

Chapter 4

The Pareto Analysis and Fishbone Diagram for Correction

After study the procedure of the energy audit report making in chapter 3, the mistake from the reviewing of the 50 energy audit reports in the past was collected and show the frequency of the mistake in each part as table 4-1. The location of the mistake in table 4-1 refers to the organization of the energy audit report in appendix or in figure 3-2. The mistakes cover 8 main parts of the location of the mistake as list below.

- Introduction
- Energy Conservation Improvement Drawing
- Chapter 1
- Chapter 2
- Chapter 3
- Chapter 4
- Chapter 5
- Appendix

In figure 4-1, the frequency of each mistake from table 4-1 is shown. Then do the Pareto analysis of the mistake from table 4.1 by ordering the frequency from maximum to minimum as shown in figure 4-2. It is found that the major mistake is the mistake, which has the frequency up to 32 marks. There are 9 major mistakes (mistake number 18, 25, 26, 59, 122, 123, 124, 125, and 126).

We select only 9 mistake to be major mistake because the next mistake has 4 marks, which is the clearest different in figure 4-2.

After that, draw the fishbone diagram as in figure 4-3, 4-4, 4-5, 4-6, 4-7 to find the causes of the mistake. From fishbone diagram we found that the mistake causes from two main problems.

- Not enough or not clear of information which can be corrected by giving and defining the clear information for energy audit report making
- Human errors, which can be preventing by the checklist, box in standard format as shown in appendix.

Then put the correction concept for major problem into the standard format of the energy audit report. The example is shown in chapter 5, which includes the correction concept for correcting the minor problem.

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
1	factor F (overhead profit)	bill of quantity	8
2	lifetime of the equipment	3	10
3	size of new air conditioner	bill of quantity	14
4	lumen per lamp in easylux program	3	7
5	sequence of the report	content	11
6	sequence of improvement drawing	improvement drawing	22
7	cover of the improvement drawing	improvement drawing	7
8	detail drawing	improvement drawing	5
9	name of system and room in the heading block of the improvement drawing	improvement drawing	11
10	signature of the engineer in the improvement drawing	improvement drawing	20
11	symbol of air conditioning system	improvement drawing	6
12	symbol of lighting system	improvement drawing	14
13	software for improvement drawing	improvement drawing	1
14	scale of the improvement drawing	improvement drawing	5
15	name of building and contract number	cover	1
16	improved lighting index	Technical data table	6
17	obstacle of roof and glass improvement	Technical data table	17

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
18	cost of investment from all energy conservation measures	bill of quantity	43
19	finishing cost	bill of quantity	28
20	material cost and labor cost conclusion	bill of quantity	9
21	electrical phase of air conditioner	bill of quantity	26
22	list of new air conditioner	bill of quantity	14
23	data of lighting system at percent of real operating	comparison table before and after lighting improvement	23
24	data of lighting system at 100% operating	comparison table before and after lighting improvement	23
25	total saving from all energy conservation measures	abstract	41
26	total cost of investment	abstract	39
27	name of air conditioner retrofitting measure	abstract	4
28	The completion of measures	abstract	19
29	cost of investment for lighting systems	abstract	21
30	saving from lighting system improvement	abstract	19
31	EIRR of lighting system improvement	abstract	21
32	cost, saving, and EIRR of the luminary increasing	abstract	27
33	value of improved OTTV	abstract	18
34	value of OTTV and RTTV	abstract	13

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
35	value of improved RTTV	abstract	16
36	name of electronic thermostat in the content	content	4
37	list of energy conservation plan	content	19
38	budget of improvement for heating system	content	12
39	sequence of improvement in the energy audit report	content	19
40	sequence of existing luminary picture	content	11
41	the software for OTTV and RTTV calculation	content	21
42	the completion of the data for the energy consevation in government or stated-owned building	content	1
43	input of OTTV and RTTV	content	3
44	the long distance telephone code	1.1	21
45	number of bed for patient	1.1	12
46	the title of the cooperater	1.1	2
47	characteristic of building	1.2	16
48	name of building in the detail of opaque wall	1.2.1	27
49	color of opaque wall	1.2.1	7
50	material of opaque wall	1.2.1	5
51	type of transparent wall	1.2.2	10

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
52	type of overhang	1.2.2	6
53	type of roof	1.2.3	4
54	the area proportion of the transparent wall to the overall wall of each side	1.2.4	13
55	picture of building	1.3	14
56	peak load	2.1	5
57	data of transformer	2.1	4
58	using energy in building	2.1	2
59	proportion of the energy in each system	2.2	38
60	name of building in the energy using of air conditioning system	2.2.3	25
61	number of table of air conditoning system	2.2.3	17
62	air conditioning system index from auduting	2.2.3	9
63	summary table of the air conditioning system	2.2.3	6
64	summary data of the air conditioning system	2.2.3	8
65	the energy using per year	2.2.3	2
66	the age of air conditioner	2.2.3	6
67	lighting system index	2.2.4	27
68	the loss from ballast	2.2.4	9

