

BUILDING STRUCTURE WORKS ESTIMATION PROGRAM – BEST's

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ABSTRACT: Building Structure Works Estimation Program – *BEST's* has been developed for the use of cost estimation on building structure works such as piling works, excavation works, foundation works, frames works and extension works. The objectives for this project are to develop a building work estimating program, to increase the accuracy of estimation and to store and retrieve the estimation. Methodology for this project development is using the SDLC Waterfall (System Development Life Cycle, also as "System Design Life Cycle") which consists of six stages such as project planning, requirements definition, design, development, integration & test and installation & acceptance. This program was developed based on window application. The system design will describe how the system is implemented and defined. For this estimation program, Use Case Diagram (USD) and Data Flow Diagram (DFD) are used to show the workflow of the object oriented approach. The database system was developed based on the standard schedules of rates from *Jabatan Kerja Raya (JKR) year 2007, Malaysia*. The user friendly interface and helpful button of the estimation program allow the user to surf the system in a better way. This estimation program is completed with the calculation function, printout function, search and edit of histories estimation function. Users are allowed to store and retrieve estimation data and information. This estimation program hopefully can be useful to help those individual, contractors and company in their project in such that this system will shorten the time usage to do the estimation compare with the old practice. Besides, increase the accuracy of estimation, the usage of this system would enable those contractors can extend their business and compete with other company in building works sector.

Keywords: Building Structure Works, Estimation Program, System Design Life Cycle, Use Case Diagram, Data Flow Diagram.

1. INTRODUCTION

Building work estimation is the process of predicting the cost of building work start from sub-structure until finishing and external works. Accurate cost estimates are critical to both developers and clients. The estimate cost can be used for generating request for proposals, contract negotiations, scheduling, monitoring and control. The estimating process for construction involves collecting, analyzing, and summarizing all available data pertaining to a project. The data may consist of a rough concept of the gross area or volume of a project, or a set of detailed plans and specifications. The estimated cost for the project is then determined by adding the estimated costs for all of the components or elements of work. Estimating program provide developers, constructors, quantity surveyors and individual client to estimate the cost of building work projects. This program will be developed based on the rate of

Malaysia's Jabatan Kerja Raya (JKR) standard. The program will be developing in English language base with the objective of user friendly to perform the estimation.

One of the greatest advancements in the estimating process has been the implementation of the computer. The early uses of computers by construction companies were limited to accounting functions. With advances in micro-computing, increased knowledge of computer capabilities, and the development of user-friendly software, construction managers have begun to use computers in everyday construction operations to make quick and accurate decisions. (Schueette, 1994). The computer's potential in construction estimating has progressed from its use as an adding machine to an integrated process of computer-aided design (CAD), building work estimating software, and job costing software. There is a variety of estimating computer software programs available. Some simply perform the mathematics of the estimation process; others integrate the estimating operation with other functions of the construction process. The program is imperative that the estimating understand the calculation methods and assumptions used in the program. Visual basic is one of the most popular programming languages used for developing Windows-based, Database and Internet applications. Visual Basic has evolved from the original BASIC language and contains several hundred statements, functions, and keywords, many of which relate directly to the Windows GUI. During this project, visual basic programming is used to develop the basic element of estimating program such as database, quantity takeoff, cost calculation and bid total of building work estimating program. (Sellappan, 2006)

2. OBJECTIVES

The objectives for this project are to develop a building work estimating program, to increase the accuracy of estimation, and the program can store and retrieve the estimation.

3. SCOPE OF STUDY

This project describes a general overview of building work estimating, analysis of building structure and study of visual basic programming. The program will be limited to the estimation of piling work, foundation and skeleton frames of building. All the estimation will base on Malaysia 2006 *Jabatan Kerja Raya* (JKR) schedule of rates.

4. METHODOLOGY

Methodology refers as a specific way of performing an operation that implies precise deliverables at the end of each stage. Usually the process of the project development is shown using the SDLC Waterfall (System Development Life Cycle, also as "System Design Life Cycle") which consists of 6 stages such as project planning, requirements definition, design, development, integration & test and installation & acceptance.

