

CHAPTER 5

RESULTS ANALYSIS

5.1 Introduction

For a clear presentation of proposed procedure, all results, including the weight of disparity factors and the normalized numerical indices for the SAIDI performance evaluation of the transmission forced service interruption, the distribution forced and the distribution scheduled service interruptions are presented in this chapter. Table 5.1 summarized the contents of evaluation results to be presented in this chapter.

The relative SAIDI target of regional or district power systems can be derived from multiplying the three items in Eq. 2-20, i.e., by multiplying the average times of service interruption per year with the average duration per service interruption and with the average number of customers affected per service interruption. Each item, called the evaluation target in Chapter 2, is structured by an AHP sub-model (ref. Tables 3.1~3.3 and Tables 4.1~4.6). Following the AHP, two types of parameters, namely the evaluation indices and the relative weights, have to be derived for each disparity factor as shown in item 2 and 3 in Table 5.1. The evaluation targets are then derived from the sum of multiplying the disparity factor's evaluation index value (i.e., item 3 of Table 5.1) with the factor's weight (item 2 of Table 5.1) from the bottom to the top of AHP sub-model. Item 4 of Table 5.1 refers to the results of SAIDI target for each regional or district power system, which is derived through the proposed procedure.

5.2 Results of Weight of Disparity Factors

The relative weight of disparity factors for the SAIDI performance evaluation of

Table 5.1 Summary of Contents of Evaluation Results in Chapter 5

Item	Department	Contents	Figs. or Tables	Section
(1) To highlight the difference of views	Transmission forced	Comparison of weight surveying results among regional offices and between transmission line and substation engineers	Figs. 5.1~5.8	5.2.1
(2) To present weight acquisition results	Transmission forced	Relative weight of each disparity factor derived from questionnaire	Table 5.2~5.4	5.2.2
	Distribution forced & scheduled		Table 5.5~5.7 Table 5.8~5.10	5.2.3 5.2.4
(3) To present the collection results on evaluation indices and the regional operation status	Transmission forced	Comparison of evaluation index values among regional offices districts	Table 5.12~5.14	5.3.1
	Distribution forced & scheduled		Table 5.15~5.17 Table 5.18~5.23	5.3.2 5.3.3
(4) To evaluate how SAIDI targets derived differ among regions and from historical records	Transmission forced	Comparison of SAIDI targets among regional or district offices and with SAIDI records	Table 5.24	5.4.1
	Distribution forced & scheduled		Table 5.25 Table 5.26	5.4.2

transmission forced service interruption have been derived on basis of the questionnaires conducted on the 90 engineers of Taipower's 6 regional transmission offices. Regarding the SAIDI performance evaluation of distribution forced and distribution scheduled service interruptions, the weights of disparity factors have also been derived through surveys on 44 engineers of Taipower's 22 distribution district offices.

5.2.1 Comparison of Questionnaire Results of Transmission Forced Service Interruption among Regional Offices

The weights given by 6 regions for each disparity factor are shown in Figs. 5.1~5.7. Although the 6 regions are given equal proportions in the estimation of factors' weight, some weight results are similar among 6 regions (ref. Fig. 5.4); some are disparate (ref. Fig. 5.1). One special example is of the impact of feeder type (overhead/ underground) on the duration of service interruption as shown in Fig. 5.4, where the weights collected are almost unanimous among 6 regions. Referring to Fig. 5.1, for the 7 factors affecting the outage frequency, the weights are disparate among the 6 regions, which can be interpretable, e.g., because of Huadong's unique weather and loading conditions, which is located at the east coast of Taiwan and far away from the metropolitan area, the weight distribution among factors given by Huadong thus differs from the weight distribution given by other regions.