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
69	water using index	2.3	1
70	source of water using	2.3	1
71	cost of existing air conditioner removing	3.1.2	4
72	example of saving calculation from air conditioner	3.1.2	19
73	operating factor of air conditioning system	3.1.2	25
74	fomular of saving calculation from air conditioner	3.1.2	22
75	energy consumption (kw/ton) for saving calculation from thermostat	3.1.2	18
76	Btu for calculation in air conditioning measures	3.1.2	26
77	saving from air conditioning system	3.1.2	21
78	cost of investment for air conditioning system retrofitting	3.1.2	23
79	area of glass for film coating	3.1.3	20
80	area for saving calculation in film coating measures	3.1.3	14
81	hours for saving calculation in film cocting measures	3.1.3	4
82	energy consumption (kW/ton) for saving calculation in film coating measures	3.1.3	2
83	reflectance of new film coating	3.1.3	6
84	cost of investment for film coating	3.1.3	6
85	area for real film coating	3.1.3	16

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
86	existing film removing	3.1.3	2
87	EIRR for film coating measures	3.1.3	12
88	area for RTTV calculation	3.1.4	7
89	sequence of measures of ceramic coating and insulating	3.1.4	24
90	the appropriate of the ceramic coating and insulating	3.1.4	24
91	kW/ton for saving calculation in the insulating measures	3.1.4	8
92	area for real insulating	improvement drawing	20
93	finishing and miscelleneouse cost for insulating measures	3.1.4	14
94	flat area for real ceramic coating	3.1.5	11
95	area for real ceramic coating	improvement drawing	14
96	color of ceramic coating	3.1.5	2
97	area for saving calculation in the ceramic coating measures	3.1.5	12
98	drain area for real ceramic coating	3.1.5	1
99	area for ceramic coating	3.1.5	11
100	type of calculation in the software for lighting simulation	3.2.1	3
101	meaning of saving in compact fluoesent measures	3.2.1	2
102	type of new fluoesent	3.2.1	6

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
103	lifetime of fluorescent in education institute	3.2.1	1
104	EIRR in new fluorescent measures	3.2.1	9
105	the replacement of the existing reflector luminary	3.2.2	4
106	saving from changing 32 watt to 12 watt luminary	3.2.2	20
107	the complete set of new luminary	3.2.2	5
108	the hanging of the luminary	3.2.2	1
109	the size of new luminary	3.2.2	10
110	new lay out of the lighting system	improvement drawing	18
111	formullar for saving calculation from new reflector luminary measures	3.2.2	27
112	the illumination on the working plane	Appendix E	10
113	miscellaneous of the reflector luminare retrofitting	Appendix E	8
114	labor cost for the lamp replacement	Appendix E	6
115	the finishing cost for reflector luminary retrofitting	Appendix E	7
116	cost of special reflector luminary	Appendix E	5
117	list in the potential of energy conservation	4	7
118	payback period and EIRR in the air conditioning system	5	26
119	payback period and EIRR of each measures in the lighting system	5	28

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
120	payback period and EIRR in the lighting system	5	28
121	the column of saving	5	4
122	scope of labor cost in air conditioning system	5	34
123	scope of material cost in air conditioning system	5	34
124	scope of labor cost in air lighting system	5	32
125	scope of material cost in lighting system	5	32
126	scope of material cost in building	5	32
127	the word of the cost of investment	5	2
128	the detail of the lighting system improvement	5	1
129	payback period for air conditioner	5.1	7
130	remark of the table of the list in the new air conditioner	5.1	6
131	table of the new air conditioner	5.1	4
132	the remark of the table of the new air conditioner	5.1	1
133	the simulation lux in the table of new reflector luminary	5.2	19
134	the existing lux in the table of new reflector luminary	5.2	1
135	actual load of transformer	A.1.2	1
136	picture of the switching device	A.1.3	2