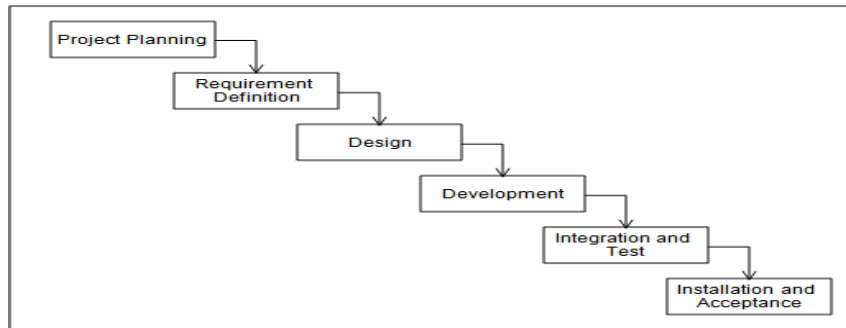


Figure 1. SDLC Waterfall

1. Project Planning

The most critical section of the project plan is a listing of high-level product requirements, also referred to as goals. All of the software product requirements to be developed during the requirements definition stage flow from one or more of these goals. The minimum information for each goal consists of a title and textual description, although additional information and references to external documents may be included.

2. Requirement Definition

The requirements gathering process takes as its input the goals identified in the high-level requirements section of the project plan. Each goal will be refined into a set of one or more requirements. These requirements define the major functions of the intended application, define operational data areas and reference data areas, and define the initial data entities.

3. Design Stage

The design stage takes as its initial input the requirements identified in the approved requirements document. For each requirement, a set of one or more design elements will be produced as a result of interviews, workshops, and/or prototype

efforts. Design elements describe the desired software features in detail, and generally include functional hierarchy diagrams, screen layout diagrams, tab, pseudocode, and a complete entity-relationship diagram with a full data dictionary. In this stage, related and suitable module is needed to be design, such as interface & navigation design, content design, component design and architecture & aesthetic design. Besides that, suitable buttons, list boxes and toolbars must be allocated in the interface. Among the interface that will include in this project is piling work, foundation, skeleton frames details. The content design for this project is to determine the relationship between each building work.

4. Development Stage

The development stage takes as its primary input the design elements described in the approved design document. For each design element, a set of one or more software artifacts will be produced. Software artifacts include but are not limited to menus, and data management forms, data reporting formats, and specialized procedures and functions. Appropriate test cases will be developed for each set of functionally related software artifacts, and an online help system will be developed to guide users in their interactions with the software.

5. Integration and Test Stage

During the integration and test stage, the software artifacts, online help, and test data are migrated from the development environment to a separate test environment. At this point, all test cases are run to verify the correctness and completeness of the software. Successful execution of the test suite confirms a robust and complete migration capability.

6. Installation and Acceptance Stage

During the installation and acceptance stage, the software artifacts, online help, and initial production data are loaded onto the production server. At this point, all test cases are run to verify the correctness and completeness of the software. Successful execution of the test suite is a prerequisite to acceptance of the software by the customer. After customer personnel have verified that the initial production data load is correct and the test suite has been executed with satisfactory results, the customer formally accepts the delivery of the software. The primary outputs of the installation and acceptance stage include a production application, a completed acceptance test suite, and a memorandum of customer acceptance of the software.

5. COMPUTER PROGRAMMING LANGUAGE

Programming language is artificial language used to write instructions that can be translated into machine language and then executed by a computer to control the behavior of a machine, particularly a computer. Programming languages are used to facilitate communication about the task of organizing and manipulating information, and to express algorithms precisely (Schneider, 1999). C programming is an imperative (procedural) systems implementation language. Its design goals were for it to be compiled using a relatively straightforward compiler, provide low-level access to memory, provide language constructs that map efficiently to machine instructions, and require minimal run-time support. C was therefore useful for many applications that had formerly been coded in assembly language. The language has become available on a very wide range of platforms, from embedded microcontrollers to supercomputers. PHP (PreHypertext PreProgramming) a scripting language used to create dynamic Web pages.

