

## **CHAPTER 1**

### **PROJECT BACKGROUND**

#### **1.1 Introduction**

Oil and gas industry is multi-billion dollar industry that drives many developing nations' economies. For example, Malaysian oil and gas industry – spearheaded by PETRONAS – accounts for 45 percent of Malaysian Gross Domestic Product (GDP) for 2010 (Chua & Oh, 2010). In addition, PETRONAS handles a large number of oil and gas fields throughout Malaysia, with hundreds of profit sharing contracts (PSC) and five recovery sharing contracts (RSC) (Chua, et. al, 2010). Since it has a very significant impact on the economy of the country, it is imperative that these scarce resources being handled efficiently to maximize its positive impact. In order to do so, PETRONAS collects production data from all its fields using daily operation/production reports. Data collected include crude oil (CRUDE), natural gas (GAS), condensate (CONDENSATE), and flare (FLARE) production. These data is sent to PETRONAS headquarter in Kuala Lumpur for data consolidation activity.

Data consolidation activity is a business process that is used to merge all daily operation/production reports into a single document – the master template. In PETRONAS Malaysia Petroleum Management (MPM), four technicians – handling each document of INPUTGASPM, INPUTGASSS, INPUTCRUDEPM, and INPUTCRUDESS – will send their document to an administrator who handles the master template. The administrator will merge all documents into the master template, and then create five different types of summary reports.

Currently, data consolidation activity is done manually in PETRONAS MPM. Data is manually combined into the master template, and the summary reports are created by the

administrator himself. This situation poses two significant problems e.g. extensive effort and time, and integrity issue. Since the business process is done manually, it requires extensive effort and time from the administrator to get the job done. Sometimes, the administrator requires half a day to get the job done. Understandably, this is an inefficient business process and as such business process automation (BPA) is required. Integrity issue arises since the master template actually changes hands multiple times a day instead of being in the hands of administrator only. Too many cooks spoil the broth, and the possibility of loss or modification of data is high.

In the light of this problem, PETRONAS MPM has requested for collaboration with Computer and Information Science Department of Universiti Teknologi PETRONAS (CIS UTP) to develop an intelligent automation script to increase the efficiency of data consolidation activity undertaken in the organization.

## **1.2 Problem Statement**

### **1.2.1 Problem Identification**

Data consolidation activity is a critical activity in PETRONAS MPM. This business process is very important since the summary reports created daily will be used to derive monthly and annual summary reports. However, current data consolidation activity is done manually and is suspect to two significant problems e.g. extensive effort and time, and integrity issue.

Administrator spends extensive effort and time to create all five summary reports. In PETRONAS MPM, the administrator spends about half a day to create the summary reports. This situation limits productivity since most working hours of the administrator is used to create these documents. Integrity issue arises when the master template changes hands multiple times a day. Human error mostly occurs due to human

intervention (Muir, 1994). A more recent study suggested that 37 percent of integrity issue is caused by multiple user engagement in a(n) business activity (Buchanan, 2007). Thus, it is imperative that the element of human intervention is removed or at least minimized to increase the efficiency of the business process.

Therefore, Operation Reporting Enhancement (ORE) project is initiated to develop an intelligent automation script that increase the efficiency of data consolidation activity by delegating the task to automation script instead of doing the business process manually.

### **1.2.2 Significance of Project**

The significance of this project is it will allow the data consolidation activity to be delegated to automation script instead of being done manually by PETRONAS MPM administrator. If the business process is done manually, it introduces two main drawbacks e.g. extensive effort and time and integrity issue.

### **1.3 Objectives**

The objectives of ORE are:-

- To study current data consolidation activity undertaken in PETRONAS MPM
- To develop an automation script using Visual Basic for Application (VBA) on Microsoft Excel macro platform
- To test the automation script developed against the Microsoft Excel database used by PETRONAS MPM

### **1.4 Scope of the Project**

The scope of the project will limit the coverage to Microsoft Excel database used by PETRONAS MPM in maintaining operation reports data. The automation script is

specifically designed and developed to be used in-house, and therefore cannot be used against other databases.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction to Microsoft Excel Macro

A macro is a set of functions and commands written in Microsoft Visual basic module. It is a built-in function in Microsoft Office. The programming language used in macro is Visual Basic for Application (VBA). VBA is a high-level programming language, and therefore this language is easy to be used to implement and to develop programs.

The use of macro allows its user to perform dull, iterative tasks e.g. creating and updating multiple documents in a faster a more efficient way (Krieger, 2012). By using macro, repetitive tasks could be done faster instead of being done one at a time manually by human. Macro could be used to perform simple and complex programming tasks alike. Figure 1 shows the position of macro interface in Microsoft Excel.

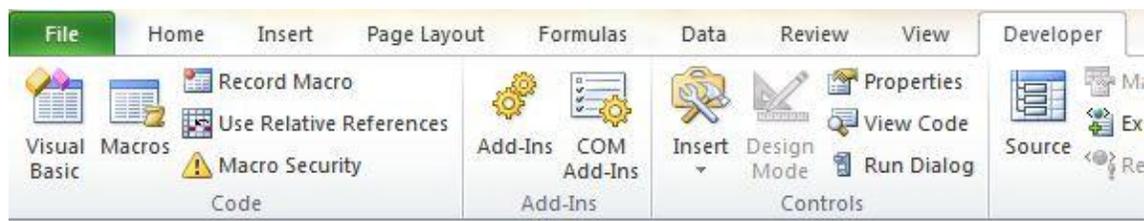


Figure 1 – Macro interface in Microsoft Excel

#### 2.2 Study of Advantages and Disadvantages of Using Macro to Develop Automation Script

Notable advantages of using macro are less human intervention and faster execution. For example, copying multiple sheets of data from one Microsoft Excel document to another is a dull, tiring task. Krieger (2012) argues that the situation introduces the possibility that the user will perform errors in the said task. He also added that if errors occurred,

data integrity is irrecoverably lost. By using macro, the automation script takes over the task altogether and minimizing human intervention. By doing so, the chance of human error is greatly minimized. Thus, in critical business process e.g. data consolidation activity business process automation is imperative. Faster execution is also an advantage. If done manually, some tasks could take days to be completed. By using automation script, these tasks could be completed in minutes, saving effort, time and money in the process.

Nevertheless, incorrect uses of macro may possibly introduce significant security issue. Krieger (2012) postulates that when a macro is created for malicious purposes it could produce irreparable damage to documents and [database] itself. For example, some documents in an important database contain malicious macro commands. If these commands are executed the database may be irreversibly corrupted. Since data is the most valuable asset to an organization the impact of this situation is massive. In critical environment these types of error are proven to be disastrous (Muir, 1994). Therefore, the use of macro should be accompanied with great provision and precaution. For this negative reason, macro security options are introduced in Microsoft Excel. Figure 2 shows macro security options in Microsoft Excel.

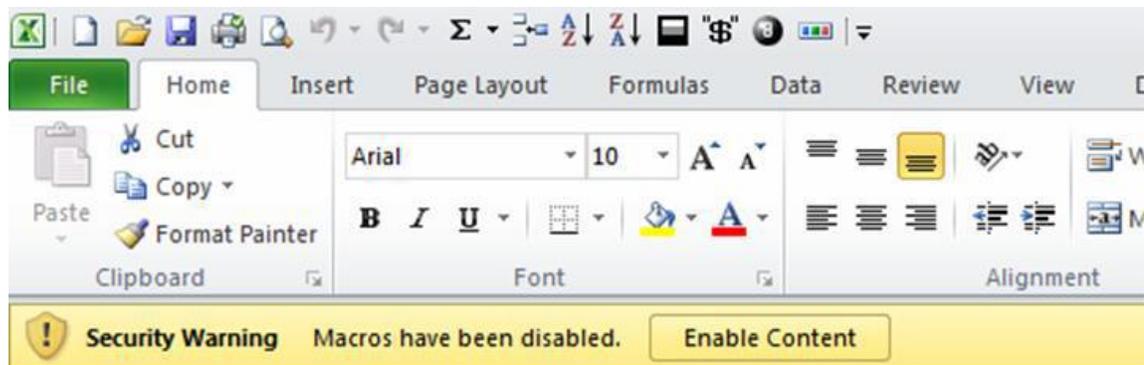


Figure 2 – Macro security option in Microsoft Excel

In conclusion, there are advantages and disadvantages of using macro to develop automation script. However, the disadvantages should not overshadow its advantages. It is imperative that an organization achieves maximum efficiency in its operation and the use of macro is one big step towards this objective.

### **2.3 Current Data Consolidation Activity at PETRONAS MPM**

Data consolidation activity undertaken in PETRONAS MPM is divided into three steps. The first step is to copy all data in four operation reports into the master template. The second step is to create five summary reports from the data in the master template. The third step is to map the data into PETRONAS map of oil and gas fields.

The first and second step will be developed in ORE, while the last step will be developed in-house by PETRONAS MPM.

The first step is to copy all data in four operation reports into the master template. These operation reports are controlled by four technicians. The master template is controlled by an administrator. Thus, the four technicians will have to send the operation reports to the administrator. The administrator will then merge all documents into the master template.

The second step is to create five summary reports from the data in the master template. In this step, the administrator will create the summary reports by developing a PivotTable for each report. A PivotTable is a built-in table in Microsoft Excel and allows data summary to be easily created. The summary reports are:-

- GAS (Malaysia) Upstream
- GAS (Malaysia Import) Upstream

- GAS (Malaysia) Downstream
- CRUDE (Malaysia)
- FLARE (Malaysia)

Figure 3 illustrates the situation.