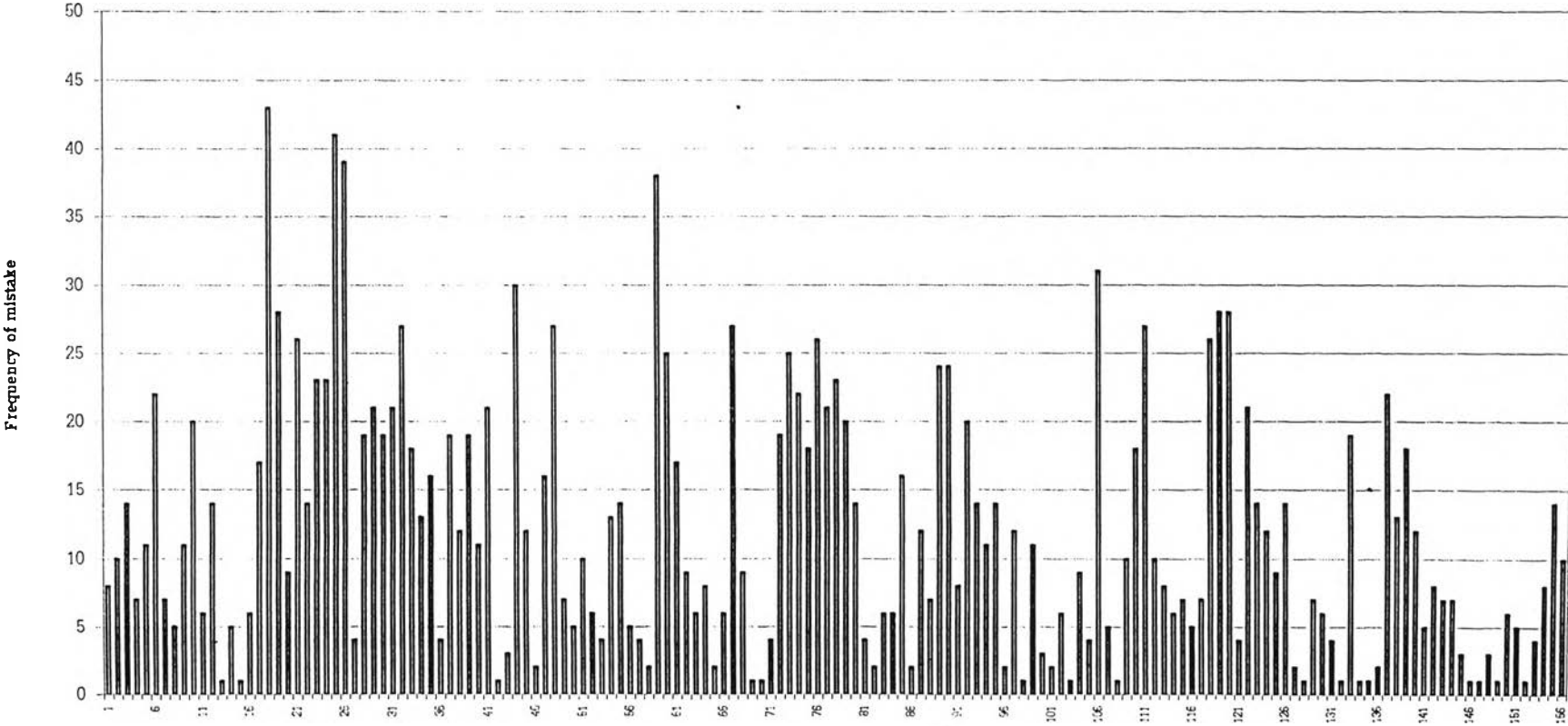
Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

No	Mistake	Item Location	Frequency
137	number of audited air conditioner	A.2	22
138	data from the EER calculation	A.2.2	13
139	kw/ton for air conditioning calculation	A.4	18
140	the overall percent for air conditioning system	A.4	12
141	OTTV and RTTV for non-air conditioning system	B.1	5
142	OTTV and RTTV after improvement	B.2	8
143	the month for data recording in the appendix C	C	7
144	the proportional of energy using in each system in the appendix C	C	7
145	code of building	D	3
146	title of building name	D	1
147	name of building	D	1
148	type of building	D	3
149	year of data recording	D	1
150	name of sub-building	D	6
151	number of building	D	5
152	name of consortium	D	1
153	proportion of the energy using in each system	D	4