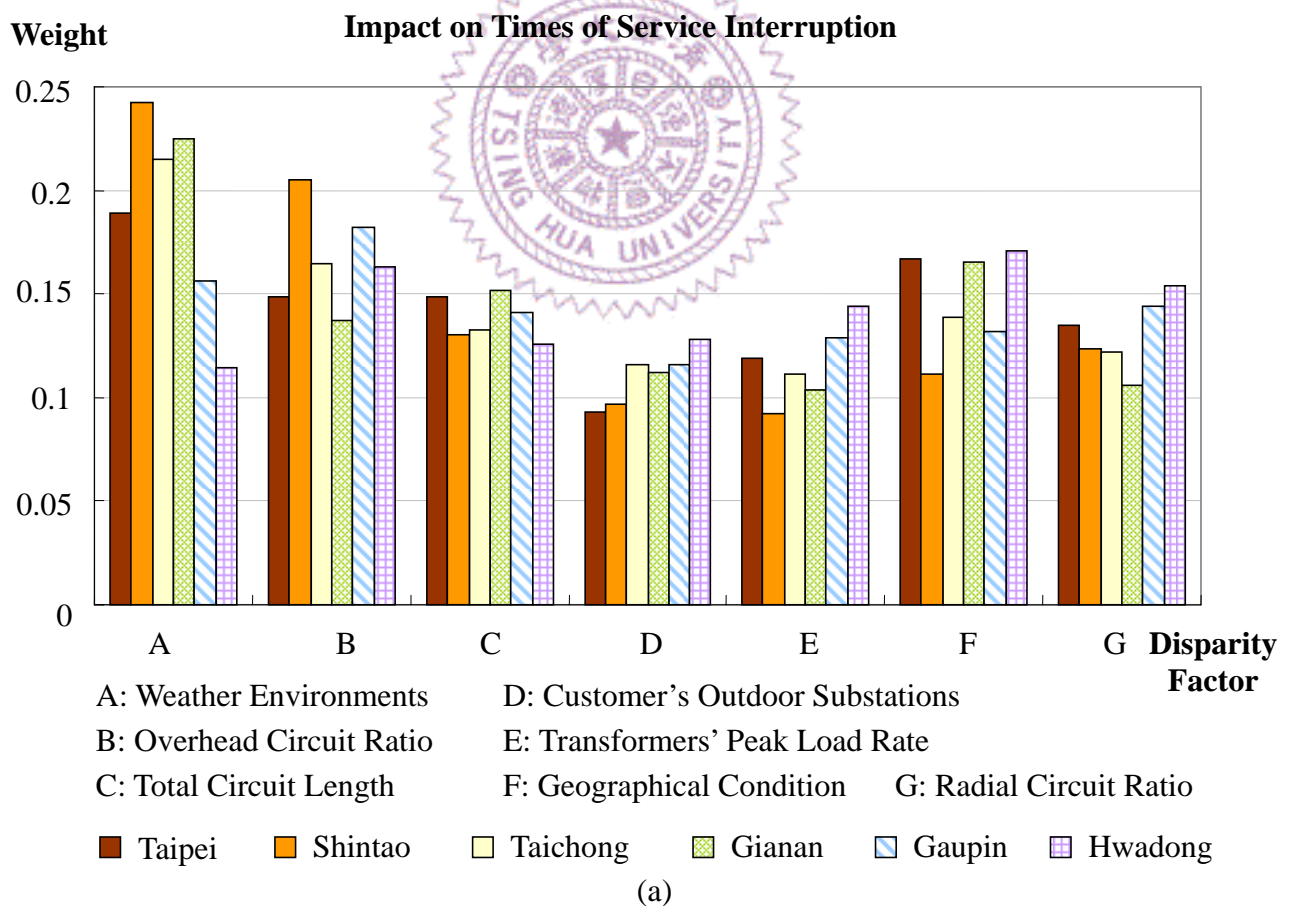


Fig. 5.1 Weights collected for the disparity factors to measure their impact on the times of forced transmission service interruptions*.

* Note: Weights collected by surveying engineers of 6 regional transmission offices.