Visual Basic 6.0 (VB) is an event driven programming language and associated development environment from Microsoft for its COM programming model. Visual Basic was derived from BASIC and enables the rapid application development (RAD) of graphical user interface (GUI) applications, access to databases using DAO, RDO, or ADO, and creation of ActiveX controls and objects. Scripting languages such as VBA and VBScript are syntactically similar to Visual Basic, but perform differently (Halvorson, 1999). In comparison of the existing computer language, it shows that there are a lot of similar products in the current software market, each with its own strength and weakness. Visual basic 6.0 is an ideal language for developing windows-based, database and internet application. The project will be developed with visual basic 6.0.

6. SYSTEM ANALYSIS AND DESIGN

6.1 System Design

System design will determinate in detail of the exact operational requirements of a system, resolution of these into file structures and input/output formats, and relation of each to management tasks and information requirements. In this section, system design will describe how the system is implemented and defined. Use case diagram and DFD (Data Flow Diagram) is used to show the workflow of the object oriented approach.

6.1.1 Use case Diagram

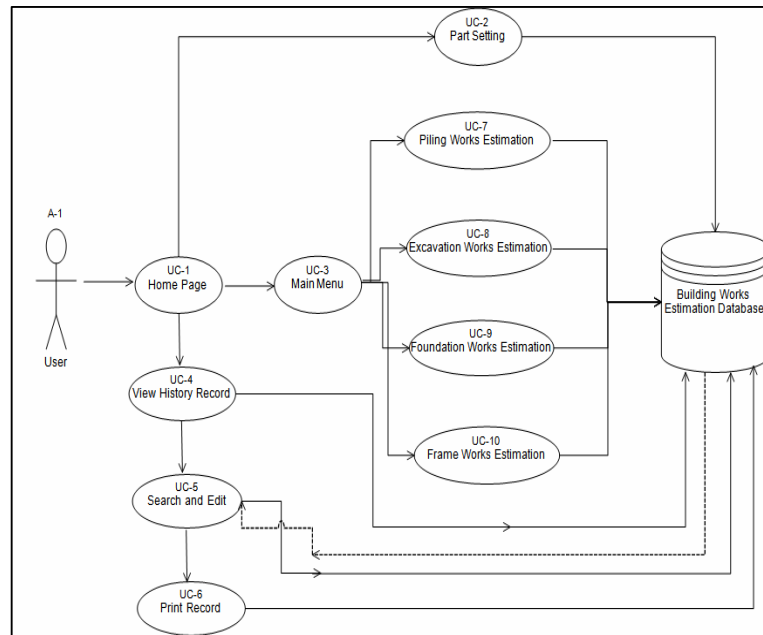


Figure 2. Use Case Diagrams

Table 1. Use Case Functions and Descriptions

Item	Use Case No.	Functions	Descriptions
1	Use Case 1	Home Page	This is the first module will show when user run building works estimation program. This module is use to connect to part setting module, main menu module, view history record module, print record module and search and edit module. In this module, user needs to locate building works estimation database with part setting command button. Only a successful and complete setting will be allow user to access the home page menu and run the estimation program.
2	Use Case 2	Part Setting	This module is used to identify the location of the database that user need to save for the estimation result. This is a very important step. This step only needs to do in the first time use of building work estimation program. The first time use program without part setting will create error and the estimation program will close down.
3	Use Case 3	Main Menu	This module is used to connect the building works estimating function modules such as piling works estimation module, excavation works module, foundation works module and frame works module.
4	Use Case 4	View History Record	This module is used to connect to the building works estimation record database. This is the place where the user can actually view the history estimation record such as the total price of building works item, item code, item description and others.
5	Use Case 5	Search and Edit	This module is used to search and edit the previous building works estimation record form the database. User may use the item code to search and edit item detail such as item description, item parameters, item price and JKR standard price.
6	Use Case 6	Print Record	This module allow user to view final estimation record and total price of the building works. User may print the building work estimation record here.
7	User Case 7	Piling Works Estimation	This module allow user to select piling works item under the Schedule of Rates for Building Works of JKR standard. The JKR' unit price will show once piling works item is selected. This module required user to fill up the parameters such as length, quantity, number and custom unit price for calculation. User may