Table 4-1 The frequency of the mistake from 50 energy audit report Reviewing

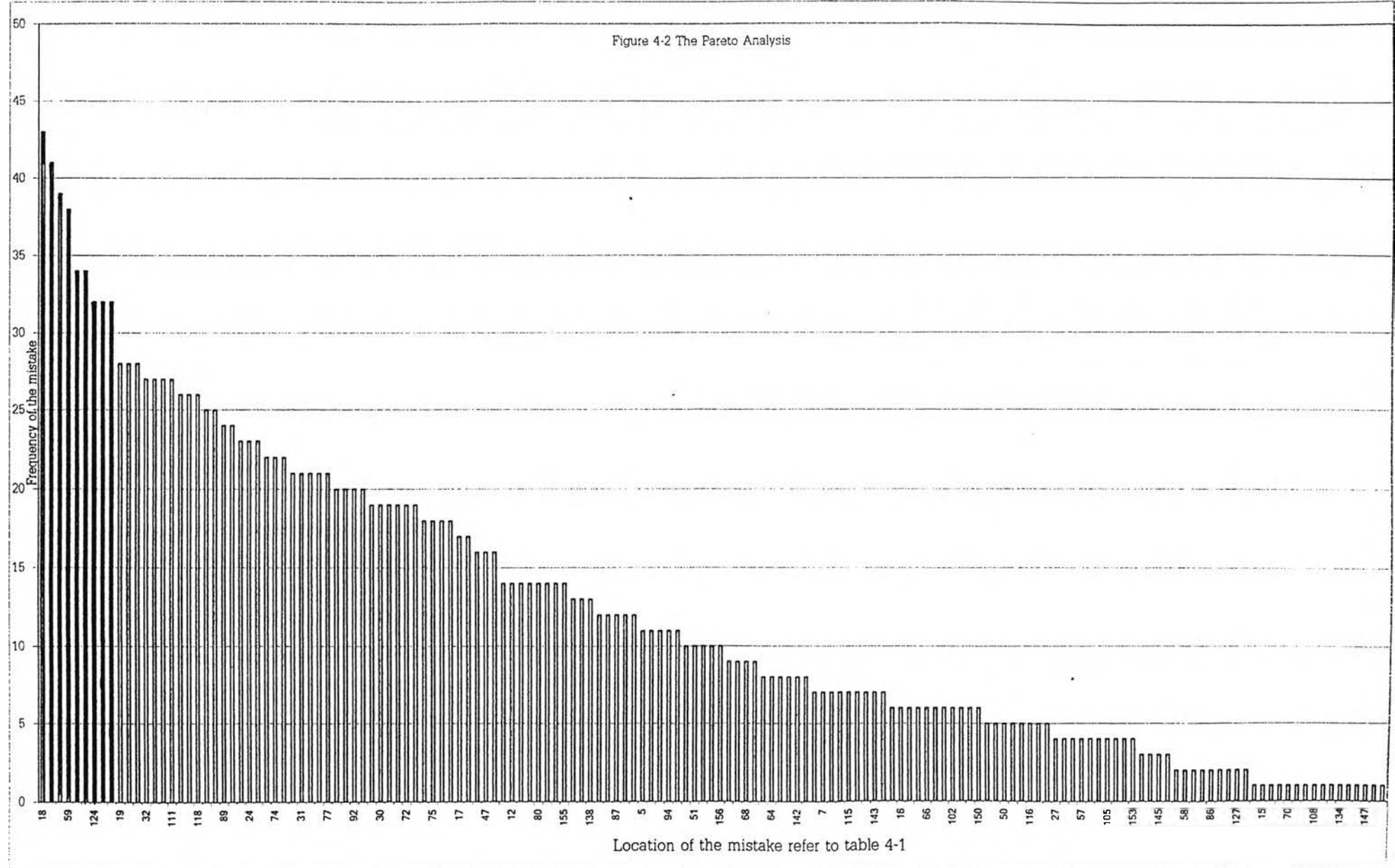
No	Mistake	Item Location	Frequency
154	list of new air conditioner	D	8
155	litre oil equivalent of saving for all measure	D	14
156	GJ of saving for all measure	D	10

