

# Universiti Teknologi Malaysia

## BORANG PENGESAHAN STATUS TESIS<sup>♦</sup>

JUDUL: DATABASE MANAGEMENT INVENTORY SYSTEM

SESI PENGAJIAN: 2005/2006

Saya

SYAHIDA BT ARIPIN

(HURUF BESAR)

mengaku membenarkan tesis (~~PSM/Sarjana/Doktor Falsafah~~)\* ini disimpan di Perpustakaan Universiti Teknologi Malaysia dengan syarat-syarat seperti berikut:

1. Tesis adalah hak milik Universiti Teknologi Malaysia.
2. Perpustakaan Universiti Teknologi Malaysia dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. \*\*Sila tandakan ( ✓ )

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

TIDAK TERHAD

Disahkan oleh

\_\_\_\_\_  
(TANDATANGAN PENULIS)

\_\_\_\_\_  
(TANDATANGAN PENYELIA)

Alamat Tetap:

**54, JALAN BAYAN 23,  
TAMAN KOTA PUTRI,  
81750 MASAI, JOHOR**

**DR ARHAM ABDULLAH**

Nama Penyelia

Tarikh : 06/07/06

Tarikh : 06/07/06

### CATATAN:

- \* Potong yang tidak berkenaan
- \*\* Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD
- ♦ Tesis dimaksudkan sebagai tesis bagi Ijazah Doktor Falsafah dan Sarjana secara penyelidikan, atau disertasi bagi pengajian secara kerja khusus dan penyelidikan, atau Laporan Projek Sarjana Muda (PSM).

“We declare that we have read through this project report and to our opinion this project report is adequate in term of scope and quality for the purpose of awarding the degree of Master of Science (Construction Management)”.

Signature : .....

Name of Supervisor I : **Dr. Arham Abdullah**

Date : 06/07/06 .....

Signature : .....

Name of Supervisor II: **En. Mohd Zamri Ramli**

Date : 06/07/06 .....

# **DATABASE MANAGEMENT INVENTORY SYSTEM**

**SYAHIDA BT ARIPIN**

A project report submitted in partial fulfillment of  
the requirements for the award of the degree of  
Master of Science (Construction Management)

Faculty of Civil Engineering  
Universiti Teknologi Malaysia

**JULY, 2006**

I declare that this project report entitled “*Database Management Inventory System*” is the result of my own research except as cited in references. The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : **Syahida bt Aripin**

Date : **06/07/06** .....

*A time to remember family and friends, too;  
A time to reminisce, and say "Thank You."*

*For my beloved parents,  
Aripin bin Jasin &  
Rokiah binti Ghazali*

*My husband,  
Ahmad Sahiri bin Maasah*

*My love is no ends.*

*Appreciation on your supervision,  
Dr. Arham Abdullah  
En. Mohd Jamri Ramli*

*Your co-operation,  
LMD, PROPEL Berhad*

*For my family,  
K/Tie, A/Man, K/Sela, A/Usop, A/Emi, K/Intan  
Aqilah, Danish, Dania, Darwish*

*And also for my friends...*

*May Allah bless you all...*

## ACKNOWLEDGEMENTS

In preparing this thesis, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my sincere appreciation to my main project supervisor, Dr. Arham Abdullah, for encouragement, guidance, critics and friendship. I am also very thankful to my co-supervisor, En. Mohd Zamri Ramli for his guidance, advices and motivation. Without their continued support and interest, this project would not have been the same as presented here.

I am also indebted to LMD, PROPEL Berhad; especially En. Suhaimi bin Aripin as the project engineer, Cik Aziah as the clerk in-charged in inventory system, Pak Harun as the storekeeper and other staffs involved directly or indirectly.

My fellow postgraduate students should also be recognised for their support. My sincere appreciation also extends to all my colleagues and others who have provided assistance at various occasions. Their views and tips are useful indeed. Unfortunately, it is not possible to list all of them in this limited space. I am grateful to all my family members.