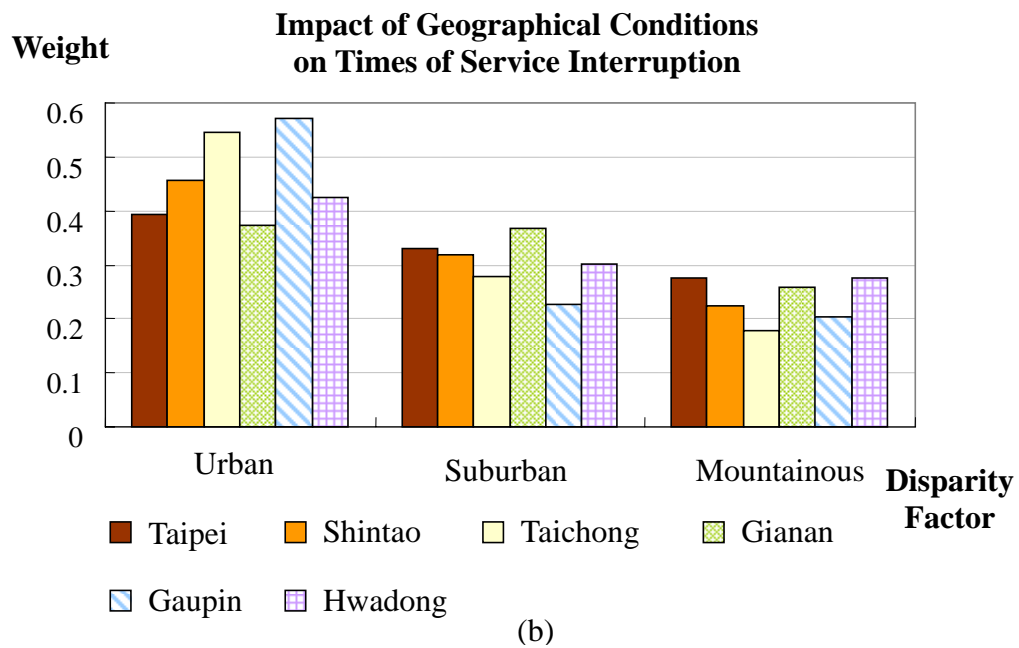


Fig. 5.2 Weights collected for the geographical conditions to measure their impact on the times of forced transmission service interruption*.

* Ref. the footnote of Fig. 5.1.

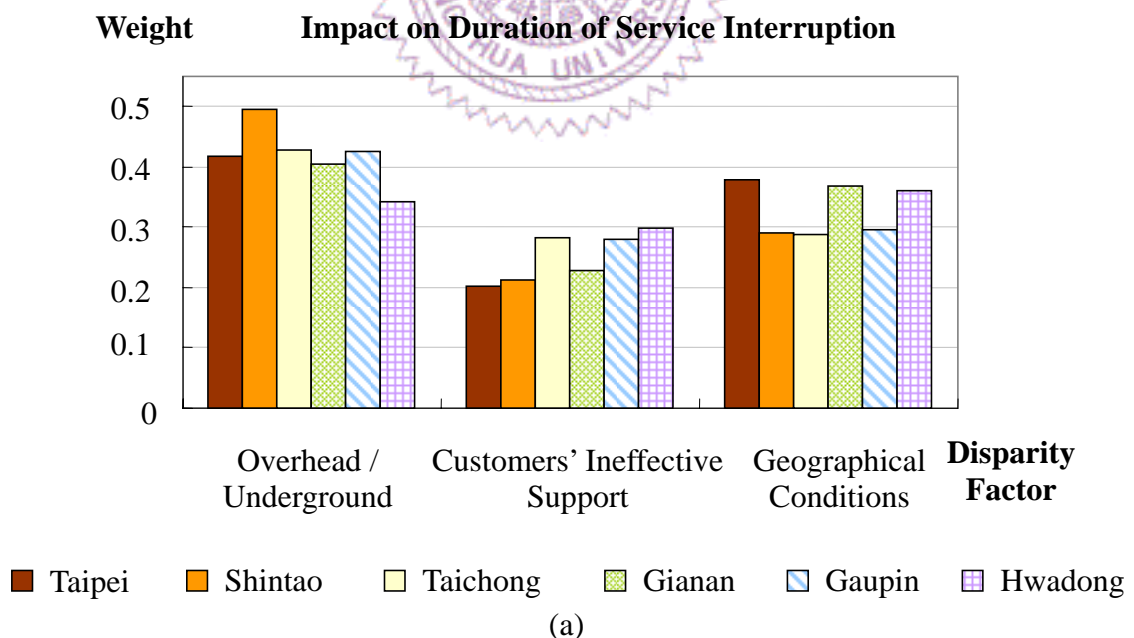


Fig. 5.3 Weights collected for the disparity factors to measure their impact on the duration of forced transmission service interruption*.

* Ref. the footnote of Fig. 5.1.