Figure 4-1 The histogram of the mistake



Location of the mistake refer to table 4-1

Figure 4-2 The Pareto Analysis



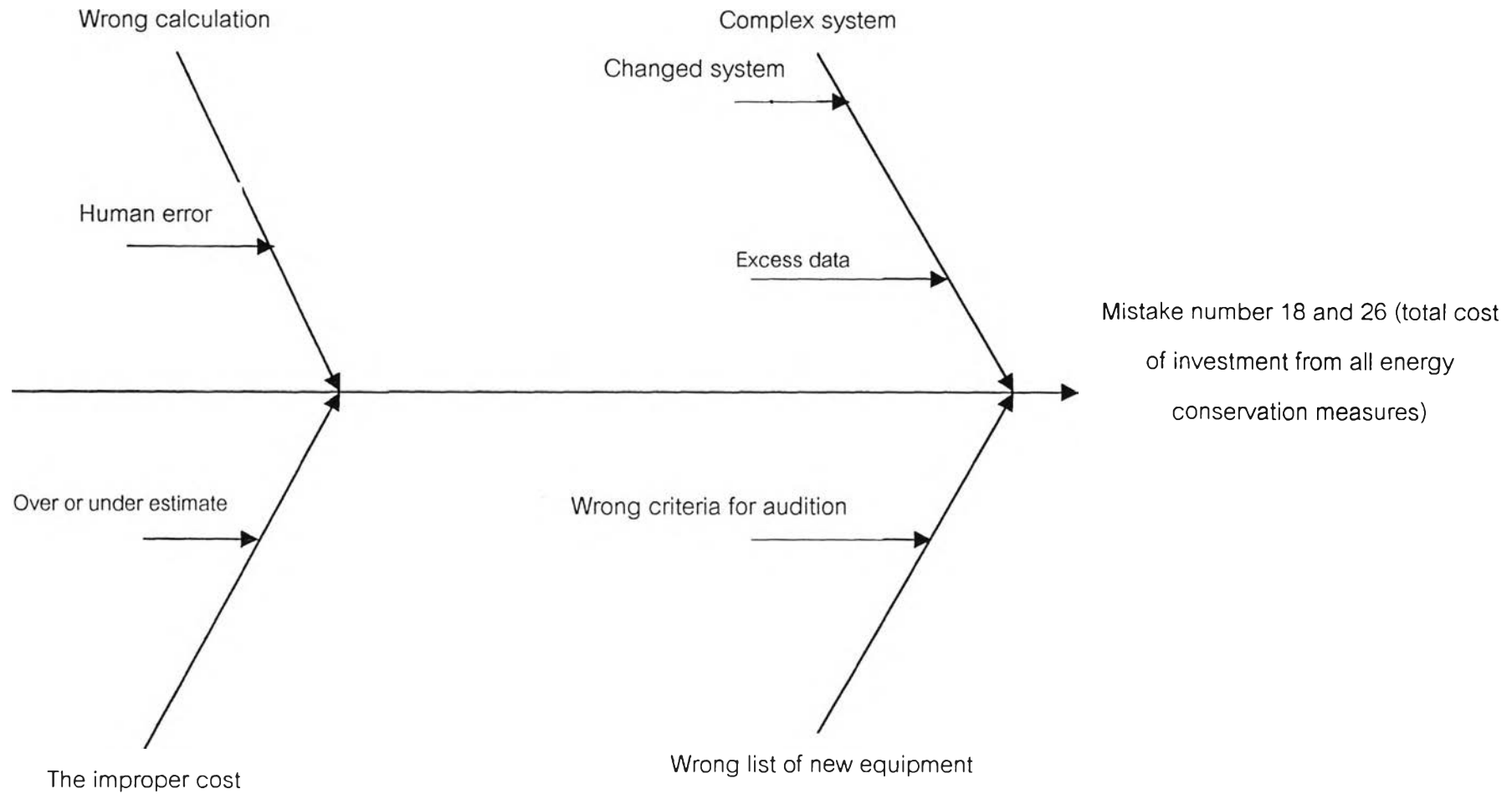