			save the piling works estimation detail to database record.
8	User Case 8	Excavation Works Estimation	This module is similar with User Case 7. User may select the excavation works item under JKR standard. The JKR' unit price will show once excavation works item is selected. This module required user to fill up the parameters such as quantity, length, width, height, number and custom unit price for calculation. User may save the excavation works estimation detail to database record.
9	User Case 9	Foundation Works Estimation	This module is similar with User Case 7 and 8. User may select the foundation works item under JKR standard. The JKR' unit price will show once foundation works item is selected. This module required user to fill up the parameters such as quantity, length, width, height, number and custom unit price for calculation. User may save the foundation works estimation detail to database record.
10	User Case 10	Frame Works Estimation	This module is similar with User Case 7, 8, and 9. User may select the frame works item under JKR standard. The JKR' unit price will show once frame works item is selected. The JKR' unit price will show once frame works item is selected. This module required user to fill up the parameters such as quantity, length, width, height, number and custom unit price for calculation. User may save the frame works estimation detail to database record.

6.1.2 Data Flow Diagram (DFD)

DFD (Data Flow Diagram) is a chart that traces the movement of data in a computer system and shows how the data is to be processed.

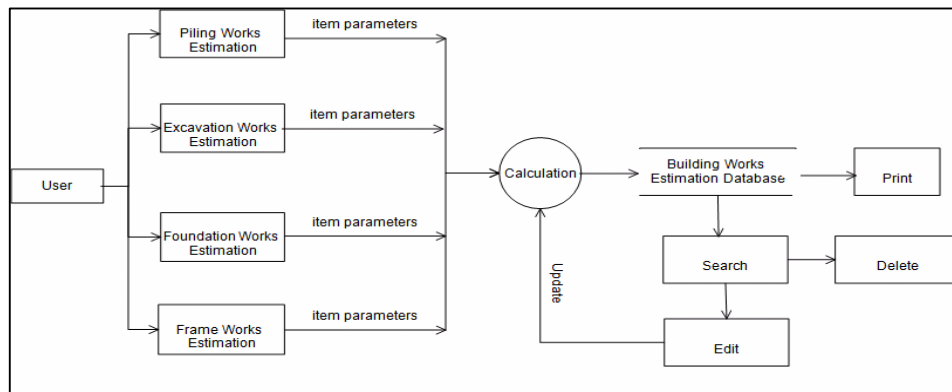


Figure 3. Data Flow Diagram (DFD)

For first time use, user need to complete the “Part Setting” with located the program database. After validation of the part name, the user can start building works estimation by proceed to the main menu with more option such as piling works estimation, excavation works estimation, foundation works estimation, frame works estimation and extension works estimation. After the selection on the specific process, calculation will be done based on the building work item parameters, custom unit price and JKR standard year 2007. All the detail estimation will stock in the building works estimation database by clicked “Save” button. User may proceed to the “Search and Edit” page to change or delete the previous detail of estimation record such as item description, item parameter or custom unit price. After completed and satisfied the estimation project, user may proceed to “Print Record”

page to view the total amount of estimation cost in both custom standard and JKR standard year 2007. User click "Print" button to print out the final result.

6.1.3 User Interface Design and System Properties

a. Home Page



Figure 4. Home Page Interface

Only the first time use of building works estimation program need to locate the program database. After validation of the "Part Setting", the program will show the "Home Page" and "Part Setting" page will be unloaded. From the "Home Page" user may process the estimation process with more option.

Table 2. Home Page Properties

Page Name:		Home Page		
Description:		As the first page to allow user process building works estimation.		
Background:		Bitmap		
No	Tools	Label / Caption	Dimension	Function
1	Command Button	Part Setting	None	To link to "Part Setting" page
2	Command Button	Start Building Works Estimation	None	To link to "Main Menu" page
3	Command Button	View History Estimation Record	None	To link to "Estimation Record" page
4	Command Button	Search and Edit Estimation Record	None	To link to "Search and Edit" page
5	Command Button	Print Estimation Record	None	To link to "Estimation Record" page
6	Command Button	Exit	None	To close down the program

b. Path Setting



Figure 5. Part Setting Interface

User may select and locate the database by using the drive list box, list box directory and file list box above. This path name is the location of the database that user need to save data into the database.