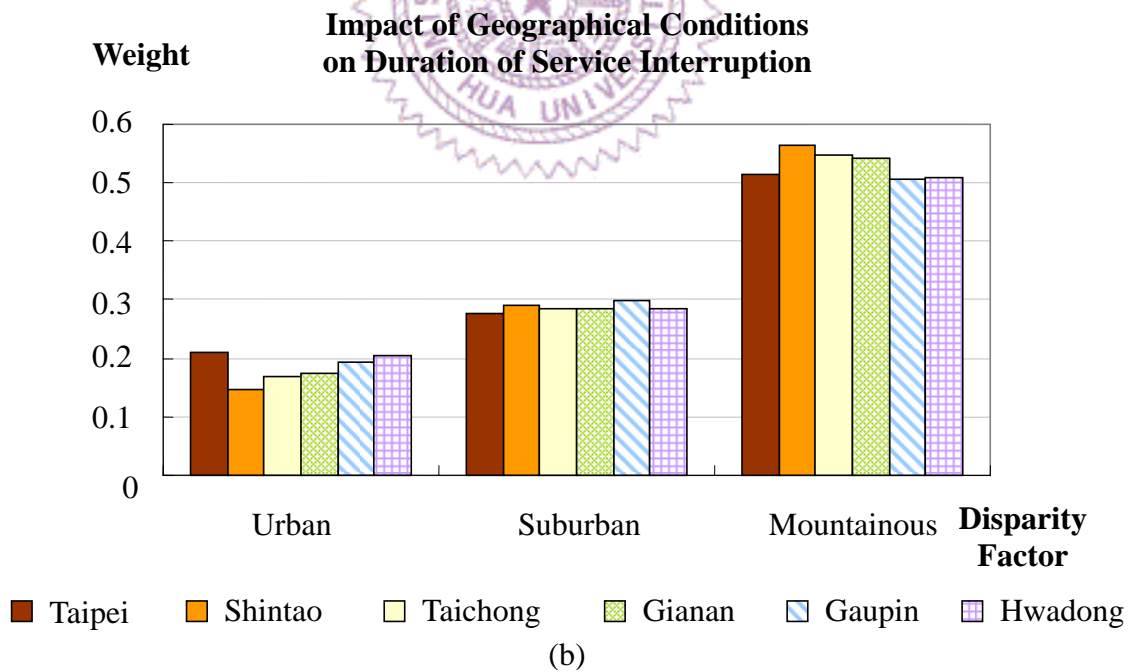
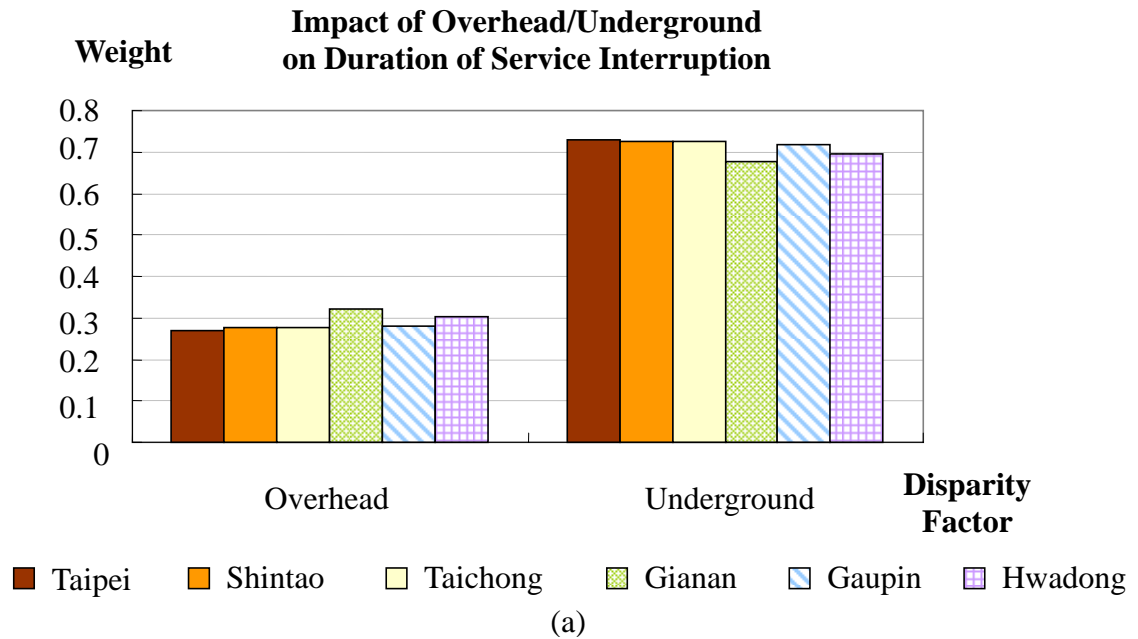