Figure 4-3 the fishbone diagram of mistake number 18 and 26

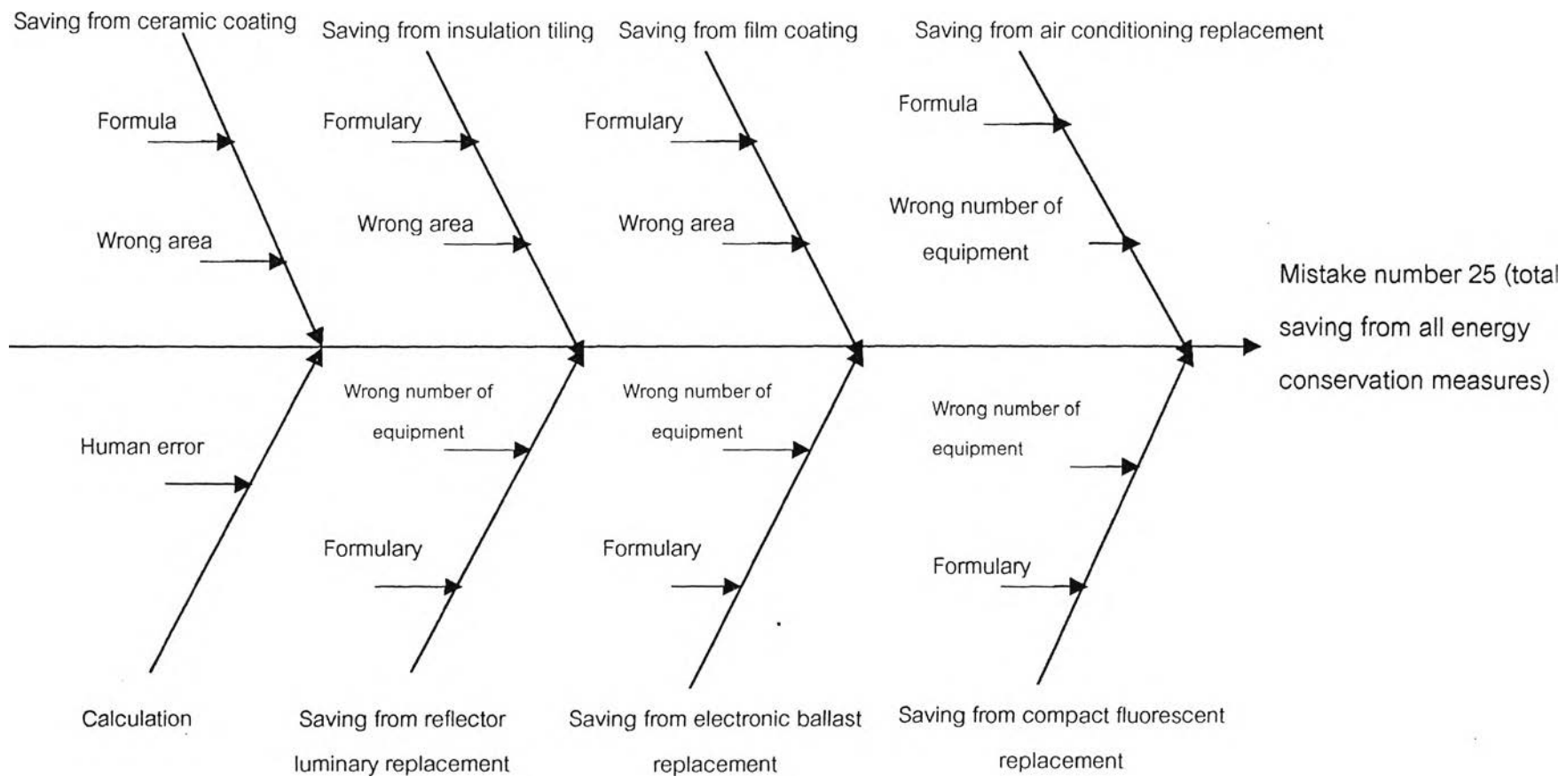


Figure 4-4 the fish bone diagram of mistake number 25