Table 3. Part Setting Properties

Page Name:		Part Setting		
Description:		Allow user to locate the estimation database		
Background:		Bitmap		
No	Tools	Label / Caption	Dimension	Function
1	Drive List Box	None	None	To locate computer driver.
2	List Box Directory	None	None	List and show the content of directory when user double clicks on it.
3	File List Box	None	None	List and show all files of a folder and allow user to select the file.
4	Text Box	Part	None	To show the location of the file user selected.
5	Command Button	OK	None	To locate the file and set as database.
6	Command Button	Exit	None	To close down the program

c. Main Menu

In this page, user can select the specific field such as piling works, excavation works, foundation works and frame works to perform the specific estimation. User may return back to the home page by using command button named “Back to Home Page”.



Figure 6. Main Menu Interface

Table 4. Main Menu Properties

Page Name:		Main Menu		
Description:		As a menu to allow user to choose the type of building works		
Background:		Bitmap		
No	Tools	Label / Caption	Dimension	Function
1	Command Button	Piling Works Estimation	None	To link to "Piling Works Estimation" page
2	Command Button	Excavation Works Estimation	None	To link to "Excavation Works Estimation" page
3	Command Button	Foundation Works Estimation	None	To link to "Foundation Works Estimation" page
4	Command Button	Frame Works Estimation	None	To link to "Frame Works Estimation" page
5	Command Button	Extension Works Estimation	None	To link to "Extension Works Estimation" page
6	Command Button	Back to Home Page	None	To link to "Home Page" page

d. Building Structure Works Estimation

User may select the building structure works element such as piling works item from the list box above or fill up own item core and item description. User is required to fill up the entire yellow color text box for estimation process. The parameters used in building structure works are varies depend to the specific element of the works, for example piling works are length, quantity and number of piling work item.



Figure 7. Piling Works Estimation Interface

Table 5. Piling Works Estimation Properties

Page Name: Description: Background:		Piling Works Estimation Allow user to estimate piling works. Bitmap		
No	Tools	Label / Caption	Dimension	Function
1	List Box	Main List Box	None	To show the content of sub list box when user select one of the item from main list box.
2	List Box	Sub List Box	None	To show the content of item list box when user select one of the item from sub list box.
3	List Box	Item List Box	None	List and show the content and allow user to select the file.
4	Text Box	Item Code	String	Automatically show the item code once user select building works item from item list box.
5	Text Box	Item Description	String	Automatically show the item description once user select building works item from item list box.
6	Text Box	Length	Double	Allow user to fill up the length of item.
7	Text Box (Behind of length text box)	Quantity	Double	Allow user to fill up the quantity of item.
8	Text Box	Number	Double	Allow user to fill up the number of item.
9	Label	Total Quantity	Double	Show the result of calculation once user click on "custom unit price" text box.
10	Text Box (Custom)	Unit Price	Double	Allow user to fill up the custom unit price.
11	Label (Custom)	Total	Double	Show total price of custom unit once user click command button "Calculate"
12	Label (JKR standard)	Unit Price	Double	Show the unit price of JKR standard once user click building works item on item list box.
13	Label (JKR standard)	Total	Double	Show total price of JKR standard once user click command button "Calculate"
14	Command Button	Calculate	None	Active the calculation program code.
15	Command Button	Save	None	Save detail estimation to estimation database.
16	Command Button	Back	None	To link "Main Menu" page.
17	Command Button	Home Page	None	To link to "Home Page" page

