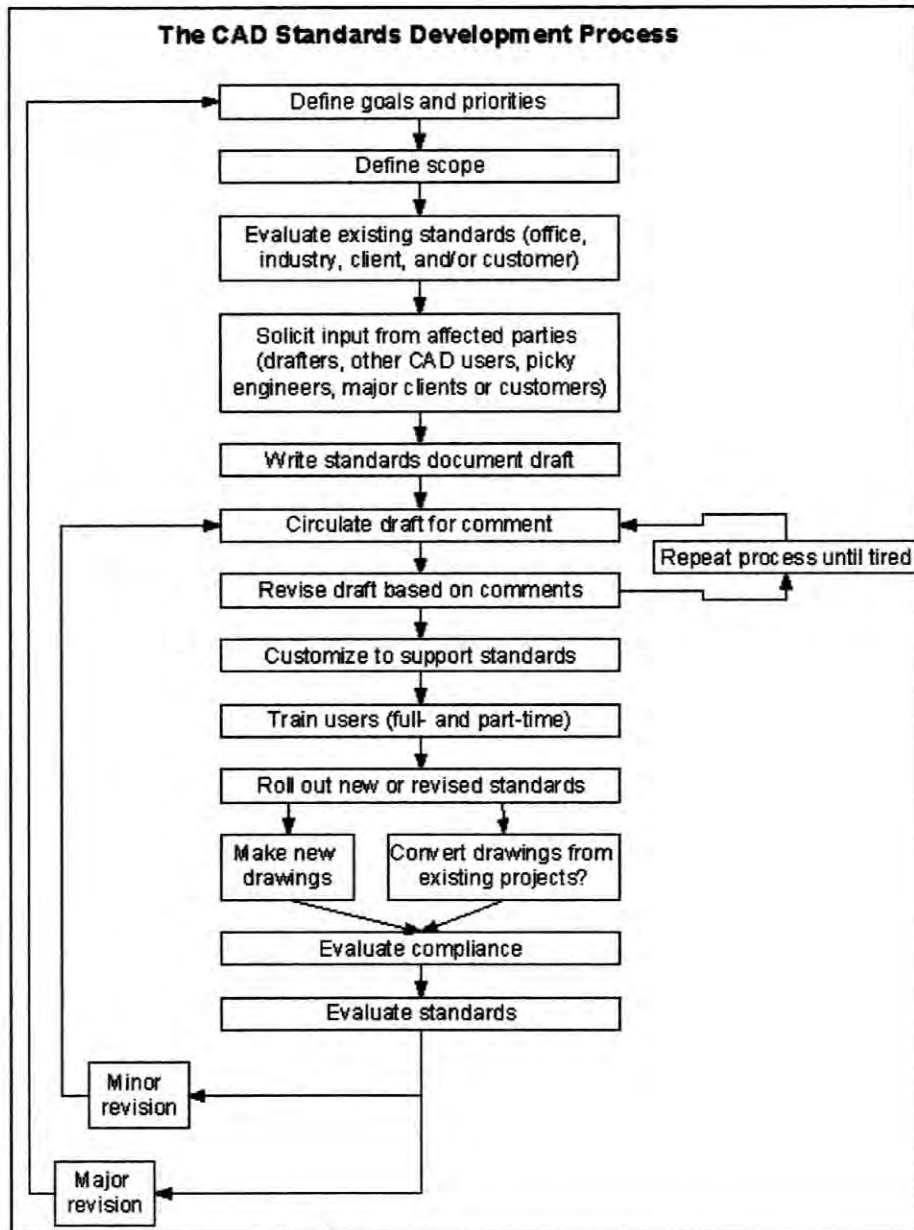


Figure 2.1: The CAD Standards Development Process

(<http://www.markcad.com/cadstandards/cadstddevflow.htm>)

## 2.1.2 Types of CAD Applications

### 2.1.2.1 CATIA

CATIA is the CAD/CAM/CAE commercial software suite developed by *Dassault Systemes*. It is marketed world-wide by IBM. It is commonly referred to as 3D PLM software. All stages of product development are supported, from conceptualization, through design (CAD) and manufacturing (CAM) until analysis (CAE).

It provides open development architecture through interfaces which can be used to customize or develop applications. The API's are supported in Fortran and C for V4 and Visual Basic and C++ for V5. These API's are called as CAA2 (or CAA V5). These interfaces provide a seamless integration for products developed on the CATIA suite of software.

CATIA V4 is principally a surface based boundary representation package. CATIA V5 is a parametric solid/surface feature based package.

CATIA is widely used throughout the engineering industry, especially in the automotive and aerospace sectors, where CATIA V4, CATIA V5 and NX (Unigraphics) are the three dominant systems.

(<http://en.wikipedia.org/wiki/CATIA>)

### **2.1.2.2 SolidWorks**

SolidWorks is a product of the SolidWorks Corporation. It is a simple to use and affordable program that can be run on Windows platforms. It is primarily designed as a high-end cost-effective alternative to 2D CAD packages.

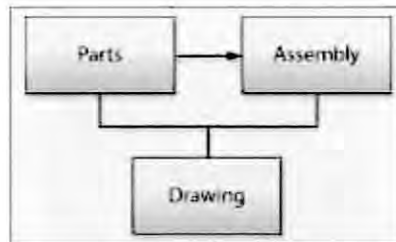
A newly-founded SolidWorks Corporation was introducing it in 1993 to act as competitor for products like AutoCAD/MDT, SDRC I-DEAS (now Unigraphics NX) and Pro/ENGINEER among many others.

To provide users with a way to harness the power of 3D without paying more than average 2D CAD software packages was the main focus of this company, plus having more features, like generating 2D drawings directly out of 3D models, and vice versa, with a single click, or finite element analysis in one package.

#### **2.1.2.2.1 The SolidWorks Approach**

SolidWorks has a quite simple approach to modeling and assembling, which is unlike other CAD packages. The geometry is defined by all dimensions. SolidWorks employs a feature-based system that can be rolled back to previous states in case something must be changed or multiple configurations of the same part must be handled, in order to create volume and modifications. Mates are created to assemble components, which define the relative positions of the components to each other.

In addition, SolidWorks has a hierarchy of putting all the things together, which can be traced as follows:

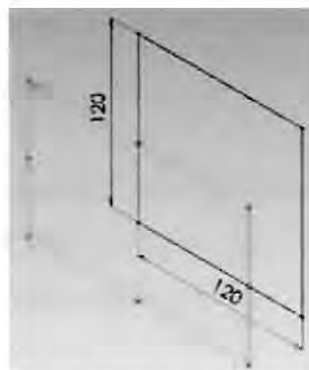


*Figure 2.2: SolidWorks Hierarchy*

By according to the main design methodology, a simple geometry parts are created. When placed in an assembly, they interact between each other. At every time, for archiving or manufacturing purposes, drawings can be created out of either parts or assemblies.

#### **2.1.2.2.1.1 Parts**

By following a feature based approach, parts are modeled. In order to define the primary geometry of the part, sketches must be created first.



*Figure 2.3: Sketching Square*