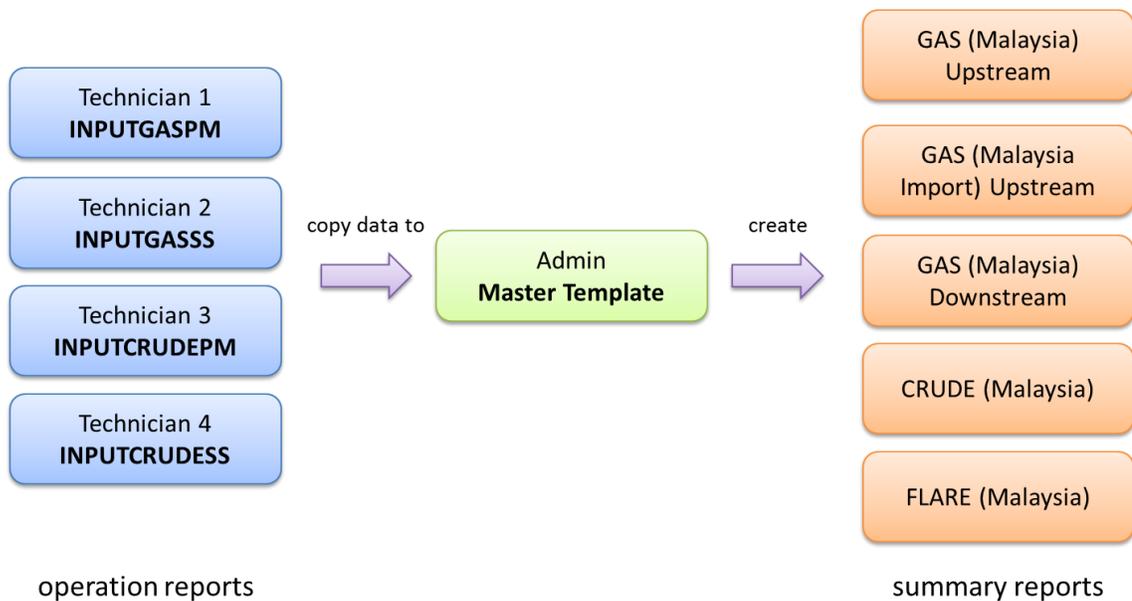


Figure 3 – Data consolidation activity in PETRONAS MPM

After thorough and extensive analyses of all operation reports it is determined that it uses complex, interrelated formulas. Although these complicated formulas are in its basic form it is still difficult to work with in automation script. Therefore, isolation of these complex formulas from user is imperative. This action prevents the user from inadvertently changes the formulas and thus damages data integrity. However, to keep this project simple all formulas are left untouched to prevent unnecessary complications.

## CHAPTER 3 METHODOLOGY

### 3.1 Research Methodology

Figure 4 summarizes the research methodology used in Operation Reporting Enhancement (ORE) project.

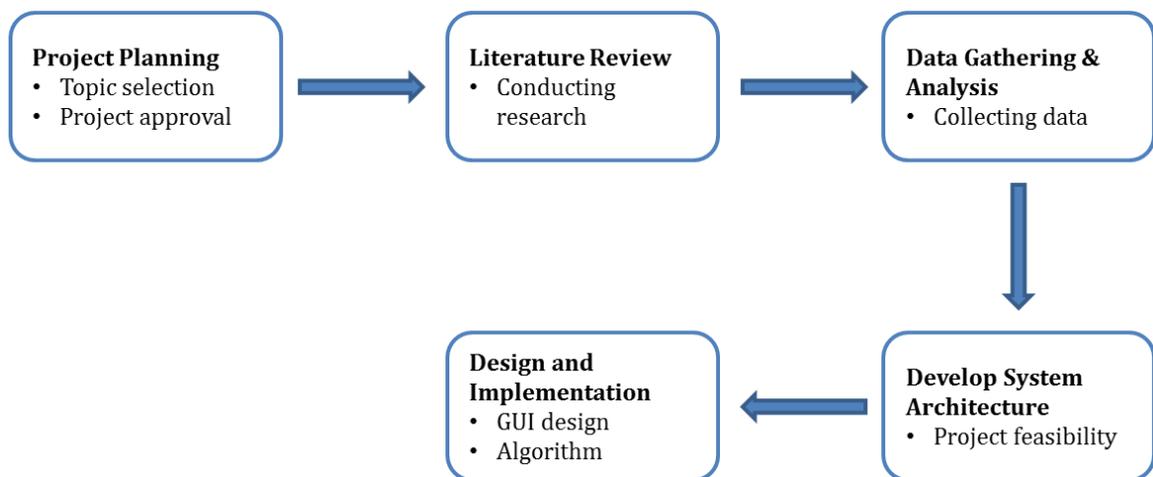


Figure 4 – Research Methodology

### 3.2 Development Methodology

The development methodology used in this project is Rapid Application Development (RAD). RAD is used in this project since the dateline for project delivery is short – about 8 to 9 months.

One of the advantages of using RAD is it is dynamic in nature. RAD allows developers to move from user design phase to construction phase and vice versa without traditional limitation. RAD is the perfect choice of methodology for the development of this project compared to waterfall methodology. Waterfall methodology is rigid in nature and is not

suitable for this project. It is imperative to have the flexibility since the project requirement may change in short notice throughout project cycles. The project will be divided to four main phases, as illustrated in Figure 5:-

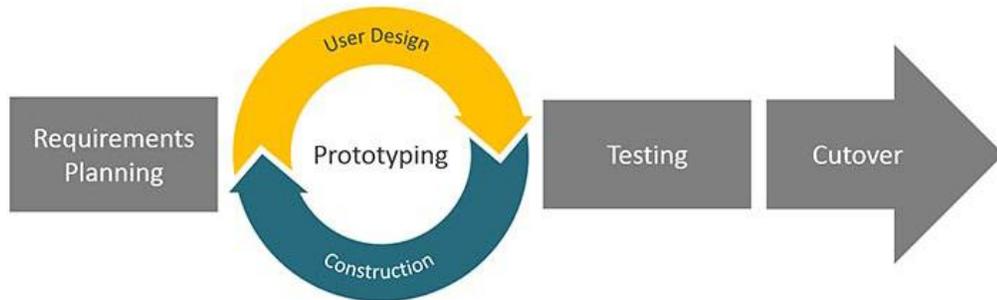


Figure 5 – Rapid Application Development (RAD) phases

➤ *Requirement Planning*

User requirements are gathered in this phase. Requirements may include datelines, core functionalities, and interfaces. These requirements are analyzed to ensure its feasibility.

➤ *Prototyping: User Design*

Graphical user interface (GUI) and core functions in the automation script are designed in this phase.

➤ *Prototyping: Construction*

The automation script and GUI are developed in this phase. Passive, internal testing is also done.

➤ *Testing*

External testing, including user acceptance testing is done in this phase.

➤ *Cutover*

The developed automation script and GUI is prototyped for testing. If the deliverables pass these tests, it is properly finalized and is delivered to the user.

### 3.3 Development Tools

Hardware and software used in ORE are:-

➤ Hardware

Microsoft Windows OS – Windows 7 and/or above

➤ Software

Microsoft Office 2010

Adobe Photoshop CS6 Extended

### 3.4 Gantt Chart

Table 1 – FYP1 Chart

Details/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Project Planning														
Literature Review/Theory														
Data Gathering and Analysis														
Develop System Architecture														

Design System UI														
Proposal Defense														
Submission of Interim Report														

Table 2 – FYP2 Chart

Details/Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Development and Prototyping														
System Testing														
Submission of Progress Report														
Implementation														
Documentation														
Pre-SEDEX and Viva														
Submission of Final Dissertation														

### 3.5 Project Milestones

A number of key milestones have been selected for this project. This selection is to ensure that all key activities are completed within the allocated time frame. Thus, this will minimize the possibility of scope creep. Table 3 shows all selected key milestones.

Table 3 – Selected ORE Key Milestones

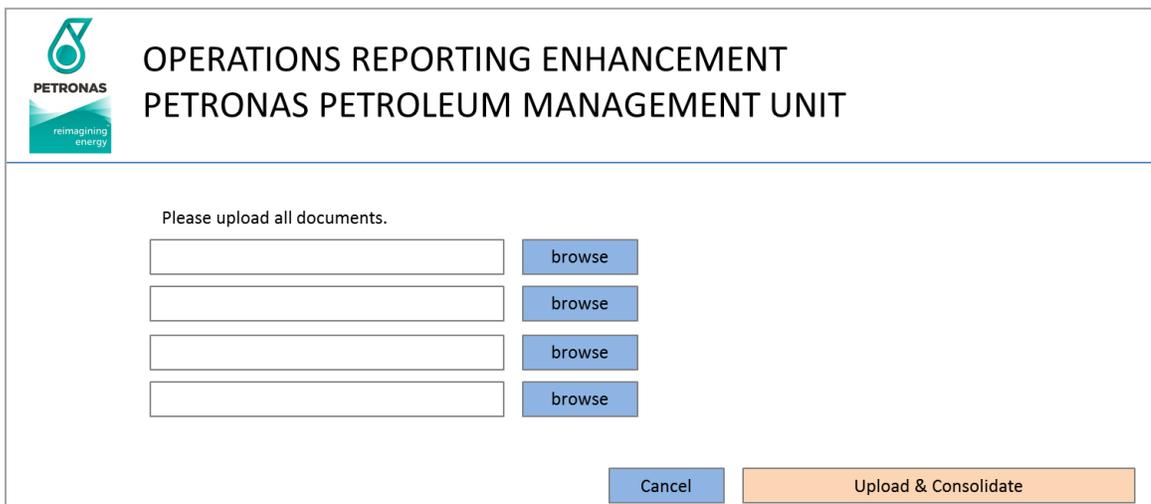
Milestone	FYP Week
Project Planning	FYP1 Week 1 – Week 2
Data Gathering and Analysis	FYP1 Week 3 – Week 8
Develop System Architecture	FYP1 Week 9 – Week 10
Design System UI	FYP1 Week 10 – Week 11
Development and Prototyping	FYP2 Week 1 – Week 2
System Testing	FYP2 Week 3 – Week 4
Implementation	FYP2 Week 5 – Week 10
Pre-SEDEX and Viva	FYP2 Week 12 – Week 13

## CHAPTER 4

### RESULT AND DISCUSSION

#### 4.1 Mock Graphical User Interface (GUI)

Graphical user interface (GUI) is introduced to the data consolidation activity to create a module-based system. In module-based system, the user cannot directly modify the content of the documents e.g. the master template. Instead, all modifications must be done via GUI. This arrangement minimizes the possibility that human errors could occur. Figure 6 shows the mock GUI of ORE.



The screenshot shows a web-based interface for uploading documents. At the top left is the Petronas logo with the tagline 'remagining energy'. To the right of the logo, the text reads 'OPERATIONS REPORTING ENHANCEMENT' and 'PETRONAS PETROLEUM MANAGEMENT UNIT'. Below this header, the instruction 'Please upload all documents.' is displayed. There are four empty text input fields arranged vertically, each followed by a blue 'browse' button. At the bottom right of the form area, there are two buttons: a blue 'Cancel' button and an orange 'Upload & Consolidate' button.