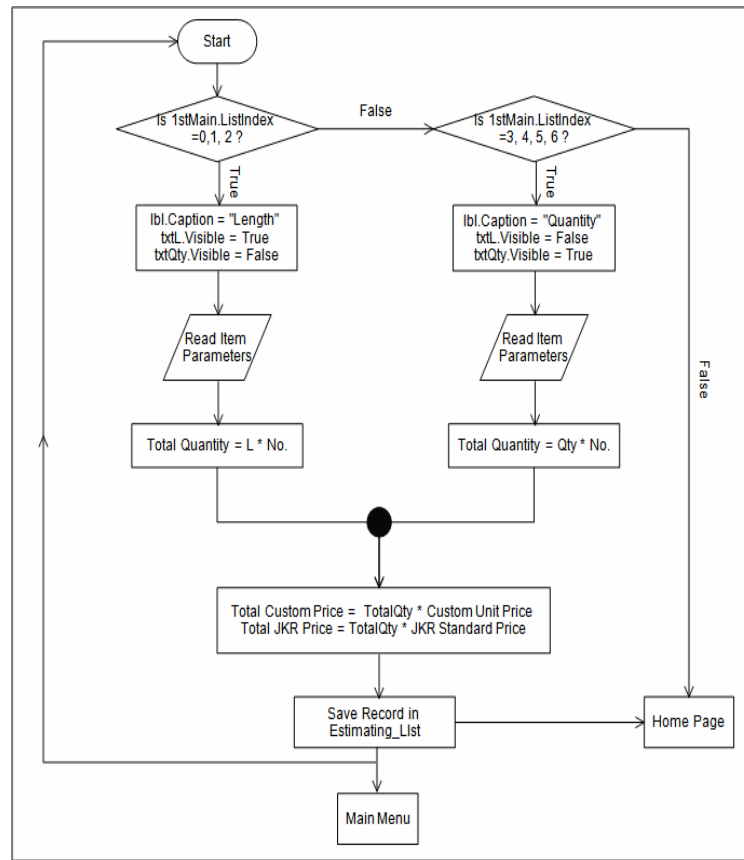


Figure 8. Piling Works Estimation Control Structure

e. Extension Works Estimation

User may select the extension works according the unit calculation of user needed. There are five types of calculation give which are in quantity form, length form, mass form, area form and volume form. User are required to fill up own item core and item description. User is needed to fill up the entire yellow color text box for estimation process. The parameters used in extension works are length, width, height, quantity and number of excavation work item.



Figure 9. Extension Works Estimation Interface

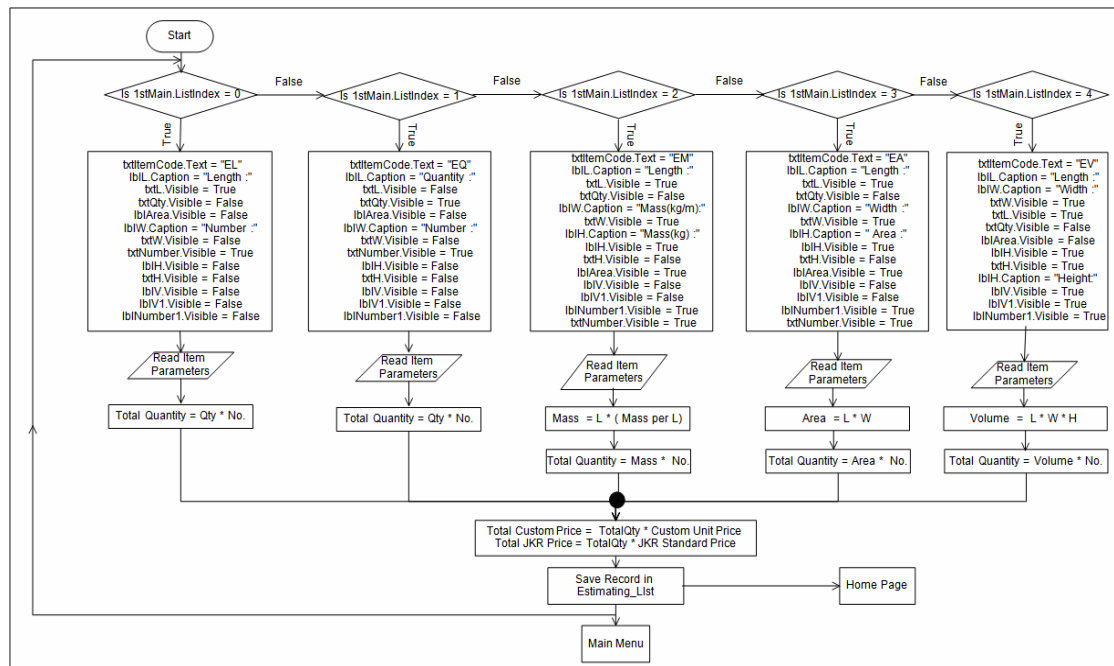


Figure 10. Extension Works Estimation Control Structure

f. Building Works Estimation Record

User may use this page to view the history of building work estimation record. Total custom price estimation and total JKR standard price estimation will show at the text box. The estimation detail such as item code, item description, quantity, length, width, height, area, volume, number, total quantity, custom unit price, total custom price estimation per item, JKR standard unit price and JKR standard total estimation per item will show in the table. After final check of detail, user may print out the building works estimation table which consists of item code, item description, quantity, length, area, volume, number, custom unit price and total custom price per item. The total estimation cost will show.

g. Search and Edit

In this page, user is required to fill up item code to search the record of building works record in database. User may change the parameter of previous item record and update it to database. User may use the delete function to delete history record at database.