Fig. 5.4 Weights collected for: (a) overhead/underground, (b) geographical, both conditions to measure their impact on the duration of forced transmission service interruption*.

* Ref. the footnote of Fig. 5.1.

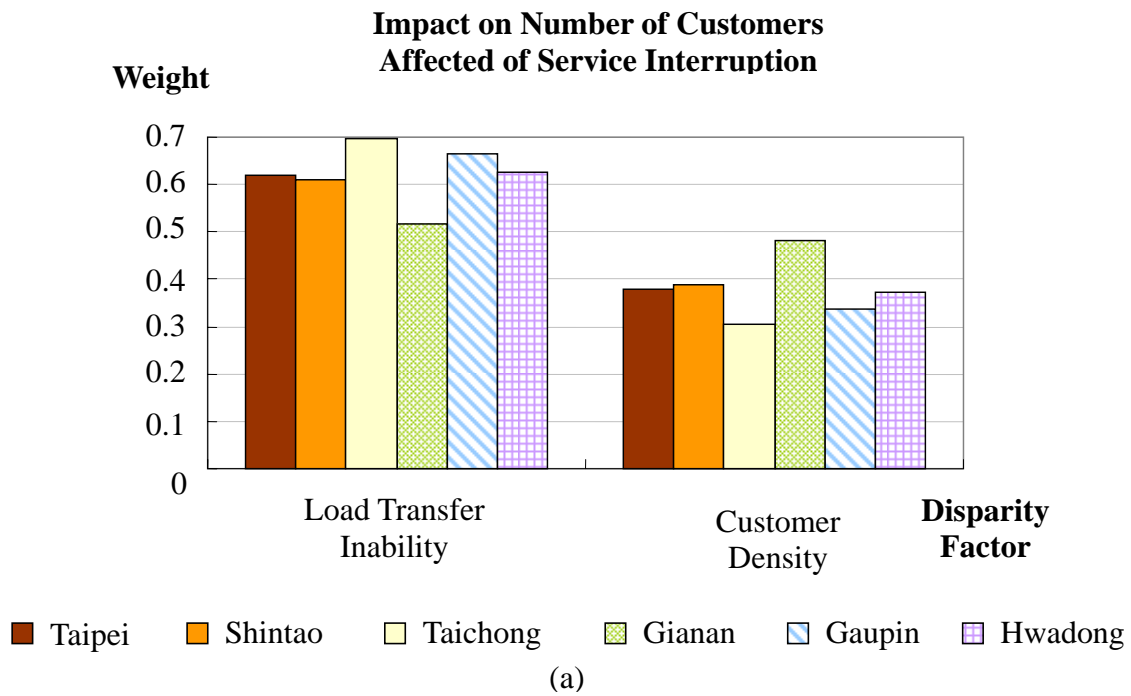


Fig. 5.5 Weights collected for the disparity factors to measure their impact on the number of customers affected of forced transmission service interruption*.

Ref. the footnote of Fig. 5.1.