Figure 6 – ORE Upload Documents module

#### *Upload Documents*

This GUI allows user to specify all operation reports required in the master template e.g. INPUTGASPM, INPUTGASSS, INPUTCRUDEPM, and INPUTCRUDESS. All files will be checked for file type error e.g. only Microsoft Excel document types (.xls, .xlsx) are allowed. If there is an error, user will be required to specify all operation reports

again. If there is no error, data from all operation reports will be extracted and merged into the master template.

## 4.2 System Flowchart

Figure 7 shows the ORE system flowchart.

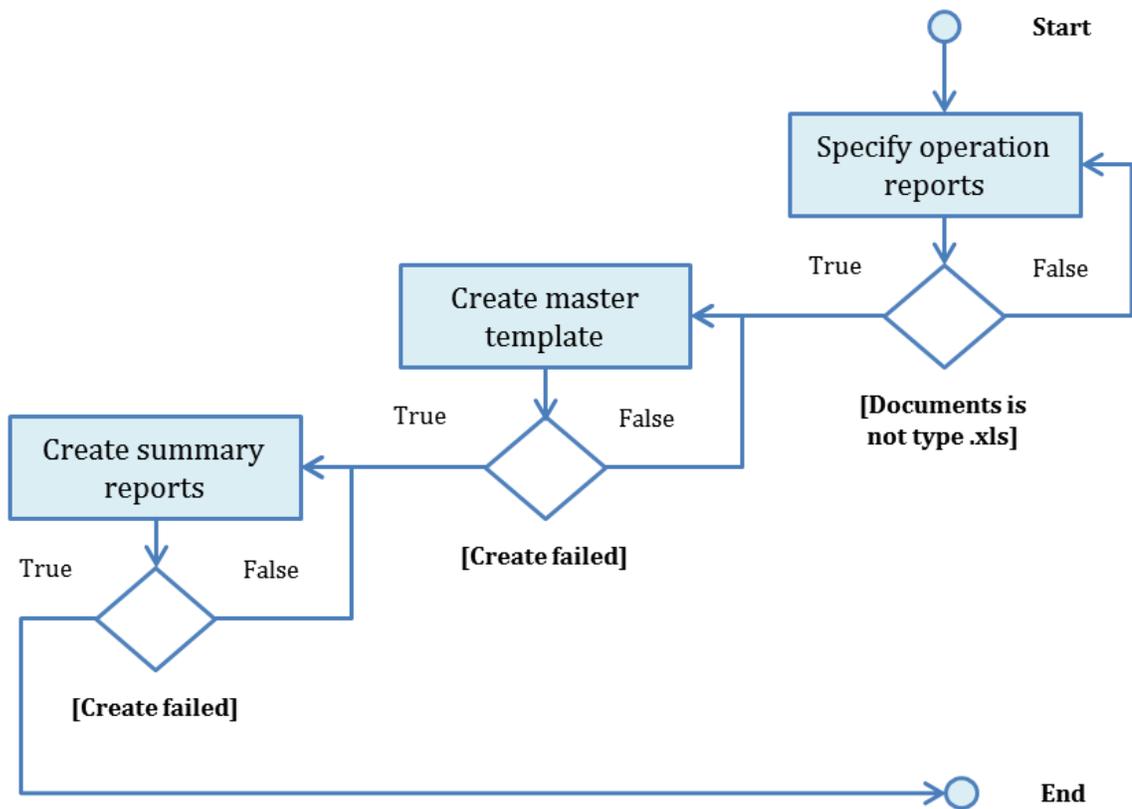


Figure 7 – ORE system flowchart

First, the automation script will notify user to specify the location of all operation reports e.g. INPUTGASPM, INPUTGASSS, INPUTCRUDEPM, and INPUTCRUDESS. If the documents specified are not Microsoft Excel document types (.xls, .xlsx) or no document is specified for any required text boxes the next step will not be executed. The

automation script will notify user to specify the location again or to abort. Else, the next step will be executed.

After all operation reports have been specified, the automation script will extract data from all operation reports, starting from INPUTGASPM, INPUTGASSS, INPUTCRUDEPM, and INPUTCRUDESS, in that order. If data extraction of any of these operation reports failed, the step is halted. The automation script will notify the user to restart the step, or to abort. Else, data will be extracted from all operation reports and merged into the master template.

After data extraction is complete, the automation script will create summary reports with aggregated data such as variances, means, standard deviations, etc. If any of the summary reports failed to be created, the step is terminated. The automation script will notify the user to restart the step, or to abort. Else, all summary reports will be created. The automation script will auto-terminate beyond this step.

### **4.3 Final Prototype**

The final automation script will work on Microsoft Excel installed in Microsoft Windows operating system (OS) only. Functions developed are not supported in other OSes. The beta release of the final automation script developed contains the first two steps of the business process – upload documents and create summary reports. The last step of data consolidation activity – data mapping – will be developed by PETRONAS MPM in-house.

The first step in the business process is to upload documents. Administrator needs to copy all four operation reports into the directory which contains the master template. For this example, all operation reports – INPUTGASPM, INPUTGASSS,

INPUTCRUDEPM, and INPUTCRUDESS – are copied into C:\ORE directory. Figure 8 shows an example of recommended ORE directory.

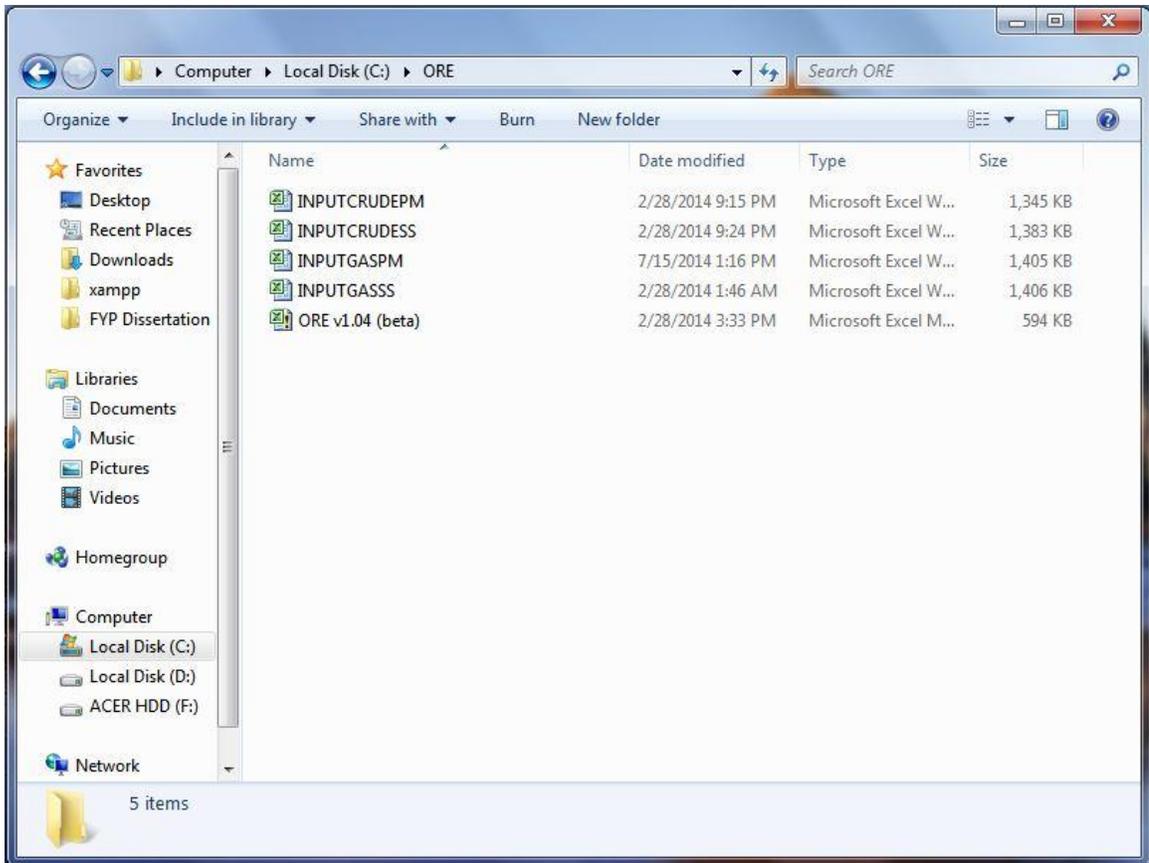


Figure 8 – Recommended ORE directory

Once all operation reports are copied, the administrator needs to specify these documents inside ORE Upload Documents module. Table 4 specifies these operation reports and its uses.

Table 4 – Operation Reports in ORE

Document Name	Uses
---------------	------

INPUTGASPM	The document contains production data for gas fields in Peninsular Malaysia. Production data is used to generate GAS (Malaysia) Upstream, GAS (Malaysia Import) Upstream, and GAS (Malaysia) Downstream summary reports.
INPUTGASSS	The document contains production data for gas fields in Sabah and Sarawak. Production data is used to generate GAS (Malaysia) Upstream, GAS (Malaysia Import) Upstream, and GAS (Malaysia) Downstream summary reports.
INPUTCRUDEPM	The document contains production data for gas fields in Peninsular Malaysia. Production data is used to generate CRUDE (Malaysia), and FLARE (Malaysia) summary reports.
INPUTCRUDESS	The document contains production data for gas fields in Sabah and Sarawak. Production data is used to generate CRUDE (Malaysia), and FLARE (Malaysia) summary reports.

After specifying these operation reports, the administrator may click the ‘consolidate’ button and these operation reports will be data mined, line by line, and all data in searched rows will be copied into the master template.

INPUTGASPM and INPUTGASSS data will be copied and merged inside GAS sheet in the master template. INPUTCRUDEPM and INPUTCRUDESS data will be copied and merged inside CRUDE sheet in the master template. At this point, the administrator may have to wait until the process is complete. A message box will appear to notify the administrator that the process is complete. The following figures show the overall first step.