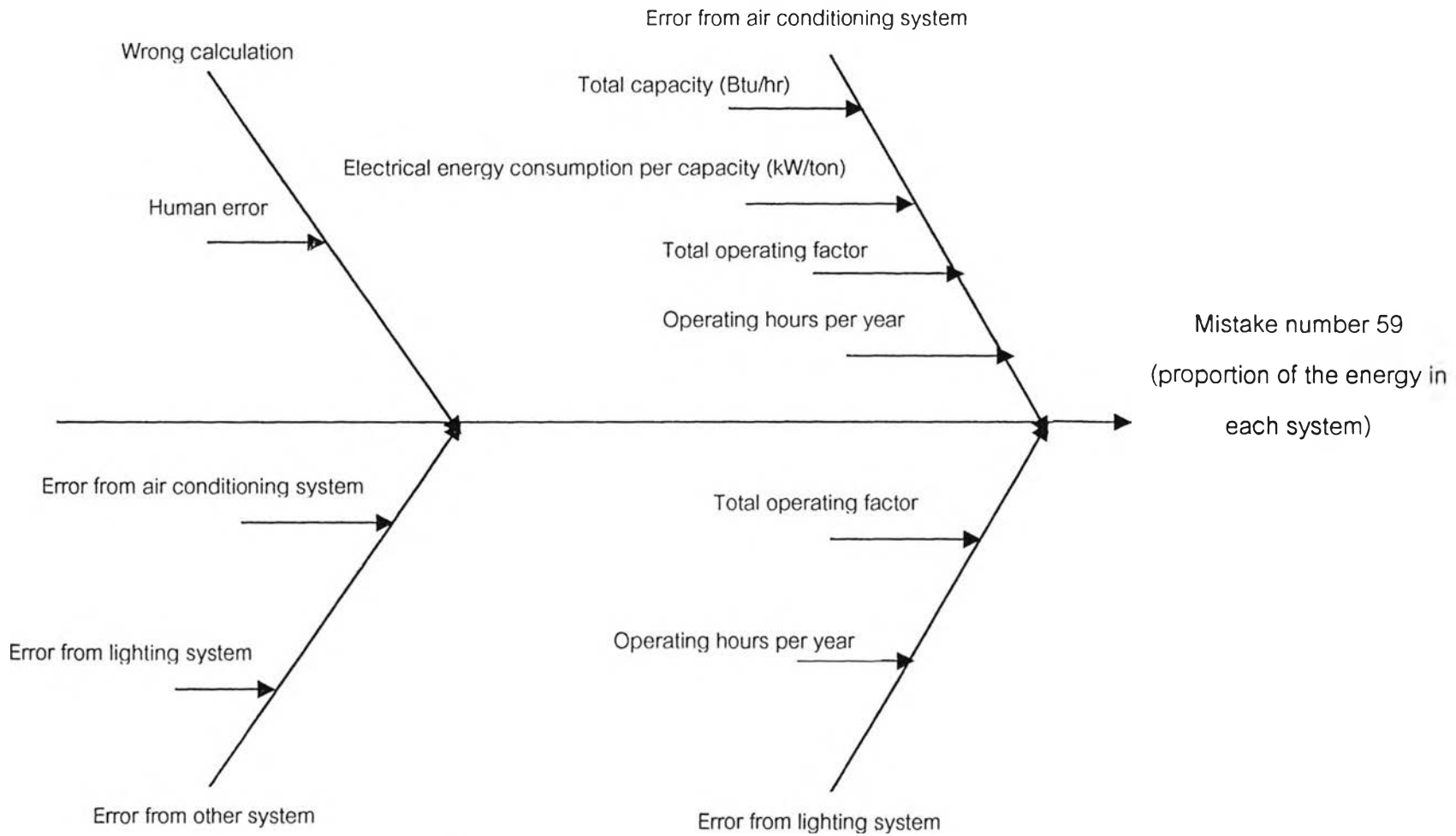


Figure 4-5 the fishbone diagram of mistake number 59

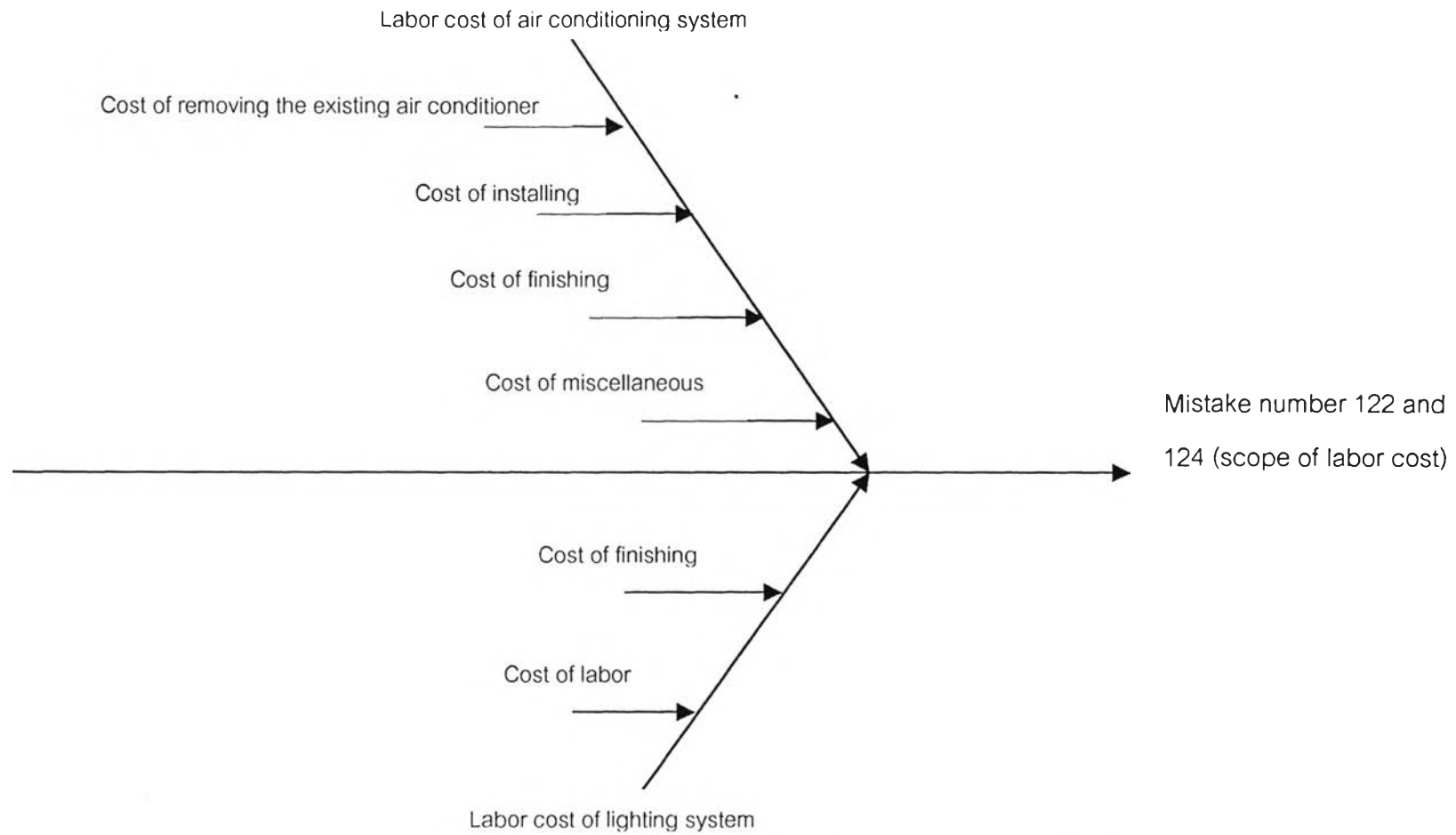