## **ABSTRACT**

Inventory control systems in construction industry needs systematic database management system. Inventory involved in construction industry are materials, machineries, spare parts, etc. This study is about to develop the inventory system that can be applied in construction industry. The objectives are to identify the problems involved in the implementation of the current inventory system at the spare parts store, Logistics and Machineries Department (LMD), PROPEL Berhad, to identify the needs of systematic inventory system at the spare parts store and to develop the prototype of the inventory system that can be implemented at the spare parts store. A case study has been carried out at LMD, PROPEL Berhad for the prototype development. The prototype used Microsoft Access and Bar Coding System. The prototype not only benefit to the person who in-charged with the system, but also benefit to all staffs dealing with the spare parts store by making it faster, more accurate and easier.

## ABSTRAK

Sistem kawalan inventori dalam industri pembinaan memerlukan sistem pengurusan pengkalan data yang sistematik. Inventori yang terlibat dalam industri pembinaan ialah bahan-bahan, mesin, alat ganti, dan sebagainya. Kajian ini adalah tentang membina sistem inventori yang boleh diaplikasikan dalam industri pembinaan. Objektifnya adalah untuk mengenalpasti masalah yang terlibat dalam pelaksanaan sistem inventori yang sedia ada di stor alat ganti, *Logistics and Machineries Department (LMD)*, PROPEL Berhad, untuk mengenalpasti keperluan sistem inventory yang sistematik di stor alat ganti tersebut dan untuk membina prototaip sistem inventory yang boleh dilaksanakan di stor alat ganti tersebut. Kajian kes dijalankan di LMD, PROPEL Berhad untuk pembangunan prototaip. Prototaip tersebut menggunakan Microsoft Access dan system barkod. Prototaip yang dibina bukan sahaja berfaedah kepada orang yang ditugaskan terhadap system tersebut, tetapi juga bermanfaat kepada semua staf yang berurusan dengan stor alat ganti tersebut dengan mempercepatkan, memudahkan dan membuatkan urusan lebih tepat.

## TABLE OF CONTENTS

CHAPTER	TITLE	PAGE
	Title	i
	Declaration of originality and exclusiveness	ii
	Dedication	iii
	Acknowledgements	iv
	Abstract	v
	Abstrak	vi
	Table of Contents	vii
	List of Tables	xiv
	List of Figures	xv
	List of Appendices	xviii
<b>1</b>	<b>INTRODUCTION</b>	<b>1</b>
	1.1 Background	1
	1.2 Problem Statement	3
	1.3 Aim and Objectives of Research	4
	1.4 Scope of Research	5
	1.5 Importance of Research	5

<b>2</b>	<b>LITERATURE REVIEW</b>	<b>6</b>
2.1	Traditional File-Based Systems	6
2.1.1	Limitations of the File-Based Approach	7
2.1.1.1	Uncontrolled Data Redundancy	8
2.1.1.2	Inconsistent Data	8
2.1.1.3	Inflexibility	9
2.1.1.4	Limited Data Sharing	9
2.1.1.5	Difficult Data Integration	9
2.1.1.6	Poor Enforcement of Standards and Controls	10
2.1.1.7	Excessive Program Maintenance	11
2.1.1.8	Productivity Losses	11
2.2	Database Management System (DBMS)	12
2.2.1	Characteristics of a DBMS	15
2.2.1.1	Data Independence	15
2.2.1.2	Complex Data Relationships and Control of Application Data Redundancy	16
2.2.1.3	Application Generality	19
2.2.1.4	Ease of Use	19
2.2.2	Components of the DBMS Environment	20
2.2.2.1	Hardware	20
2.2.2.2	Software	21
2.2.2.3	Data	22
2.2.2.4	Procedures	22
2.2.2.5	People	23
2.2.3	Advantages of DBMS	25
2.2.3.1	Control of Data Redundancy	25
2.2.3.2	Data Consistency	25
2.2.3.3	More Information from the Same Amount of Data	25