Operations Reporting Enhancement (ORE) - Upload Documents

**PETRONAS**  
 Petroleum Management Unit [PMU]  
 Operation Reporting Enhancement



Step 1: Upload
Step 2: Generate Summary Report
Step 3: Map Data

**Upload Documents** ?

GAS Peninsular Malaysia: <input type="text" value="C:\ORE\INPUTGASPM.xlsx"/> <input type="button" value="browse"/>	CRUDE Peninsular Malaysia: <input type="text" value="C:\ORE\INPUTCRUDEPM.xlsx"/> <input type="button" value="browse"/>
GAS Sabah & Sarawak: <input type="text" value="C:\ORE\INPUTGASSS.xlsx"/> <input type="button" value="browse"/>	CRUDE Sabah & Sarawak: <input type="text" value="C:\ORE\INPUTCRUDESS.xlsx"/> <input type="button" value="browse"/>

Copyright 2014. Operations Reporting Enhancement (ORE) ver. 1.04

Figure 9 – Specifying all operation reports for ORE

175	DULANG_GAS_FUEL_HYPIS		ACT			FG_DAILY PM	PMO	2006 Dulang	Dulang		0.0
176	MASA_GAS_FUEL_OI_HYPIS		ACT			FG_DAILY PM	PMO	PM6/12	MASA		0.0
177	PENARA_GAS_FUEL_HYPIS		ACT			FG_DAILY PM	PMO	AAKBNLP	Penara-North Lukut		9.0
178	ABU_CLUSTER_GAS_HYPIS		ACT			FG_DAILY PM	PMO	AAKBNLP	Abu		1.7
179	PUTERI_GAS_FUEL_C_HYPIS		ACT			FG_DAILY PM	PMO	PM318	Puteri		0.0
180	DUYONG_GAS_FUEL_HYPIS		ACT			FG_DAILY PM	PMO		Duyong		0.0
181	RESAK_GAS_FUEL_O_HYPIS		ACT			FG_DAILY PM	PMO		Resak		0.0
182	LEDANG_ANOA_GAS_HYPIS		ACT			FG_DAILY PM	PMO		Ledang		0.0
183	BUNGA_RAYA_GAS_HYPIS		ACT			FG_DAILY PM	TML	PM3-CAA	Southern Field (Bun)		35.3
184	BUNGA_ORKID_GAS_HYPIS		ACT			FG_DAILY PM	TML	PM3-CAA	Northern Field (Bun)		15.0
185	SA_GAS_FUEL_OFF_I_HYPIS		ACT			FG_DAILY PM	TML	PM305	South Angsi		1.9
186	CENDOR_GAS_FUEL_HYPIS		ACT			FG_DAILY PM	PML	PM304	Cendor		0.3
187	E_BELUMUT_GAS_FU_HYPIS		ACT			FG_DAILY PM	NFX	PM323	East Belumut		3.4
188	CHEMINGAT_GAS_FL_HYPIS		ACT			FG_DAILY PM	NFX	PM323	Chermingat		0.0
189	E_PIATU_GAS_FUEL_HYPIS		ACT			FG_DAILY PM	NFX	PM329	East Piatu		1.4
190	SAMARANG_KECHIL_HYPIS		PLAN			GASPLAN SBH	SBO	Sam-AP	Samarang Kechil		0.0
191	KINARUT_GAS_SALE_HYPIS		PLAN			GASPLAN SBH	SBO	Sam-AP	Kinarut		127.5
192	SAMARANG_GAS_SA_HYPIS		PLAN			GASPLAN SBH	SBO	Sam-AP	Samarang		0.0
193	SUMANDAK_GAS_SA_HYPIS		PLAN			GASPLAN SBH	SBO	Sam-AP	Sumandak		42.0
194	ERB_WEST_GAS_SAL_HYPIS		PLAN			GASPLAN SBH	SBO	Sam-AP	Erb West		10.0
195	KN_EAST_GAS_SALE_HYPIS		PLAN			GASPLAN SBH	SBO	KNAG SOGT	KN East		5.0

Ready | Sheet1 | GASCopy | GASCopyNew | GASpivot | GAS | CRUDE | Average: 101.7975946 | Count: 7539 | Sum:

Figure 10 – INPUTGASPM and INPUTGASSS data is copied into GAS

490	GUMUSUT_KAKAP_J_HYPIS_FL	ACT			FLAREDAI SBH	SSPC	GK_UUOA	Gumusut Kakap	0
491	GUMUSUT_KAKAP_K_HYPIS	ACT			CRUDEDAL SBH	SSPC	GK_UUOA	Gumusut Kakap	0
492	GUMUSUT_KAKAP_K_HYPIS_FL	ACT			FLAREDAI SBH	SSPC	GK_UUOA	Gumusut Kakap	0
493	TRML_CRUDE_SA_D/HYPIS	ACT			TERMINAL PM	TML	PM305	FSO South Angsi	164.3
494	TRML_CRUDE_PM3C_HYPIS	ACT			TERMINAL PM	TML	PM3-CAA	FSO Bunga Orkid	441.1
495	TRML_CRUDE_BO_D/HYPIS	ACT			TERMINAL PM	TML	PM3-CAA	FSO PM3-CAA	480.0
496	TRML_CRUDE_CNDR_HYPIS	ACT			TERMINAL PM	PML	PM304	FSO Cendor	207.4
497	TRML_CRUDE_BRNT_HYPIS	ACT			TERMINAL PM	PML	Berantai RSC	FSO Berantai	92.5
498	TRML_CRUDE_KBM_HYPIS	ACT			TERMINAL PM	CEKBM	KBM RSC	FSO KBM	375.7
499	TRML_CRUDE_MASA_HYPIS	ACT			TERMINAL PM	PMO	PM6/12	FPSO Perintis (MASA	17.1
500	TRML_CRUDE_SEPAT_HYPIS	ACT			TERMINAL PM	PMO	SEPAT	FSO Sepat	99.5
501	TRML_CRUDE_PD_D/HYPIS	ACT			TERMINAL PM	PMO	2006 Dulang	FSO Puteri Dulang	216.3
502	TRML_CRUDE_BK_D/HYPIS	ACT			TERMINAL PM	PMO	AAKBNLP+PM318	FPSO Bunga Kertas	124.0
503	TRML_CRUDE_F_ABL_HYPIS	ACT			TERMINAL PM	PMO	AAKBNLP	FSO Abu	301.2
504	TRML_CRUDE_LCOT_HYPIS	ACT			TERMINAL SBH	SBO	-	LCOT	1003.3
505					TERMINAL SBH	SBO	-	SCOT	0.0
506	TRML_CRUDE_KIKEH_HYPIS	ACT			TERMINAL SBH	MOC	-	FPSO Kikeh	1177.5
507	TRML_CRUDE_MCOT_HYPIS	ACT			TERMINAL SWK	SKO	-	MCOT (MLC)	0.0
508	TRML_CRUDE_BCOT_HYPIS	ACT			TERMINAL SWK	SKO	-	BCOT (BIC)	0.0
509	TRML_CRUDE_KDRN_HYPIS	ACT			TERMINAL SWK	MOC	-	KMT (Kidurong)	308.1
510	TRML_COND_BCOT_HYPIS	ACT			TERMINAL SWK	SKO	-	BCOT (BNC)	875.3

Figure 11 - INPUTCRUDEPM and INPUTCRUDESS data copied into CRUDE

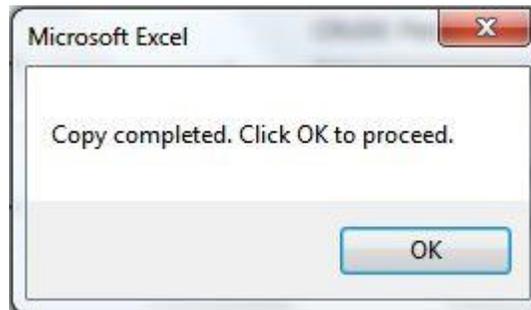


Figure 12 – Message box to notify the process is complete

The second step in ORE is to create summary reports. Graphical user interface (GUI) will show five buttons, each to generate a specific summary report. When any of these buttons is clicked, summarization process will be started. The summarization process has three stages, namely Raw-Copy, Copy-CopyNew, and CopyNew-Pivot.

### *Raw-Copy*

In this stage, relevant data will be copied into a Copy document. There are two Copy documents – GASCOPY and CRUDECopy. In these documents, the data will be sorted

by area code. Copy documents contain planned production and actual production data only.

For example, GASCopy document contains GASPLAN and GASDAILY data. CRUDECopy document contains CRUDEPLAN and CRUDEDAILY data. All other columns will be deleted except current date data e.g. 28 Feb 2014 data, and month-to-date (MTD) data. Current date is derived from system date. The following figures show Copy document before column deletion and after column deletion.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	CODE	A	HYPIS	B	C	D	E	HYPIS REV	DATA	AREA_COI	OPERATO	PSC	SYS	FIELD	31/1	1/2
2	JERNEH_GAS_SALES_HYPIS				PLAN				GASPLAN	PM	EMEPMI	GPSC	OSC	Jerneh		267.7
3	LAWIT_GAS_SALES_I	HYPIS			PLAN				GASPLAN	PM	EMEPMI	GPSC	OSC	Lawit		79.4
4	BINTANG_GAS_SALE	HYPIS			PLAN				GASPLAN	PM	EMEPMI	GPSC	OSC	Bintang		197.9
5	GUNTONG_DE_GAS_HYPIS				PLAN				GASPLAN	PM	EMEPMI	GPSC	OSC	Guntong D/E		429.3
6	SELIGI_GPSC_GAS_S	HYPIS			PLAN				GASPLAN	PM	EMEPMI	GPSC	OSC	Seligi		0.0
7	DAMAR_GAS_SALES_HYPIS				PLAN				GASPLAN	PM	EMEPMI	GPSC	OSC	Damar		0.0
8	ANGSI_GAS_SALES_I	HYPIS			PLAN				GASPLAN	PM	PMO	GPSC	OSC	Angsi		114.7
9	BESAR_GAS_SALES_I	HYPIS			PLAN				GASPLAN	PM	PMO	GPSC	OSC	Besar		0.0
10	BERANTAI_GAS_SALI	HYPIS			PLAN				GASPLAN	PM	PML	Berantai R	OSC	Berantai		80.3
11	E_PIATU_GAS_SALES	HYPIS			PLAN				GASPLAN	PM	NFX	PM329	OSC	East Piatu		0.0
12	KAMELIA_GAS_SALE	HYPIS			PLAN				GASPLAN	PM	HESS	KAMELIA	OSC	Kamelia		93.7
13	RESAK_GAS_SALES_I	HYPIS			PLAN				GASPLAN	PM	PMO	PM6	RDS	Resak		107.9
14	TANGGA_BARAT_GA	HYPIS			PLAN				GASPLAN	PM	PMO	TBC	RDS	Tangga Barat		49.1
15	MELOR_GAS_SALES_HYPIS				PLAN				GASPLAN	PM	PMO	TBC	RDS	Melor		0.0
16	LAHOR_GAS_SALES_HYPIS				PLAN				GASPLAN	PM	PMO	TBC	RDS	Lahor		0.0
17	BUNGA_RAYA_GAS_HYPIS				PLAN				GASPLAN	PM	TML	PM3CAA	RDS	Bunga Raya		106.0
18	BANANG_GAS_SALE	HYPIS			PLAN				GASPLAN	PM	COASTAL	Banang	RDS	Banang		0.0
19	DUYONG_GAS_SALE	HYPIS			PLAN				GASPLAN	PM	PMO	PM12	JDS	Duyong		38.6
20	MASA_GAS_SALES_I	HYPIS			PLAN				GASPLAN	PM	PMO	PM12	JDS	MASA		0.0
21	BEKOK_PM9_GAS_S	HYPIS			PLAN				GASPLAN	PM	PMO	PM9	JDS	Bekok C		43.4
22	TIONG_PM9_GAS_S	HYPIS			PLAN				GASPLAN	PM	PMO	PM9	JDS	Tiong		24.1
23	PULAI_PM9_GAS_SA	HYPIS			PLAN				GASPLAN	PM	PMO	PM9	JDS	Pulai		9.6
24	LEDANG_ANOA_GAS	HYPIS			PLAN				GASPLAN	PM	PMO	PM309	JDS	Ledang		38.6
25	WEST_NATUNA_GAS	HYPIS			PLAN				GASPLAN	PM	CONOCO	WEST NAT	JDS	West Natuna		235.2