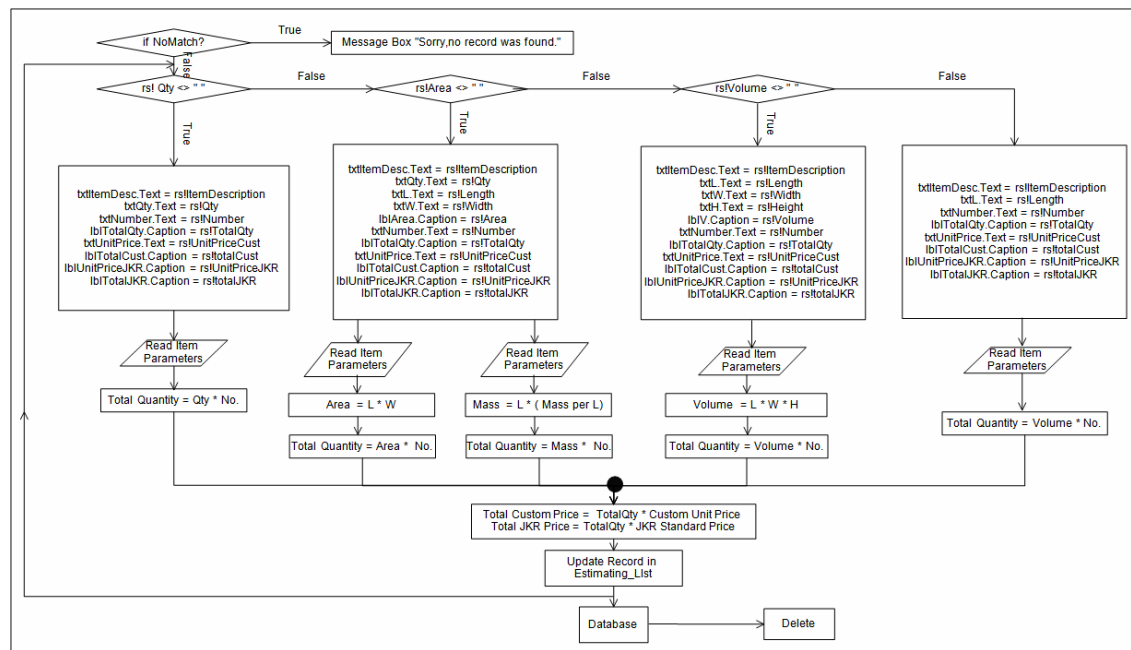


Figure 11. Search and Edit Control Structure

6.1.4 Database Design

Database design is the process of producing a detailed data model of a database. This contains all the needed logical and physical design choices and physical storage parameters needed to generate a design in a Data Definition Language. A fully attributed data model contains detailed attributes for each entity.

Table 6. Database Design View

No	Field Name	Data Type	Field Size
1	EstimateID (Primary Key)	AutoNumber	Long Integer
2	ItemCode	Text	50
3	ItemDescription	Text	100
4	Qty	Number	Double
5	Length	Number	Double
6	Width	Number	Double
7	Height	Number	Double
8	Area	Number	Double
9	Volume	Number	Double
10	Number	Number	Double
11	TotalQty	Number	Double
12	UnitPriceCust	Number	Double
13	TotalCust	Number	Double
14	UnitPriceJKR	Number	Double
15	TotalJKR	Number	Double

7. INSTALLATION AND CONFIGURATION

This stage carries development through from design to operation. It involves programming testing and installation of the required software. After

implementation, there are necessary ways to run the building works estimation program. Start by going to the building works estimation program setup folder and select setup file. Double clicks to run the setup file and the first screen that user should see is shown in figure below, which welcomes the user to the setup of the project and press "OK".