2.2.3.4	Sharing of Data	26
2.2.3.5	Improved Data Integrity	26
2.2.3.6	Improved Security	26
2.2.3.7	Enforcement of Standards	27
2.2.3.8	Save Cost	27
2.2.3.9	Balance of Conflicting Requirements	28
2.2.3.10	Improved Data Accessibility and Responsiveness	28
2.2.3.11	Increased Productivity	28
2.2.3.12	Improved Maintenance through Data Independence	29
2.2.3.13	Increased Concurrency	29
2.2.3.14	Improved Backup and Recovery Services	29
2.2.4	Database Design Methodology	30
2.2.4.1	Critical Success Factors in Database Design	33
2.3	Facility Management: Operations and Maintenance	33
2.3.1	System Records Management and Document Control	35
2.3.2	How a Computerized Maintenance Management System (CMMS) Works	35
2.3.3	Selecting a CMMS	36
2.3.4	Implementing the CMMS	37
2.3.5	CMMS in Digital	38
2.3.5.1	Barcoding	39
2.4	Inventory System	39
2.4.1	Effects of Inaccurate Inventory Data	40
2.4.1.1	Impact on Systems	40
2.4.1.2	Impact on Users	41
2.4.1.3	Impact on the Business	42

2.4.2	Automatic Identification	42
2.4.2.1	Bar Coding System	43
2.4.2.1.1	Bar Code	45
	Symbologies	
2.4.2.1.2	Bar Code Printers	51
2.4.2.1.3	Bar Code Scanners	51
2.4.3	Other Identification Technologies	52
2.4.4	Available Inventory System in the Market	53
2.5	Related Past Researchs	54
<b>3</b>	<b>RESEARCH METHODOLOGY</b>	<b>57</b>
3.1	Introduction	57
3.2	Collecting Data	58
3.2.1	Preview Current Inventory System	59
3.2.2	Interview	59
3.2.3	Questionnaires	60
3.3	Entity-Relationship Modeling	60
3.3.1	The Concepts of the Entity-Relationship Model	60
3.3.1.1	Entities	61
3.3.1.2	Attributes	62
3.3.1.3	Relationships	64
3.3.2	Building an Entity-Relationship Diagram (ERD)	66
3.4	Database Management Inventory System Design Methodology	67
3.4.1	Conceptual and Logical Database Design	70
3.4.2	Physical Database Design	74
3.5	Database Management Inventory System Prototype Development: Microsoft Access 2002	77
3.5.1	Capabilities of Microsoft Access	77

3.5.1.1	True Relational Database Management	77
3.5.1.2	Context-Sensitive Help and the Office Assistant	78
3.5.1.3	Ease-of-Use Wizards and Builders	78
3.5.1.4	Importing, Exporting and Linking External Files	78
3.5.1.5	WYSIWYG Forms and Reports	79
3.5.1.6	Multiple-Table Queries and Relationships	80
3.5.1.7	Business Graphs and Charts	80
3.5.1.8	DDE and OLE Capabilities	81
3.5.1.9	Built-In Functions	81
3.5.1.10	Macros: Programming without Programming	82
3.5.1.11	Modules: Visual Basic for Applications – Database Programming	82
3.5.2	Components on the Access Screen	82
3.5.3	The Seven Steps Method of Design	84
3.6	Bar Coding System	85
3.6.1	Symbology: Code 39 – Full ASCII	86
3.6.1.1	The Character Set	87
3.6.1.2	Character Density Loss with Code 39 – Full ASCII	87
3.6.1.3	The Start and Stop Characters	87
3.7	Conclusion	88

