Chapter 5

Correction Measures of the Energy Audit Report

5.1 Variety of Interpretation on Term of Reference and Example

The content in term of reference of the energy audit report is complex but it was stated unclearly. Therefore auditors could interpret it in many ways. For example about the cost of investment, which is stated too short in the term of reference i.e.:

" Calculate the cost of main equipment and accessories, labor cost, and miscellaneous cost such as in air conditioner of each set "

The energy conservation plan of the energy audit report concerns the cost of investment as stated in the term of reference. To see it clearly, the example of the energy conservation equipment that the contractor has to buy for building owner are listed here.

1 set of 12000 Btu high EER air conditioners

1 lamp of 7 Watt compact fluorescent

1 set of reflector luminary 36 Watt lamp per set: surfaced type, louver Cover

1 set of 36 Watt electronics ballast

The median price are shown in table 5-1

Table 5-1 the median price of example building

Equipment	Material cost Excluded 10% VAT (baht)	Material cost Included 10% VAT (baht)	Labor cost (baht)	Removing cost (baht)
12000 Btu high EER air conditioner	19414	21355.40	3500	500
7 Watt compact fluorescent	495	544.50	-	-
Reflector Luminary 36 Watt per set: surfaced type, louver cover	1242	1366.20	170	-
36 Watt electronics ballast	450	495	30	-

Except the median price from table 5-1 there are other two costs i.e.

- Finishing cost means cost for clean the site and make the site go to the existing condition.
- Miscellaneous cost means cost for buying something beyond normal work such as the circuit breaker if existing was damaged.

The auditor or energy audit report maker read the term of reference and the data base of each year about median price and then put it into the energy conservation plan. Although the blank table of the energy conservation plan was set roughly by all auditors, but some auditors changed it or filled it in his style as example 1 in table 5-2 and example 2 in table 5-3.

Table 5-2 Example 1 of the Energy Conservation Plan

x means the information, which has not to pay attention in example

(1),(2),...,(10) means the point of different between example 1 and example 2

- means no data in that block

Measures	Investment (baht)			Saving (4)		Payback	Rate of Return
	Material	Labor	Total	baht/year	kWh/year	(year)	
(A) Air conditioning system	(7)						
Air conditioner	19414		19414				
Removing cost (5)		500	500				
Installing cost		2500	2500				
Finishing cost		500	500				
Miscellaneous cost		500	500				
Total (A)	19414	4000	23414			- (1)	-
(B) Lighting system	(8)						
7 Watt compact fluorescent	495		495				
Reflector luminary	1242		1242				
Installing cost (6)		170	170				
Finishing cost		100	100				
Miscellaneous cost		100	100				
36 Watt electronics ballast	450		450				
Installing cost		30	30				
Total (B)	2187	400	2587			- (2)	-
Total (A)+(B)	21601 (9)	4400	26001			- (3)	-
Factor F for overhead profit and VAT (detail in appendix)			1.42480				
Total is 26001 x 1.42480 = 37046 baht (10)							

Table 5-3 Example 2 of the Energy Conservation Plan

x means the information, which has not to pay attention in example

(1),(2),…,(10) means the point of different between example 1 and example 2

Measures	Investment (baht)			Saving (4)		Payback	Rate of Return
	Material	Labor	Total	KWh/year	Baht/year	(year)	(%)
(A) Air conditioning system	(7)			x	x	x	X
Air conditioner	21355.40		21355.40				
Removing cost (5)			500				
Installing cost			2500				
Finishing cost			600				
Miscellaneous cost			600				
Total (A)	21355.40	4000	25555.40			X (1)	X
(B) Lighting system	(8)			x	x	x	X
7 Watt compact fluorescent	544.50		544.50				
Reflector luminary	1366.20		1366.20				
Installing cost (6)			170				
Finishing cost			200				
Miscellaneous cost			200				
36 Watt electronics ballast	495		495				
Installing cost		30	30				
Total (B)	2405.70	400	3005.70			x(2)	X
Total (A)+(B)	23761.10 (9)	4400	28561.10			X (3)	x
Factor F for overhead profit and VAT (detail in appendix)			1.42480				
Total is 28561.10 x 1.42480 = 40694 : Forty thousand six hundred and ninety four baht (10)							

From example, there are ten points of difference between example 1 and example 2 because of the term of reference does not define the detail of presentation I report.

The lists of difference are:

1 The payback period and rate of return in air conditioning system are not shown in example 1.

2 The payback period and rate of return in lighting system are not shown in example 1.

3 The payback period and rate of return in for building are not shown in example 1.

4 The column of baht per year and kWh/year is place alternatively.

5 There are over or under estimation and inappropriate of filling the finishing cost and miscellaneous cost in air conditioning system.

6 There are over or under estimation and inappropriate of filling the finishing cost and miscellaneous cost in lighting system.

7 Material cost in air conditioning system is included VAT only in examples 2.

8 Material cost in lighting system is included VAT only in examples 2.

9 Total material cost is included VAT only in examples 2.

10 There are no words of total cost in example 1.

From the difference of interpretation leads to the difference of the total cost of investment. The following problem is the budget approval and the installing phase of energy conservation.