Figure 13 – Copy document before column deletion

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	DATA	AREA_COI	OPERATO	PSC	FIELD	28/2 MTD										
2	GASPLAN	PM	EMEPMI	GPSC	Jerneh	256.2	275.4									
3	GASPLAN	PM	EMEPMI	GPSC	Lawit	66.9	73.9									
4	GASPLAN	PM	EMEPMI	GPSC	Bintang	186.4	191.9									
5	GASPLAN	PM	EMEPMI	GPSC	Guntong C	504.7	529.0									
6	GASPLAN	PM	EMEPMI	GPSC	Seligi	0.0	3.4									
7	GASPLAN	PM	EMEPMI	GPSC	Damar	13.4	16.3									
8	GASPLAN	PM	PMO	GPSC	Angsi	162.5	147.8									
9	GASPLAN	PM	PMO	GPSC	Besar	0.0	0.0									
10	GASPLAN	PM	PML	Berantai R	Berantai	90.8	95.7									
11	GASPLAN	PM	NFX	PM329	East Piatu	0.0	0.0									
12	GASPLAN	PM	HESS	KAMELIA	Kamelia	82.2	93.8									
13	GASPLAN	PM	PMO	PM6	Resak	87.2	117.2									
14	GASPLAN	PM	PMO	TBC	Tangga Ba	98.0	84.7									
15	GASPLAN	PM	PMO	TBC	Melor	0.0	0.0									
16	GASPLAN	PM	PMO	TBC	Lahor	0.0	0.0									
17	GASPLAN	PM	TML	PM3CAA	Bunga Ray	63.7	78.6									
18	GASPLAN	PM	COASTAL	Banang	Banang	0.0	0.0									
19	GASPLAN	PM	PMO	PM12	Duyong	38.5	38.6									
20	GASPLAN	PM	PMO	PM12	MASA	0.0	0.0									
21	GASPLAN	PM	PMO	PM9	Bekok C	43.3	43.4									
22	GASPLAN	PM	PMO	PM9	Tiong	9.6	20.7									
23	GASPLAN	PM	PMO	PM9	Pulai	9.6	9.6									
24	GASPLAN	PM	PMO	PM309	Ledang	38.5	35.8									
25	GASPLAN	PM	CONOCO	WEST NAT	West Nat	209.7	224.2									

Figure 14 – Copy document after column deletion

### *Copy-CopyNew*

After Copy documents are ready, the automation script will create CopyNew documents. There are two CopyNew documents – GASCopyNew and CRUDECopyNew. In these CopyNew documents, data will be sorted by area code. CopyNew documents use data collected by Copy documents and sort it according to planned production and actual production data. For GAS example, the field will have a planned production data (GASPLAN), an actual production data (GASDAILY), a planned MTD production data (MTDPLAN), and an actual MTD production data (MTD). The variances will be calculated in pairs between planned production and actual production data e.g. GASDAILY and GASPLAN, and MTD and MTDPLAN. The following figure shows the said columns.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	AREA_COI	OPERATO	PSC	FIELD	DAILY	PLAN	VARIANCE									
2	PM	EMEPMI	GPSC	Jerneh	266.3	256.2	10.2									
3	PM	EMEPMI	GPSC	Lawit	75.1	66.9	8.2									
4	PM	EMEPMI	GPSC	Bintang	193.2	186.4	6.8									
5	PM	EMEPMI	GPSC	Guntong L	547.3	504.7	42.6									
6	PM	EMEPMI	GPSC	Seligi	0.0	0.0	0.0									
7	PM	EMEPMI	GPSC	Damar	11.7	13.4	-1.7									
8	PM	PMO	GPSC	Angsi	28.3	162.5	-134.2									
9	PM	PMO	GPSC	Besar	0.0	0.0	0.0									
10	PM	PML	Berantai F	Berantai	85.4	90.8	-5.4									
11	PM	NFX	PM329	East Piatu	5.1	0.0	5.1									
12	PM	HESS	KAMELIA	Kamelia	96.6	82.2	14.4									
13	PM	PMO	PM6	Resak	83.3	87.2	-3.9									
14	PM	PMO	TBC	Tangga Ba	110.4	98.0	12.4									
15	PM	PMO	TBC	Melor	0.0	0.0	0.0									
16	PM	PMO	TBC	Lahor	0.0	0.0	0.0									
17	PM	TML	PM3CAA	Bunga Ray	66.3	63.7	2.5									
18	PM	COASTAL	Banang	Banang	0.0	0.0	0.0									
19	PM	PMO	PM12	Duyong	54.5	38.5	16.0									
20	PM	PMO	PM12	MASA	0.0	0.0	0.0									
21	PM	PMO	PM9	Bekok C	64.4	43.3	21.1									
22	PM	PMO	PM9	Tiong	0.0	9.6	-9.6									
23	PM	PMO	PM9	Pulai	4.0	9.6	-5.7									
24	PM	PMO	PM309	Ledang	37.6	38.5	-0.8									
25	PM	CONOCO	WEST NAT	West Natu	224.9	209.7	15.1									

Figure 15 – GASDAILY and GASPLAN columns

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	AREA_COI	OPERATO	PSC	FIELD				MTD	MTDPLAN	VARIANCE						
2	PM	EMEPMI	GPSC	Jerneh				278.7	275.4	3.4						
3	PM	EMEPMI	GPSC	Lawit				72.5	73.9	-1.3						
4	PM	EMEPMI	GPSC	Bintang				191.9	191.9	0.0						
5	PM	EMEPMI	GPSC	Guntong L				475.3	529.0	-53.7						
6	PM	EMEPMI	GPSC	Seligi				4.4	3.4	1.0						
7	PM	EMEPMI	GPSC	Damar				15.7	16.3	-0.6						
8	PM	PMO	GPSC	Angsi				147.1	147.8	-0.7						
9	PM	PMO	GPSC	Besar				0.0	0.0	0.0						
10	PM	PML	Berantai F	Berantai				87.5	95.7	-8.2						
11	PM	NFX	PM329	East Piatu				1.3	0.0	1.3						
12	PM	HESS	KAMELIA	Kamelia				97.6	93.8	3.8						
13	PM	PMO	PM6	Resak				130.3	117.2	13.1						
14	PM	PMO	TBC	Tangga Ba				91.1	84.7	6.5						
15	PM	PMO	TBC	Melor				0.0	0.0	0.0						
16	PM	PMO	TBC	Lahor				0.0	0.0	0.0						
17	PM	TML	PM3CAA	Bunga Ray				99.4	78.6	20.8						
18	PM	COASTAL	Banang	Banang				0.0	0.0	0.0						
19	PM	PMO	PM12	Duyong				45.7	38.6	7.2						
20	PM	PMO	PM12	MASA				0.0	0.0	0.0						
21	PM	PMO	PM9	Bekok C				58.4	43.4	15.0						
22	PM	PMO	PM9	Tiong				15.2	20.7	-5.4						
23	PM	PMO	PM9	Pulai				15.4	9.6	5.7						
24	PM	PMO	PM309	Ledang				34.3	35.8	-1.6						
25	PM	CONOCO	WEST NAT	West Natu				223.2	224.2	-1.0						

Figure 16 – MTD and MTDPLAN columns

CopyNew-Pivot

The last stage in the second step is to create summary report in a PivotTable. PivotTable is a built-in table builder in Microsoft Excel. PivotTable allows user to create summary of data easily. The automation script will develop tables which are used to sort CopyNew data into proper summary reports formatting. Figure 17 shows the proper formatting.

	A	B	C	D	E	F	G
3	Row Labels	Sum of DAILY	Sum of PLAN	Sum of VARIANCE	Sum of MTD	Sum of MTDPLAN	Sum of VARIANCE2
4	PM	2130.1	2124.0	6.1	2246.7	2247.8	-1.1
5	CH MUTIARA	119.1	120.0	-0.9	114.6	120.0	-5.4
6	COASTAL	0.0	0.0	0.0	0.0	0.0	0.0
7	CONOCO (IMPORT)	224.9	209.7	15.1	223.2	224.2	-1.0
8	EMEPMI	1134.3	1059.3	75.0	1069.8	1126.8	-57.0
9	HESS	96.6	82.2	14.4	97.6	93.8	3.8
10	NFX	5.1	0.0	5.1	1.3	0.0	1.3
11	PML	85.4	90.8	-5.4	87.5	95.7	-8.2
12	PMO	398.5	498.3	-99.7	553.4	508.8	44.6
13	TML	66.3	63.7	2.5	99.4	78.6	20.8
14	PM3CAA	66.3	63.7	2.5	99.4	78.6	20.8
15	Bunga Raya	66.3	63.7	2.5	99.4	78.6	20.8
16	SBH	183.0	266.2	-83.3	229.3	250.8	-21.5
17	MOC	92.2	80.0	12.2	39.8	80.0	-40.2
18	SBO	85.7	182.0	-96.3	184.1	166.7	17.4
19	SSPC	0.0	0.0	0.0	2.0	0.0	2.0
20	TML	5.0	4.2	0.8	3.4	4.1	-0.7
21	2012 Kinabalu Oil	5.0	4.2	0.8	3.4	4.1	-0.7
22	KN	5.0	4.2	0.8	3.4	4.1	-0.7
23	SWK	4353.0	4414.1	-61.1	4307.9	4401.6	-93.8
24	JX-NIPPON	150.0	250.0	-100.0	256.8	250.1	6.6
25	SK10	150.0	250.0	-100.0	256.8	250.1	6.6
26	Helang	150.0	250.0	-100.0	256.8	250.1	6.6
27	MOC	237.5	245.1	-7.6	239.3	229.4	10.0

Figure 17 – PivotTable and proper formatting

## **CHAPTER 5**

### **CONCLUSION**

#### **5.1 Conclusion**

In this dissertation, most details about ORE have been explained. Some functions e.g. creating summary reports have been implemented. Additional features will be developed in the future to increase efficiency and offer more flexibility to the user.