<b>4</b>	<b>PROTOTYPE SYSTEM DEVELOPMENT AND OPERATIONS</b>	<b>89</b>
4.1	Questionnaires Analysis	89
4.1.1	Background	89
4.1.2	Inventory System	92
4.2	Entity-Relationship Diagram (ERD)	97
4.2.1	Entities	97
4.2.2	Attributes	97
4.2.3	Relationships	100
4.2.3.1	One-to-One Relationships	100
4.2.3.2	One-to-Many Relationships	101
4.2.3.3	Many-to-Many Relationships	102
4.2.4	Developed Entity-Relationship Diagram (ERD)	103
4.3	Database Management Inventory System Prototype Operation	104
4.3.1	Tables	104
4.3.2	Relationships	105
4.3.3	Queries	106
4.3.3.1	Choose Records and Perform Calculation	107
4.3.3.2	Create Forms based on a Query and Make Table Changes	108
4.3.3.3	As a Source of Data for Other Queries (Subquery)	109
4.3.4	Forms	110
4.3.5	Reports	111
4.3.6	Macros	111
4.3.7	Prototype Operation	112
4.3.8	Security Mechanisms	121
4.3.8.1	Password	121
4.3.8.2	Startup Options	121

4.4	Bar Coding System	122
<b>5</b>	<b>CONCLUSION AND RECOMMENDATIONS</b>	<b>124</b>
5.1	Summary	124
5.2	Recommendations	125
5.3	Conclusion	125
	<b>REFERENCES</b>	<b>127</b>
	<b>APPENDICES A – E</b>	<b>129 – 154</b>

**LIST OF TABLES**

<b>TABLE NO.</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Table of Symbologies	48
2.2	TrueLine Construction System's Descriptions	54
4.1	Importance Level of Data Accuracy in a Database	95
4.2	Respondent's Knowledge about Bar Code System	95
4.3	Needs of Systematic Database Management Inventory System at the Spare Parts Store, LMD	96
4.4	Characteristics Needed in the Systematic Database Management Inventory System at the Spare Parts Store, LMD	96

## LIST OF FIGURES

FIGURE NO.	TITLE	PAGE
2.1	File-Based Processing	7
2.2	Database Processing	13
2.3	Three Record Types in a 'Flat File' Student Registration System	17
2.4	Three Record Types in a Database Student Registration	17
2.5	A Personnel Database	18
2.6	DBMS Environment	20
2.7	<i>DreamHome</i> Hardware Configuration	21
2.8	Conceptual Database Design Phase	30
2.9	Logical Database Design Phase	31
2.10	Physical Database Design Phase	32
2.11	FM Components	34
2.12	Linear Symbology	45
2.13	2D Stacked Symbology	45
2.14	2D Matrix Symbology	46
2.15	Composite Symbology	46
3.1	Research Methodology Chart	58
3.2	Deriving ER Data Model Components	61
3.3	Entities	62
3.4	Attributes	62
3.5	One-to-One Relationship	64
3.6	One-to-Many Relationship	65
3.7	Many-to-Many Relationship	65
3.8	The Microsoft Access Window	83
3.9	The Seven Steps of Design Flowchart	84
3.10	Code 39 – Full ASCII	86

4.1	Respondent's Role in the Company	90
4.2	Respondent's Frequency Dealings with the Spare Parts Store, LMD in a Week	91
4.3	Respondent's Types of Dealings with the Spare Parts Store, LMD	91
4.4	Respondent's Problems Dealings with the Spare Parts Store, LMD	92
4.5	Manual File System Currently Used	93
4.6	Current Inventory System Problems at the Spare Parts Store, LMD	94
4.7	Data Redundancy and Inconsistent Data	94
4.8	Attributes – Supplier	98
4.9	Attributes – Supplier Specialization	98
4.10	Attributes – Spare Parts	99
4.11	Attributes – Machineries	99
4.12	Attributes – Transaction	99
4.13	Attributes – Transaction Info	99
4.14	Supplier – Supplier Specialization Relationship (One-to-One Relationship)	100
4.15	Supplier – Spare Parts Relationship (One-to-Many Relationship)	101
4.16	Spare Parts – Transaction Relationship (One-to-Many Relationship)	101
4.17	Transaction Info – Transaction Relationship (One-to-Many Relationship)	102
4.18	Spare Parts – Machineries Relationship (Many-to-Many Relationship)	102
4.19	Improved Spare Parts – Machineries Relationship	103
4.20	Developed ERD	103
4.21	Table Design Window	104
4.22	Table Machineries	105
4.23	Involved Relationships	106
4.24	Developed Queries List	107