5.2 The Interpretation to the Standard Format

The term of reference is that:

"Calculate the cost of main equipment and accessories, labor cost, and miscellaneous cost"

The interpretations are:

- The main equipment and accessories mean equipment and accessories that make the saving such as air conditioner with electronics thermostat, luminary with reflector, compact fluorescent with inner electronics ballast, and electronics ballast.
- Labor cost means cost for installing the main equipment and accessories which is divided into two system.

  (a) Air conditioning system

  - Cost of removing is defined in median price, which has only for removing the existing air conditioner.
  - Cost of installing is defined in median price.

- Cost of finishing is not defined in median price but for the standard, ECCT defined it not over 5% of material cost. The cost of finishing should plus with the labor cost and write in only one figure in the labor cost column in the energy conservation plan because the energy conservation plan is the summary used for budget approval.
- Miscellaneous cost is not defined in median price but for the standard, ECCT defined it not over 3% of material cost. The miscellaneous cost should plus with the labor cost and write in only one figure in the labor cost column in the energy conservation plan because the energy conservation plan is the summary used for budget approval.

(b) Lighting System

- Cost of installing is defined in median price
- Cost of finishing is not defined in median price but for the standard, ECCT defined it not over 5% of material cost. The finishing cost should plus with the labor cost and write in only one figure in the labor cost column in the energy conservation plan because the energy conservation plan is the summary used for budget approval.
- In lighting system, there are no cost of removing and miscellaneous because the main equipment and accessories are fixed in the same set, light weight, and easy to remove.

The next step is to set the standard meaning into the standard format of the energy audit report.

The standard format with the checkpoint box is presented in the form as figure 5-1. The checkpoint box shows the mistake number, which refers to the detail of mistake in table 4-1. Below the mistake number is the concept for correcting the mistake.

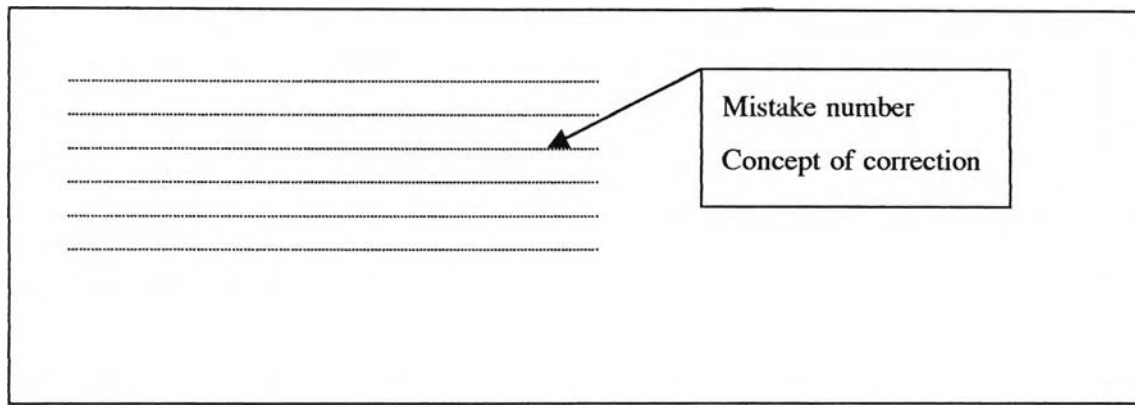

Figure 5-1 Form of the checkpoint box in the standard format of the energy audit report

From the Pareto Analysis and the Fishbone Diagram, the causes of the major mistake in the energy audit report are discovered. Moreover it is found that the minor mistake is the causes of the major mistake. Therefore the correction measures are set in the form of checkpoint box around the report to cover both major and minor mistake. Before the auditor send the energy audit report to reviewer, the auditor can check the energy audit report by himself along the checkpoint box in the standard format. (All of standard format is shown in appendix. The mistakes from number 1 to12 are the mistakes from the confusion about the references, which are used in the energy audit

report. So the 12 references in the 12 checkpoint boxes will be set in the first three pages of the standard format as the following.)

Now the example standard format of the energy conservation plan was set as the interpretation and show in table 5-4 with the checklist box. Except the standard format, the format with formula in Microsoft Excel is used for preventing the foolproof as shown in table 5-5. To understand the standard format concept, example number 3 of energy conservation plan after implemented the standard format is shown in table 5-6.