It is hoped that this initiative has achieved its main objectives and helped in making data consolidation activity undertaken in PETRONAS MPM more efficient.

#### **5.2 Recommendation and Future Works**

There are some recommendations that could be implemented to improve ORE. These recommendations are not intended to change the project as a whole, but to provide insights and ideas for improvements to be done on certain aspects of the automation script. These recommendations could be used as the basis of future works on ORE. Among the recommendations are formula sanitization and restructuring, and data error checking.

##### *Formula sanitization and restructuring*

Automation script developed in ORE directly uses the formulas used in data consolidation activity without any alteration. However, the automation script is not completely efficient due to the complexity of the formulas. Therefore, it is imperative that to increase the efficiency of the automation script, the formulas must be made less complicated, hence the recommendation to develop it in future works of ORE.

##### *Data error checking*

The error-checking subroutine in this project only checks the integrity of the operation reports' naming convention. The subroutine basically checks whether the correct document types e.g. Microsoft Excel document types (.xls, .xlsx) is specified in the text boxes. However, it does not include data checking e.g. the corrective analyses of data and data structure inside the documents. These analyses are manually done by the technician.

Therefore, it is hoped that these recommendations could be taken to improve this project and make it better for the user.

## CHAPTER 6

### REFERENCES

About macros in Excel. *Microsoft.com*. Retrieved from <http://office.microsoft.com/en-001/excel-help/about-macos-in-excel-HP005201201.aspx>

About macro security. *Microsoft.com*. Retrieved from <http://office.microsoft.com/en-001/excel-help/about-macro-security-HP003084611.aspx>

Ahmad, S., Kadir, M. Z. A. A., & Shafie, S. (2011). Current perspective of the renewable energy development in Malaysia. *Renewable and Sustainable Energy Reviews*, 15(2), 897-904.

Buchanan, E. (2007). *Internet Research Ethics Questions and Considerations*, 397-402.

Chin, J. (2008). Petronas posts record profit, declares RM6b dividend to govt (updated). *TheStar.com.my*. Retrieved from <http://www.thestar.com.my/story/?file=%2f2008%2f7%2f15%2fbusiness%2f20080715121235&sec=business>

Chua, S. C., & Oh, T. H. (2010). Review on Malaysia's national energy developments: Key policies, agencies, programmes and international involvements. *Renewable and Sustainable Energy Reviews*, 14(9), 2916-2925.

Discover Our Heritage. *Petronas.com.my*. Retrieved from <http://www.petronas.com.my/about-us/pages/corporate-profile.aspx>

Exploration & Production. *Petronas.com.my*. Retrieved from <http://www.petronas.com.my/our-business/exploration-production/Pages/default.aspx>

Jayaseelan, R. (2014). Petronas splits exploration, production unit to enhance ownership, accountability. *TheStar.com.my*. Retrieved from <http://www.thestar.com.my/Business/Business-News/2014/04/09/Malaysias-national-petroleum-company-reorganises/>

Krieger, S. (2003). Macros demystified: What they are and why to use them. *Microsoft.com*. Retrieved from <http://office.microsoft.com/en-001/help/macros-demystified-what-they-are-and-why-to-use-them-HA010007210.aspx>

Koswanage, N. & Kaiser, E. Special Report: Petronas chafes at its role as Malaysia's piggy bank. *Reuters.com*. Retrieved from <http://www.reuters.com/article/2012/07/02/us-malaysia-petronas-idUSBRE86105420120702>

Muir, B. M. (1994). Trust in automation: Part I. Theoretical issues in the study of trust and human intervention in automated systems. *Ergonomics*, 37(11), 1905-1922.

Muir, B. M., & Moray, N. (1996). Trust in automation. Part II. Experimental studies of trust and human intervention in a process control simulation. *Ergonomics*, 39(3), 429-460.

Ong, H. C., Mahlia, T. M. I., & Masjuki, H. H. (2011). A review on energy scenario and sustainable energy in Malaysia. *Renewable and Sustainable Energy Reviews*, 15(1), 639-647.

Petronas continues to play role in nation building. *TheBorneoPost.com*. Retrieved from <http://www.theborneopost.com/2014/02/21/petronas-continues-to-play-role-in-nation-building/>

## APPENDEX

### Appendix 1 – Upload Documents module source code

```
Private Sub Consolidate_Btn_Click()
    If (GASPM_Box.Value = "") Or (GASSS_Box.Value = "") Or
(CRUDEPM_Box.Value = "") Or (CRUDESS_Box.Value = "") Then
        MsgBox "Some required files for upload are not specified."
    Else
        CheckIfSheetExists "GAS"
        CheckIfSheetExists "CRUDE"

        CopyDataFromWorkbook

        ORE_2.Show
        ORE_1.Hide
    End If
End Sub

'find data in column
Sub CopyDataFromWorkbook()
    Application.DisplayAlerts = False

    Dim wkbSource As Workbook

    'copying
    Set wkbSource = Workbooks.Open(GASPM_Box.Value)

    wkbSource.Worksheets("GAS").Range("A1:FO189").Copy
    ThisWorkbook.Worksheets("GAS").Range("A1:FO189").PasteSpecial
    Paste:=xlPasteValuesAndNumberFormats

    'close copied source
    wkbSource.Saved = True
```

```

wkbSource.Close

'copying
Set wkbSource = Workbooks.Open(GASSS_Box.Value)

wkbSource.Worksheets("GAS").Range("A190:FO388").Copy
ThisWorkbook.Worksheets("GAS").Range("A190:FO388").PasteSpecial
Paste:=xlPasteValuesAndNumberFormats

'close copied source
wkbSource.Saved = True
wkbSource.Close

'copying
Set wkbSource = Workbooks.Open(CRUDEPM_Box.Value)

wkbSource.Worksheets("CRUDE").Range("A1:FO282").Copy
ThisWorkbook.Worksheets("CRUDE").Range("A1:FO282").PasteSpecial
Paste:=xlPasteValuesAndNumberFormats

wkbSource.Worksheets("CRUDE").Range("A493:FO503").Copy
ThisWorkbook.Worksheets("CRUDE").Range("A493:FO503").PasteSpecial
Paste:=xlPasteValuesAndNumberFormats

'close copied source
wkbSource.Saved = True
wkbSource.Close

'copying
Set wkbSource = Workbooks.Open(CRUDESS_Box.Value)

wkbSource.Worksheets("CRUDE").Range("A283:FO492").Copy
ThisWorkbook.Worksheets("CRUDE").Range("A283:FO492").PasteSpecial
Paste:=xlPasteValuesAndNumberFormats

```

```
wkbSource.Worksheets("CRUDE").Range("A504:FO755").Copy
ThisWorkbook.Worksheets("CRUDE").Range("A504:FO755").PasteSpecial
Paste:=xlPasteValuesAndNumberFormats
```

```
'close copied source
wkbSource.Saved = True
wkbSource.Close
```

```
Application.DisplayAlerts = True
MsgBox ("Copy completed. Click OK to proceed.")
```

```
End Sub
```

```
Private Sub GASPM_Btn_Click()
```

```
Dim file As String
file = Application.GetOpenFilename("Excel workbooks,*.xls*")
```

```
If file = "False" Then
    GASPM_Box.Value = ""
Else
    GASPM_Box.Value = file
End If
```

```
End Sub
```

```
Private Sub GASSS_Btn_Click()
```

```
Dim file As String
file = Application.GetOpenFilename("Excel workbooks,*.xls*")
```

```
If file = "False" Then
    GASSS_Box.Value = ""
Else
    GASSS_Box.Value = file
End If
```

```
End Sub
```

```

Private Sub CRUDEPM_Btn_Click()
    Dim file As String
    file = Application.GetOpenFilename("Excel workbooks,*.xls*")

    If file = "False" Then
        CRUDEPM_Box.Value = ""
    Else
        CRUDEPM_Box.Value = file
    End If
End Sub

Private Sub CRUDESS_Btn_Click()
    Dim file As String
    file = Application.GetOpenFilename("Excel workbooks,*.xls*")

    If file = "False" Then
        CRUDESS_Box.Value = ""
    Else
        CRUDESS_Box.Value = file
    End If
End Sub

'help button
Private Sub Image2_Click()
    MsgBox ("This module is used to upload documents needed for consolidation.")
End Sub

'reset button
Private Sub Reset_Btn_Click()
    GASPM_Box.Value = ""
    GASSS_Box.Value = ""
    CRUDEPM_Box.Value = ""
    CRUDESS_Box.Value = ""
End Sub

```

'check if the sheet exists  
'if yes, it deletes the existing sheet, and replaces with new, empty one  
'if no, it creates new, empty one

```
Sub CheckIfSheetExists(wks As String)
```

```
    Dim wsSheet As Worksheet  
    On Error Resume Next  
    Set wsSheet = Worksheets(wks)  
    On Error GoTo 0
```

```
    If Not wsSheet Is Nothing Then  
        DeleteSheetNoConfirm wks  
    End If
```

```
    AddSheetNoConfirm wks  
End Sub
```

'deletes sheet with the specified name without prompt

```
Sub DeleteSheetNoConfirm(wks As String)
```

```
    Application.DisplayAlerts = False  
    Worksheets(wks).Delete  
    Application.DisplayAlerts = True  
End Sub
```

'adds sheet with the specified name without prompt

```
Sub AddSheetNoConfirm(wks As String)
```

```
    Application.DisplayAlerts = False  
    Dim ws As Worksheet  
    Set ws = Worksheets.Add(After:=Worksheets(Worksheets.count))  
    ws.Name = wks  
    Application.DisplayAlerts = True  
End Sub
```