4.25	Query Design Window	107
4.26	Query MM	108
4.27	Form Milling Machine	109
4.28	Query Transaction	109
4.29	Query Current Balance Spare Parts Design View	110
4.30	Developed Forms List	110
4.31	Data Mode	111
4.32	Macro for Password Application	112
4.33	Prototype Operations Flow Chart	113
4.34	Startup Options	122
4.35	Bar Code Design	123
4.36	Bar Code Catalogue Sheet	123

**LIST OF APPENDICES**

<b>APPENDIX</b>	<b>TITLE</b>	<b>PAGE</b>
A	Questionnaires	121
B	Microsoft Access (Tables)	141
C	Microsoft Access (Query)	145
D	Microsoft Access (Reports)	149
E	Bar Coding: Catalogue Sheet	153

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

According to Concise Oxford Dictionary (COD10) on CD-ROM Tenth Edition, '*data*' means 'the quantities, characters, or symbols on which operations are performed by a computer'. Meanwhile, '*database*' means 'a structured set of data held in a computer'. Connolly and Begg said that '*database*' is 'a shared collection of logically related data (and a description of this data), designed to meet the information needs of an organization'. They also said that '*Database Management System (DBMS)*' means a software system that enables users to define, create, and maintain the database and provides controlled access to this database'. According to Concise Oxford Dictionary (COD10) on CD-ROM Tenth Edition, '*inventory*' means 'a complete list of items such as goods in stock or the contents of a building'. Meanwhile, '*system*' means 'a complex whole; a set of things working together as a mechanism or interconnecting network'.

Inventory control systems require the frequent identification of things to the computer. For instance, to record the movement of a pallet of material from one point in the facility to another, three identifications must be made: the material being moved, its origin and its destination. In large warehouses and distribution centers, tens of thousands of identifications can be needed each day. Automatic identification is faster than manual identification and keying. It also can save labour cost (Young J.B., 1991).

Nowadays, bar coding is the most widely automatic identification technology applied. Bar code technology is well developed, the equipment required to print and read bar codes is inexpensive, and the resulting reliability and accuracy are extremely high. A bar code is a series of light and dark printed bars. The pattern of the bars is pre-established to represent alphabetic and numeric characters in any of a number of standard schemes. When a laser beam is run across the bars at a constant velocity, light is reflected from the bars and spaces in a series of pulses that can be electronically detected and converted into the appropriate characters.

Because bar code symbols are printed, they are not easily updated. Bar codes, therefore, are most applicable when the information to be encoded does not change rapidly. Things that can be readily identified with bar codes including products (a bar-coded label might be attached to a pallet or preprinted on the product or its carton), storage locations (often labels are attached to the rack or bin), employees (the bar code is usually on an ID badge or card), vehicles, tote pans, etc. in all these cases, the information contained in the bar code is constant and unvarying; it serves to identify one particular item or kind of item among many similar ones without doubt and with only a small chance for error.

Young (1991) said that in early 1950s or late 1940s, the first large-scale application was in railroad car identification. A program was sponsored by the American Association of Railroads in 1960, with Sylvania Manufacturing (now a part of GTE) producing the equipment. The railroad car identification project ultimately failed because the bar codes were not able to withstand the wear and lack of maintenance that railroad equipment is subjected to. The idea, however, was a good one and made a good test bed for bar coding as a concept. Industry has gained a great deal as a result.