Figure 4-6 the fish bone diagram of mistake number 122 to 124

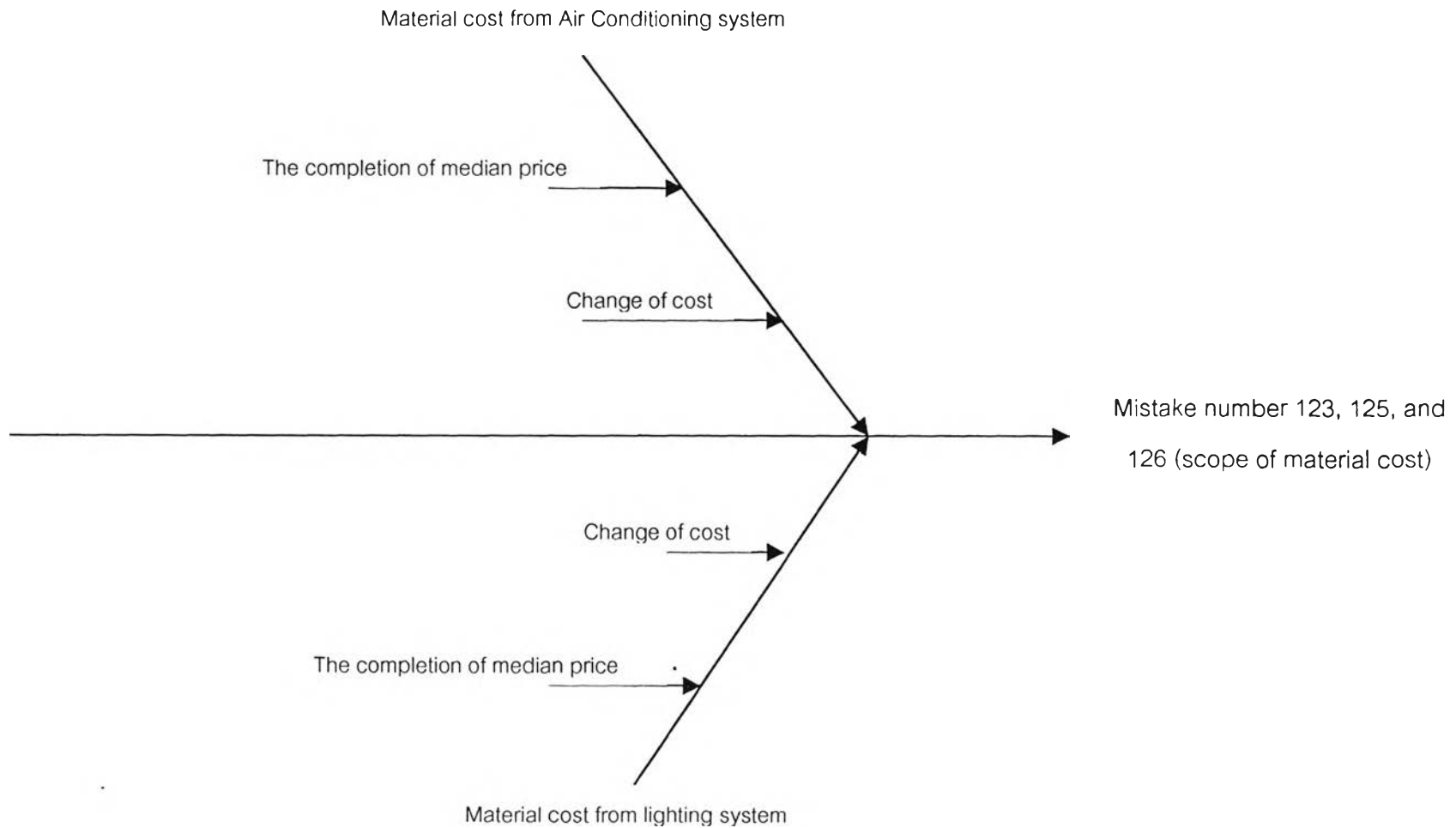


Figure 4-7 the fish bone diagram of mistakes number 123, 125, and 126