Table 5-4 Standard Format with the Checklist box of Energy Conservation Plan

5. Energy Conservation Plan

Item	Investment			Saving		Payback period	Economic investment rate of return EIRR (%)
	Material cost (baht)	Labor cost (baht)	Total (baht)	(kWh/year)	(bahtyear)	(year)	
Electrical Energy							
1. Air conditioning system							
1.1 High EER air conditioner with electronics thermostat replacement							
Total 1							
2. Lighting system							
2.1 Compact fluorescent replacement							
2.2							
Total 2							
Conclusion							

Mistake number 123 material cost from list of median price exclude VAT

Mistake number 125 material costfrom list of median price exclude VAT

Mistake number 126 Material cost from median pricefrom list of median price exclude VAT

Mistake number 122 Put the cost of removing + installation cost + finishing cost + miscelleneous cost in this block for air conditioning system

Mistake number 124 Put the installation cost +finishing cost + miscelleous cost

Mistake number 121 kWh/year is on the left hand baht/year is on the right hand

Mistake number 118. Show the payback period and the EIRR for each measures

Mistake number 119. Show the payback period and the EIRR for each measures

Mistake number 120 Show the payback period and the EIRR for the lighting system

3. Total 1-2 baht

4. Factor F baht

5. Total cost baht

Word of the cost of investment baht

Mistake number 127 Check the word of investment as the figure

Mistake number 128 The state ment number 2 is quoted from abstract

Remark: 1. High EER air conditioner can be replaced only the EIRR more than 9%only

2. Lighting system improvement should not make the illumination less than the existing by investing....baht. It saves.....baht and the EIRR is ..... %

If improve the quality of life as the commitment number 3/2541 (Number 15) of 14 October 1998, the cost of investment iscrease .....baht

The saving reduces to ...baht and the EIRR is....%

Table 5-5 Standard Format with the Checklist box of Energy Conservation Plan

5. Energy Conservation Plan

	A	B	C	D	E	F	G	H
	Item	Investment			Saving		Payback period	Economic
		Material cost (baht)	Labor cost (baht)	Total (baht)	(kWh/year)	(bahtyear)	(year)	investment rate of return EIRR (%)
	Electrical Energy							
	1. Air conditioning system							
1	1.1 High EER air conditioner with electronics thermostat			D1				
2								
3	**Total 1**	B3	C3	If B3+C3 equal to D1 Put D1 in D3				
	2. Lighting system							
3	2.1 Compact fluorescent replacement			F2				
4	2.2							
5	**Total 2**	B5	C5	If B5+C5 equal to D2 Put D2 in D5				
6	**Conclusion**	B3+B5	C3+C5	If (B3+B5) + (C3+C5) equal to (D3+D5) put (D3+D5) in F6				

3. Total 1-2 baht

4. Factor F baht

5. Total cost baht

Word of the cost of investment baht

Table 5-6 Example Number 3 the Energy Conservation Plan after Implemented the Standard Format

5. Energy Conservation Plan

Item	Investment			Saving		Payback period	Economic investment rate of return EIRR (%)
	Material cost (baht)	Labor cost (baht)	Total (baht)	(kWh/year)	(baht/year)	(year)	
Electrical Energy							
1. Air conditioning system							
1.1 High EER air conditioner with electronics thermostat	19,414.00	5,553.00	24,967.00				
Total 1	19,414.00	5,553.00	24,967.00				
2. Lighting system							
2.1 Compact fluorescent replacement	495.00	0.00	495.00				
2.2 Reflector luminary replacement	1,242.00	232.00	1,474.00				
2.3 Electronics ballast replacement	450.00	30.00	1,969.00				
Total 2	2,187.00	262.00	2,449.00				
Conclussion	21,601.00	6,815.00	27,416.00				

3. Total 1-2 27416 baht

4. Factor F 1.4248 baht

5. Total cost 39062 baht

Thirty nine thousand and sixty two baht

5.3 How Does the Standard Format Correct and Prevent Mistake

From the example of the standard format and the energy conservation plan in Ms Excel of the energy conservation plan, it can reduce the mistakes by correction and prevention as shown in table 5-7

Table 5-7 the corrective and preventive method for energy conservation plan.

Mistake	Correction or Prevention
Incomplete of the payback period and internal rate of return in air conditioning system	Checklist box and Ms Excel
Incomplete of the payback period and internal rate of return in lighting system	Checklist box and Ms Excel
Incomplete of the payback period and internal rate of return in building	Checklist box and Ms Excel
Alternative column between kWh/year and baht/year	Ms Excel
No system of labor cost for air conditioning system	Checklist box and more information
No system of material cost for air conditioning system	Checklist box and more information
No system of labor cost for lighting system	Checklist box and more information
No system of material cost for lighting system	Checklist box and more information
No total cost and tax confusion	Ms Excel and more information
No word for cost of investment	Checklist
Remark under the energy conservation plan is not same as in abstract	Checklist box and Ms Excel

5.4 Pugh Matrix for Comparing the Standard Format to the Report in the Past (Example 1 and Example 2)

Example 1 and Example 2 were used for comparing the example of the energy conservation plan after implemented the standard format as shown in table 5-8.

Table 5-8 Pugh Matrix for comparing the standard format to the report in the past

Criteria/Example	Example 1	Example 2	Example 3 (After implemented standard format)
Easy for read	D	-	+
Systematic		-	+
Clear Detail information	A	-	-
Suitable for budget approval	T	S	S
Fool proof		-	+
Meet term of reference	U	S	S
Summary form		-	+
Appropriate cost	M	-	+

+ mean better - mean worse S mean same

From the re-running the Pugh Matrix 3 times relative to the datum the example 3 which is the energy conservation plan after implemented the standard, it was found that the example 3 is the best format relative the others.