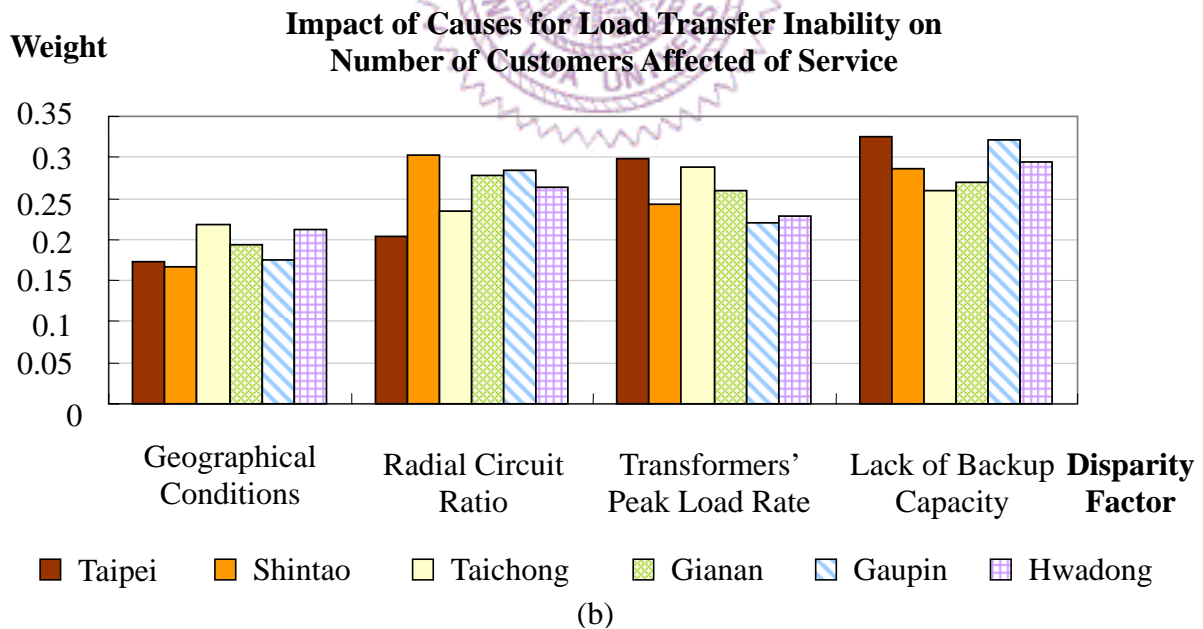


Fig. 5.6 Weights collected for the causes of load transfer inability to measure their impact on the number of customers affected of forced transmission service interruption*.

* Ref. the footnote of Fig. 5.1.