'returns the number of last row used

```
Function LastUsedInRow(wks As String) As Integer
```

```
    Dim FinalRow
```

```

    FinalRow = Worksheets(wks).Cells(Rows.count, 1).End(xlUp).Row
    LastUsedInRow = FinalRow
End Function

```

```

'return the number of last column used
Function LastUsedInColumn(wks As String) As Integer
    Dim FinalCol
    FinalCol = Worksheets(wks).Cells(1, Columns.count).End(xlToLeft).Column
    LastUsedInColumn = FinalCol
End Function

```

```

'convert column numbers to letters
Function ColumnLtr(col As Integer) As String
    Dim arr
    arr = Split(Cells(1, col).Address(True, False), "$")
    ColumnLtr = arr(0)
End Function

```

```

Function LastInRow(wbk As String, wks As String) As Integer
    'only for other workbooks
    'open workbook, set as active
    'find the last row in that workbook
    'close the workbook and return the result
    Dim wbkOpen As Workbook
    Set wbkOpen = Workbooks.Open(wbk)

    Dim result
    result = wbkOpen.Worksheets(wks).Cells(Rows.count, 1).End(xlUp).Row

    wbkOpen.Close
    LastInRow = result
End Function

```

```

Function LastInColumn(wbk As String, wks As String) As Integer
    'only for other workbooks

```

```

'open workbook, set as active
'find the last column in that workbook
'close the workbook and return the result
Dim wbkOpen As Workbook
Set wbkOpen = Workbooks.Open(wbk)

Dim result
result = wbkOpen.Worksheets(wks).Cells(1, Columns.count).End(xlToLeft).Column

wbkOpen.Close
LastInColumn = result
End Function

```

#### Appendix 2 – Create Summary Reports module source code

```

Private Sub Image2_Click()
    MsgBox ("This module is used to generate various types of summary report.")
End Sub

```

```

Private Sub SumCRUDEPM_Btn_Click()
    CheckIfSheetExist "CRUDECopy"
    CheckIfSheetExist "CRUDECopyNew"
    CheckIfSheetExist "CRUDEPivot"

    'initialize GASCopy
    'copy all data
    'delete unused columns
    InitCopy "CRUDE", "CRUDECopy"
    FindInColumn "CRUDE", "CRUDECopy", "CRUDEPLAN", "PM"
    FindInColumn "CRUDE", "CRUDECopy", "CRUDEPLAN", "SBH"
    FindInColumn "CRUDE", "CRUDECopy", "CRUDEPLAN", "SWK"
    FindInColumn "CRUDE", "CRUDECopy", "CRUDEDAILY", "PM"
    FindInColumn "CRUDE", "CRUDECopy", "CRUDEDAILY", "SBH"
    FindInColumn "CRUDE", "CRUDECopy", "CRUDEDAILY", "SWK"
    DeleteUnusedColumn "CRUDECopy"

```

```

'initialize GASCopyNew
'populate table
'create pivot table
InitCopyNew "CRUDECopy", "CRUDECopyNew", "CRUDEPLAN"
PopulateTable "CRUDECopy", "CRUDECopyNew", "CRUDEPLAN",
"CRUDEDAILY"
CreatePivot "CRUDECopyNew", "CRUDEPivot"
End Sub

```

```

Private Sub SumCRUDESS_Btn_Click()

```

```

CheckIfSheetExist "FLARECopy"
CheckIfSheetExist "FLARECopyNew"
CheckIfSheetExist "FLAREPivot"

```

```

'initialize GASCopy

```

```

'copy all data

```

```

'delete unused columns

```

```

InitCopy "CRUDE", "FLARECopy"

```

```

FindInColumn "CRUDE", "FLARECopy", "FLARELIMIT", "PM"

```

```

FindInColumn "CRUDE", "FLARECopy", "FLARELIMIT", "SBH"

```

```

FindInColumn "CRUDE", "FLARECopy", "FLARELIMIT", "SWK"

```

```

FindInColumn "CRUDE", "FLARECopy", "FLAREDAILY", "PM"

```

```

FindInColumn "CRUDE", "FLARECopy", "FLAREDAILY", "SBH"

```

```

FindInColumn "CRUDE", "FLARECopy", "FLAREDAILY", "SWK"

```

```

DeleteUnusedColumn "FLARECopy"

```

```

'since PMTOTAL is not found in FLARELIMIT, it is an exception

```

```

INSTALLING BALANCER

```

```

Dim x As Integer

```

```

x = LastUsedInRow("FLARECopy")

```

```

Worksheets("FLARECopy").Cells(x + 1, 1).Value = "FLARELIMIT"

```

```

Worksheets("FLARECopy").Cells(x + 1, 2).Value = "PM"

```

```

Worksheets("FLARECopy").Cells(x + 1, 3).Value = "PMO"
Worksheets("FLARECopy").Cells(x + 1, 4).Value = "PM9"
Worksheets("FLARECopy").Cells(x + 1, 5).Value = "PM9TOTAL"
Worksheets("FLARECopy").Cells(x + 1, 6).Value = "0.0"
Worksheets("FLARECopy").Cells(x + 1, 7).Value = "0.0"
'BALANCER ENDS

'initialize GASCopyNew
'populate table
'create pivot table
InitCopyNew "FLARECopy", "FLARECopyNew", "FLARELIMIT"
PopulateTable "FLARECopy", "FLARECopyNew", "FLARELIMIT",
"FLAREDAILY"
CreatePivot "FLARECopyNew", "FLAREPivot"
End Sub

Private Sub SumGASPM_Btn_Click()
CheckIfSheetExist "GASCopy"
CheckIfSheetExist "GASCopyNew"
CheckIfSheetExist "GASPivot"

'initialize GASCopy
'copy all data
'delete unused columns
InitCopy "GAS", "GASCopy"
FindInColumn "GAS", "GASCopy", "GASPLAN", "PM"
FindInColumn "GAS", "GASCopy", "GASPLAN", "SBH"
FindInColumn "GAS", "GASCopy", "GASPLAN", "SWK"
FindInColumn "GAS", "GASCopy", "GASDAILY", "PM"
FindInColumn "GAS", "GASCopy", "GASDAILY", "SBH"
FindInColumn "GAS", "GASCopy", "GASDAILY", "SWK"
DeleteUnusedColumn "GASCopy"

'initialize GASCopyNew
'populate table

```

```

'create pivot table
InitCopyNew "GASCopy", "GASCopyNew", "GASPLAN"
PopulateTable "GASCopy", "GASCopyNew", "GASPLAN", "GASDAILY"
CreatePivot "GASCopyNew", "GASPivot"
End Sub

Private Sub SumGASPMI_Btn_Click()
    CheckIfSheetExist "GASImCopy"
    CheckIfSheetExist "GASImCopyNew"
    CheckIfSheetExist "GASImPivot"

'initialize GASCopy
'copy all data
'delete unused columns
InitCopy "GAS", "GASImCopy"
FindInColumn "GAS", "GASImCopy", "GASPLAN", "PM (IMPORT)"
FindInColumn "GAS", "GASImCopy", "GASDAILY", "PM (IMPORT)"
DeleteUnusedColumn "GASImCopy"

'initialize GASCopyNew
'populate table
'create pivot table
InitCopyNew "GASImCopy", "GASImCopyNew", "GASPLAN"
PopulateTable "GASImCopy", "GASImCopyNew", "GASPLAN", "GASDAILY"
CreatePivot "GASImCopyNew", "GASImPivot"
End Sub

Private Sub SumGASSS_Btn_Click()
    CheckIfSheetExist "GASDwnCopy"
    CheckIfSheetExist "GASDwnCopyNew"
    CheckIfSheetExist "GASDwnPivot"

'initialize GASCopy
'copy all data
'delete unused columns

```

```

InitCopy "GAS", "GASDwnCopy"
FindInColumn "GAS", "GASDwnCopy", "GASPLAN_DS", "PM"
FindInColumn "GAS", "GASDwnCopy", "GASPLAN_DS", "SBH"
FindInColumn "GAS", "GASDwnCopy", "GASPLAN_DS", "SWK"
FindInColumn "GAS", "GASDwnCopy", "GASACTUAL_DS", "PM"
FindInColumn "GAS", "GASDwnCopy", "GASACTUAL_DS", "SBH"
FindInColumn "GAS", "GASDwnCopy", "GASACTUAL_DS", "SWK"
DeleteUnusedColumn "GASDwnCopy"

'initialize GASCopyNew
'populate table
'create pivot table
InitCopyNew "GASDwnCopy", "GASDwnCopyNew", "GASPLAN_DS"
PopulateTable "GASDwnCopy", "GASDwnCopyNew", "GASPLAN_DS",
"GASACTUAL_DS"
CreatePivot "GASDwnCopyNew", "GASDwnPivot"
End Sub

'prepare Copy sheets
Sub InitCopy(wksLoc As String, wksDest As String)
Worksheets(wksLoc).Range("2:2").Copy
Worksheets(wksDest).Range("1:1").PasteSpecial
Paste:=xlPasteValuesAndNumberFormats
End Sub

'find data in column
Sub FindInColumn(wksLoc As String, wksDest As String, data As String, areaCode As
String)
Dim i, x, y, count As Integer
x = LastUsedInRow(wksLoc)
'MsgBox (x)

For i = 1 To x
If Worksheets(wksLoc).Cells(i, 9).Value = data And Worksheets(wksLoc).Cells(i,
10).Value = areaCode Then

```

```

        count = count + 1
        Worksheets(wksLoc).Range(CStr(i) + ":" + CStr(i)).Copy
        y = LastUsedInRow(wksDest)
        Worksheets(wksDest).Range(CStr(y + 1) + ":" + CStr(y + 1)).PasteSpecial
Paste:=xlPasteValuesAndNumberFormats
    End If
Next i

```

```

    MsgBox count
End Sub

```

'delete unused column based on the value of table headers

```

Sub DeleteUnusedColumn(wks As String)

```

```

    Dim i, count As Integer

```

```

    Dim d As String

```

```

    count = 1

```

```

    x = LastUsedInColumn(wks)