In 1970, the Uniform Code Council was formed and the Universal Product Code (UPC) became a reality. It is intended specifically for retail sales applications but has possible uses wherever retail products are handled. Bar code development accelerated in the 1970s and 1980s. In 1974, the Code 39 was developed. In 1982, the Department of Defense adopted bar coding standards. In 1983 the American

National Standards Institute accepted bar coding. And since that time developments have occurred at an ever-accelerating pace (Young J.B., 1991).

## **1.2 Problem Statement**

Most businesses require a continuing flow of materials and supplies. To avoid disruption of that flow, most make an effort to keep track of the amounts of each item on hand. In small businesses with small amounts of inventory, it is often sufficient for a human to remember approximate inventory records. When the human thinks that supplies may be getting low, he or she can walk to the stock room and check. Even a moderately industrious person can effectively control several dozen items this way.

However, as the amount of inventory increases and as the rate of material flow into and out of stock increases, it becomes more and more difficult for a human to remember even approximate inventory balances. Some form of record keeping is needed to supplement the human mind.

In most businesses it is normal for several people to be involved in the keeping of inventory records. Often the clerical job of doing the arithmetic and writing the results on cards is separated from the material handling jobs of placing items on shelves, removing them when they are needed, and performing occasional counts to verify the recorded balance. In a typical manual system, material handlers move material into and out of the warehouse and create written records (called transactions) as they work. Periodically, the transactions are turned over to a clerk for posting to ledger cards. When things go right, manual inventory records can be an efficient way for businesses to assure that they have the materials they need. Unfortunately, this method of keeping inventory records, simple as it may seem, is vulnerable to a long list of possible problems (Young J.B., 1991).

The next step up from clerk and cards system is computerization in a batch environment. Batch inventory systems simply automate the clerical portion of the inventory system. Material handlers still manually record the receipt and shipment of material for central processing. But the written transactions are keyed and electronically posted to records inside a computer. There is little or no change in data gathering and material handling procedures.

Independent data collected usually keyed in by human actions which may cause errors. It is important that the information be removed from the control of humans to the extent possible to eliminate errors. Bar code error rates are very low, and they make it impossible, for all practical purposes, to cheat. Bar coding, therefore, is an effective way of gathering independent data.

Projek Penyelenggaraan Lebuhraya (PROPEL) Berhad currently have 42 machineries to support their highway project over Malaysia which is covers from North to South. All these machineries handled under Logistics and Machineries Department (LMD). They maintain these machineries more than 50 percent by their own. To support the maintenance, they have their own spare parts store which is located at Southbound Dengkil Rest and Service Area (RSA), ELITE Highway. With the current situation at the spare parts store, the department uses the combination of manual file system and file-oriented system for their current inventory system to manage about 260 items of spare parts, it is necessary to develop a new inventory system to eliminate current problems. The problems facing with current inventory system are data redundancy, difficult to update and maintain, inconsistent data, bad security, difficult to impose constraints on various data file and difficult to backup.

### **1.3 Aim and Objectives of Research**

The aim of this research is to develop the inventory system that can be applied in construction industry.

The objectives of this study are:

- i. to identify the problems involved in the implementation of the current inventory system at spare parts store, LMD, PROPEL Berhad;
- ii. to identify the needs of systematic inventory system at spare parts store, LMD, PROPEL Berhad;
- iii. to develop the prototype of the inventory system that can be implemented at spare parts store, LMD, PROPEL Berhad.

#### **1.4 Scope of Research**

This research was done to provide Database Management Inventory System for the spare parts store at LMD, PROPEL Berhad. It involved operating data in the spare parts store which are capturing, validation, sorting, classifying, calculation, summarizing, storing, retrieving, reproducing and communicating. The system uses bar code system and Microsoft Access 2002.

#### **1.5 Importance of Research**

This research was made to prepare the Database Management Inventory System for the spare parts store at Logistics and Machineries Department (LMD), PROPEL Berhad. This research could provide useful inventory system as the outcome of the research for the spare parts store.