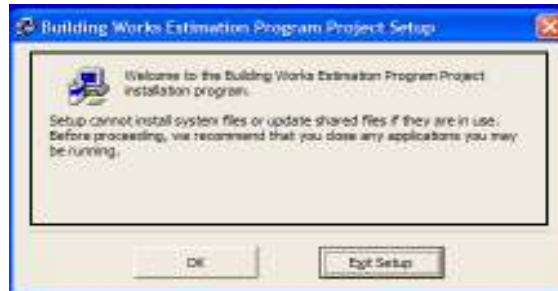


Figure 12. Setup Information

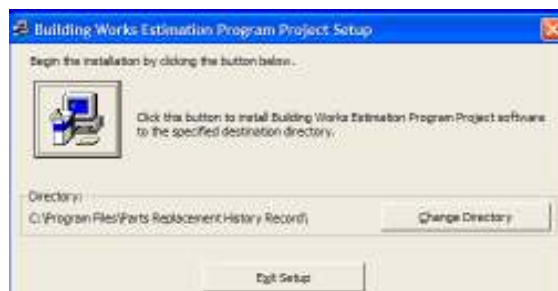


Figure 13 Setup Destination Directories

Choose the default destination directory or change the desired location and click the button. On the next screen select "Building Works Estimation Program Project" and click "Continue" to install the setup.

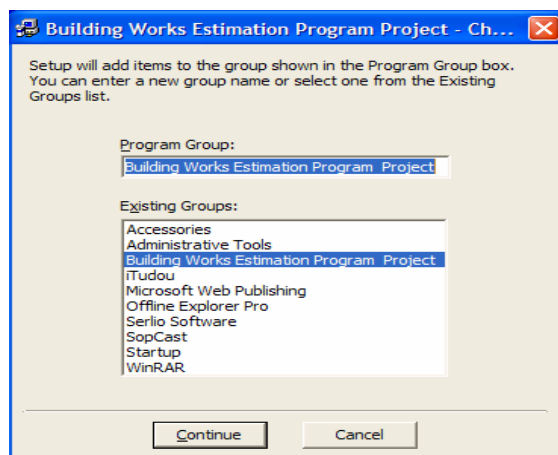


Figure 14. Program Group Box

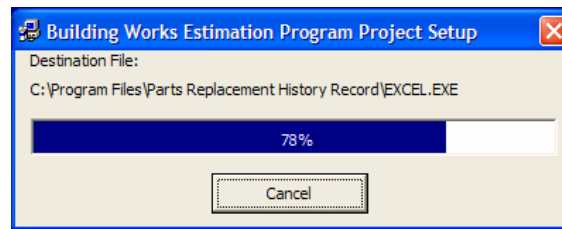


Figure 15. Load Bar

The installation will start and user required waiting for the installation to complete. User may click the "Cancel" button to cancel and quite the installation of the project. The installation will finish by showing message box "Building Works Estimation Program Project Setup was completed successfully".

8. TESTING AND RESULT

In this section, testing and result phase required to perform on the application of system. Generally testing takes an external perspective of the test object to derive test cases. These tests can be functional or non-functional, though usually functional. The test designer selects valid and invalid input and determines the correct output. This type of test is applicable to all levels of software testing: unit, integration, functional testing, system and acceptance. Basically, the testing is performed in Unit Test, Linking Test and System Test. Development of the building works estimation program is to help those individual and company who want to prepare the building works estimation and compare between user custom price and JKR standard year 2007.

9. CONCLUSION

Usually a good application system requires a very detailed attention and great creativity in planning the SDLC (System Development Life Cycle). To produce a good system, selection of the development tools also very important, it will affect the appearance and acceptance of the system. The workflow of the project should clearly stated and in the correct order to prevent confusion. In some condition, sometime even the appearance of a button during the interface design will affect the overall appearance. Graphic and animation usage should as minimum as possible to prevent the user from long time waiting for the page to complete loading.

However, the most important matter in building works estimation is the simplicity and applicability of the system to the factual cost. Cost estimation program system must be simple, reliable and flexible. The building works estimation program based on functional elements helps user to estimate the selected building works using custom unit price and unit price JKR standard year 2007. This estimation program (Building Works Estimation Program) can be useful to help those individual and company in their project in such that this system will shorten the time usage to do the estimation compare with the old practice. Besides, increase the accuracy of estimation, the usage of this system would enable those contractors can extend their business and compete with other company in building works sector.

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