```

```

    dt = Date

```

```

For i = 1 To x

```

```

    If Worksheets(wks).Cells(1, count).Value = "DATA" Then

```

```

        count = count + 1

```

```

    ElseIf Worksheets(wks).Cells(1, count).Value = "AREA_CODE" Then

```

```

        count = count + 1

```

```

    ElseIf Worksheets(wks).Cells(1, count).Value = "OPERATOR" Then

```

```

        count = count + 1

```

```

    ElseIf Worksheets(wks).Cells(1, count).Value = "PSC" Then

```

```

        count = count + 1

```

```

    ElseIf Worksheets(wks).Cells(1, count).Value = "FIELD" Then

```

```

        count = count + 1

```

```

    ElseIf Worksheets(wks).Cells(1, count).Value = dt Then

```

```

        count = count + 1

```

```

    ElseIf Worksheets(wks).Cells(1, count).Value = "MTD" Then

```

```

        count = count + 1

```

```

Else
    Worksheets(wks).Range(ColumnLtr(count) + ":" + ColumnLtr(count)).Delete
End If
Next i
End Sub

```

'prepare GASCopyNew sheet

```
Sub InitCopyNew(wksLoc As String, wksDest As String, wksPlan As String)
```

```
    'copy column headers
```

```
    Worksheets(wksDest).Cells(1, 1).Value = "AREA_CODE"
```

```
    Worksheets(wksDest).Cells(1, 2).Value = "OPERATOR"
```

```
    Worksheets(wksDest).Cells(1, 3).Value = "PSC"
```

```
    Worksheets(wksDest).Cells(1, 4).Value = "FIELD"
```

```
    Worksheets(wksDest).Cells(1, 5).Value = "DAILY"
```

```
    Worksheets(wksDest).Cells(1, 6).Value = "PLAN"
```

```
    Worksheets(wksDest).Cells(1, 7).Value = "VARIANCE"
```

```
    Worksheets(wksDest).Cells(1, 8).Value = "MTD"
```

```
    Worksheets(wksDest).Cells(1, 9).Value = "MTDPLAN"
```

```
    Worksheets(wksDest).Cells(1, 10).Value = "VARIANCE"
```

```
    'copy row headers
```

```
    Dim i, x, y As Integer
```

```
    x = LastUsedInRow(wksLoc)
```

```
    For i = 1 To x
```

```
        y = LastUsedInRow(wksDest)
```

```
        If Worksheets(wksLoc).Cells(i, 1).Value = wksPlan Then
```

```
            Worksheets(wksLoc).Range("B" + CStr(i) + ":" + "E" + CStr(i)).Copy
```

```
            Worksheets(wksDest).Range("A" + CStr(y + 1) + ":" + "D" + CStr(y + 1)).PasteSpecial Paste:=xlPasteValuesAndNumberFormats
```

```
        End If
```

```
    Next i
```

```
End Sub
```

'populate table GASMAS

```

Sub PopulateTable(wksLoc As String, wksDest As String, wksPlan As String,
wksActual As String)
    Dim i, m As Integer
    m = LastUsedInRow(wksLoc)
    For i = 1 To m
        Dim val
        val = Worksheets(wksLoc).Cells(i, 5).Value

        Dim tw
        tw = 0
        tw = FindInCells(CStr(val), wksDest)

        If Worksheets(wksLoc).Cells(i, 1).Value = wksPlan Then
            Worksheets(wksLoc).Cells(i, 6).Copy
            Worksheets(wksDest).Cells(tw, 6).PasteSpecial
            Paste:=xlPasteValuesAndNumberFormats
            On Error Resume Next

            Worksheets(wksLoc).Cells(i, 7).Copy
            Worksheets(wksDest).Cells(tw, 9).PasteSpecial
            Paste:=xlPasteValuesAndNumberFormats
            On Error Resume Next

            ElseIf Worksheets(wksLoc).Cells(i, 1).Value = wksActual Then
                Worksheets(wksLoc).Cells(i, 6).Copy
                Worksheets(wksDest).Cells(tw, 5).PasteSpecial
                Paste:=xlPasteValuesAndNumberFormats
                On Error Resume Next

                Worksheets(wksLoc).Cells(i, 7).Copy
                Worksheets(wksDest).Cells(tw, 8).PasteSpecial
                Paste:=xlPasteValuesAndNumberFormats
                On Error Resume Next
            End If
        Next i

```

```

'variance calculation and formatting
Dim vStr1, vStr2, y, intNum
y = LastUsedInRow(wksDest)
For i = 2 To y
    vStr1 = Worksheets(wksDest).Cells(i, 5).Value
    vStr2 = Worksheets(wksDest).Cells(i, 6).Value
    intNum = CDbl(vStr1) - CDbl(vStr2)
    Worksheets(wksDest).Cells(i, 7).Value = intNum
    Worksheets(wksDest).Cells(i, 7).NumberFormat = "0.0"

    vStr1 = Worksheets(wksDest).Cells(i, 8).Value
    vStr2 = Worksheets(wksDest).Cells(i, 9).Value
    intNum = CDbl(vStr1) - CDbl(vStr2)
    Worksheets(wksDest).Cells(i, 10).Value = intNum
    Worksheets(wksDest).Cells(i, 10).NumberFormat = "0.0"
Next i
End Sub

'create pivot table
Sub CreatePivot(wksLoc As String, wksDest As String)
    Worksheets(wksDest).Activate

    Dim s, t

    s = LastUsedInRow(wksLoc)
    MsgBox (s)

    t = LastUsedInColumn(wksLoc)
    MsgBox (t)

    ActiveWorkbook.PivotCaches.Create(SourceType:=xlDatabase, SourceData:= _
        wksLoc + "!R1C1:R" + CStr(s) + "C" + CStr(t),
Version:=xlPivotTableVersion14).CreatePivotTable _

```

```

    TableDestination:=wksDest + "!R3C1", TableName:="PivotTable5",
DefaultVersion _
    :=xlPivotTableVersion14

Worksheets(wksDest).Cells(3, 1).Select

With ActiveSheet.PivotTables("PivotTable5").PivotFields("AREA_CODE")
    .Orientation = xlRowField
    .Position = 1
End With

With ActiveSheet.PivotTables("PivotTable5").PivotFields("OPERATOR")
    .Orientation = xlRowField
    .Position = 2
End With

With ActiveSheet.PivotTables("PivotTable5").PivotFields("PSC")
    .Orientation = xlRowField
    .Position = 3
End With

With ActiveSheet.PivotTables("PivotTable5").PivotFields("FIELD")
    .Orientation = xlRowField
    .Position = 4
End With

ActiveSheet.PivotTables("PivotTable5").AddDataField ActiveSheet.PivotTables( _
    "PivotTable5").PivotFields("DAILY"), "Sum of DAILY", xlSum
With ActiveSheet.PivotTables("PivotTable5").PivotFields("Sum of DAILY")
    .NumberFormat = "0.0"
End With

ActiveSheet.PivotTables("PivotTable5").AddDataField ActiveSheet.PivotTables( _
    "PivotTable5").PivotFields("PLAN"), "Sum of PLAN", xlSum
With ActiveSheet.PivotTables("PivotTable5").PivotFields("Sum of PLAN")

```

```

        .NumberFormat = "0.0"
    End With

    ActiveSheet.PivotTables("PivotTable5").AddDataField ActiveSheet.PivotTables( _
        "PivotTable5").PivotFields("VARIANCE"), "Sum of VARIANCE", xlSum
    With ActiveSheet.PivotTables("PivotTable5").PivotFields("Sum of VARIANCE")
        .NumberFormat = "0.0"
    End With

    ActiveSheet.PivotTables("PivotTable5").AddDataField ActiveSheet.PivotTables( _
        "PivotTable5").PivotFields("MTD"), "Sum of MTD", xlSum
    With ActiveSheet.PivotTables("PivotTable5").PivotFields("Sum of MTD")
        .NumberFormat = "0.0"
    End With

    ActiveSheet.PivotTables("PivotTable5").AddDataField ActiveSheet.PivotTables( _
        "PivotTable5").PivotFields("MTDPLAN"), "Sum of MTDPLAN", xlSum
    With ActiveSheet.PivotTables("PivotTable5").PivotFields("Sum of MTDPLAN")
        .NumberFormat = "0.0"
    End With

    ActiveSheet.PivotTables("PivotTable5").AddDataField ActiveSheet.PivotTables( _
        "PivotTable5").PivotFields("VARIANCE2"), "Sum of VARIANCE2", xlSum
    With ActiveSheet.PivotTables("PivotTable5").PivotFields("Sum of VARIANCE2")
        .NumberFormat = "0.0"
    End With

    MsgBox ("Pivot table completed!")
End Sub

'check if the sheet exists
'if yes, it deletes the existing sheet, and replaces with new, empty one
'if no, it creates new, empty one
Sub CheckIfSheetExist(wks As String)
    Dim wsSheet As Worksheet

```

```

On Error Resume Next
Set wsSheet = Sheets(wks)
On Error GoTo 0

If Not wsSheet Is Nothing Then
    MsgBox "I do exist"
    DeleteSheetNoConfirm wks
Else
    MsgBox "I do NOT exist"
End If

AddSheetNoConfirm wks
End Sub

'deletes sheet with the specified name without prompt
Sub DeleteSheetNoConfirm(wks As String)
    Application.DisplayAlerts = False
    Sheets(wks).Delete
    Application.DisplayAlerts = True
End Sub

'adds sheet with the specified name without prompt
Sub AddSheetNoConfirm(wks As String)
    Application.DisplayAlerts = False
    Dim ws As Worksheet
    Set ws = Sheets.Add(After:=Sheets(Sheets.count))
    ws.Name = wks
    Application.DisplayAlerts = True
End Sub

'returns the number of last row used
Function LastUsedInRow(wks As String) As Integer
    Dim FinalRow
    FinalRow = Worksheets(wks).Cells(Rows.count, 1).End(xlUp).Row
    LastUsedInRow = FinalRow

```

End Function

'return the number of last column used

Function LastUsedInColumn(wks As String) As Integer

Dim FinalCol

FinalCol = Worksheets(wks).Cells(1, Columns.count).End(xlToLeft).Column

LastUsedInColumn = FinalCol

End Function

'convert column numbers to letters

Function ColumnLtr(col As Integer) As String

Dim arr

arr = Split(Cells(1, col).Address(True, False), "\$")

ColumnLtr = arr(0)

End Function

'find values in cell and matches them

Function FindInCells(wrd As String, wksCopyNew As String) As Integer

Dim i, x, y, count As Integer

x = LastUsedInRow(wksCopyNew)

count = 0

For i = 1 To x

If Worksheets(wksCopyNew).Cells(i, 4).Value = wrd Then

count = i

Exit For

End If

Next i

FindInCells = count

End Function