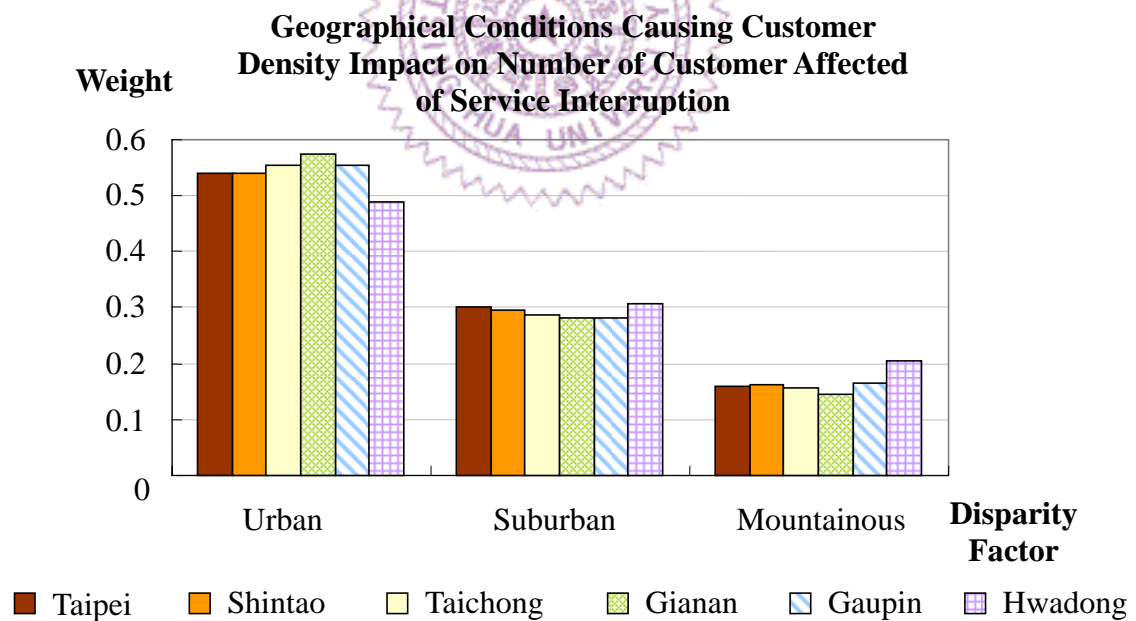
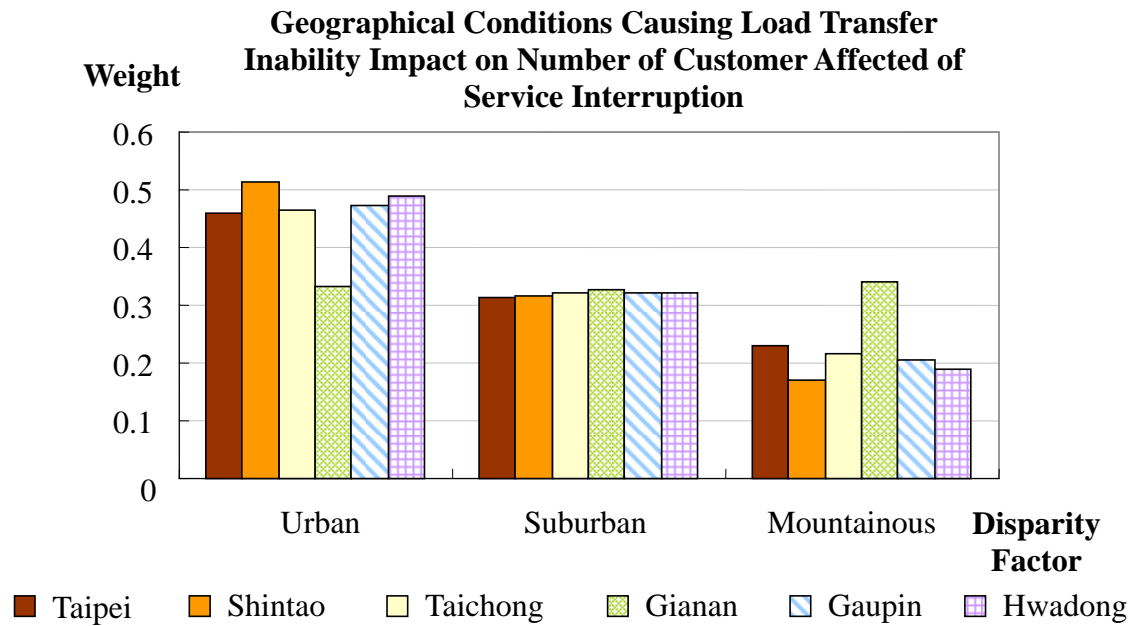


Fig. 5.7 Weights collected for the geographical conditions: (a) to measure load transfer inability impact, (b) to measure customer density impact, both on the number of customers affected of forced transmission service interruption*.

* Ref. the footnote of Fig. 5.1.

Engineers came from the transmission line department and the substation department, have the similar opinions on most of the questions except on the disparity factors of the average times of service interruption per year and of the load transfer inability. Referring to Fig. 5.8(a), comparing transformers' peak load rate with radial circuit ratio, engineers from substation department count radial circuit ratio as the more important factor. Adversely, engineers from the transmission line department count transformers' peak load ratio as more important. It implies that engineers from the substation department think that the factor having a higher impact on service interruption mainly belong to duty of the transmission line department and vice versa. Fig. 5.8(b) also implies this situation by comparing the weights between transformers' peak load rate and radial circuit ratio.

5.2.2 Geometric Mean of Weights Collected from 90 Transmission Engineers on Transmission Forced Service Interruption

The results of geometric mean weights of disparity factors surveyed on total 90 transmission engineers are shown in Tables 5.2~5.4 following the structure of 3 AHP sub-models described in Chapter 2. Referring to the second layer of the sub-model in Table 5.2, among the 7 factors under evaluation, weather environments is reckoned as the most important (0.187) in affecting the times of service interruptions per year, although the differences among the 7 factors are not significant. Because of the high circuit density, urban area is given the highest weight (0.461) among the three geographical areas.

As to the factors affecting service interruption duration (ref. the second layer in Table 5.3), the power restoration after underground cable fault usually takes longer time than overhead; thus the former is given a higher weight (0.71) than the later (0.29). Due to the same reason, mountain area is given a higher weight (0.53) than the remaining 2 geographical areas.

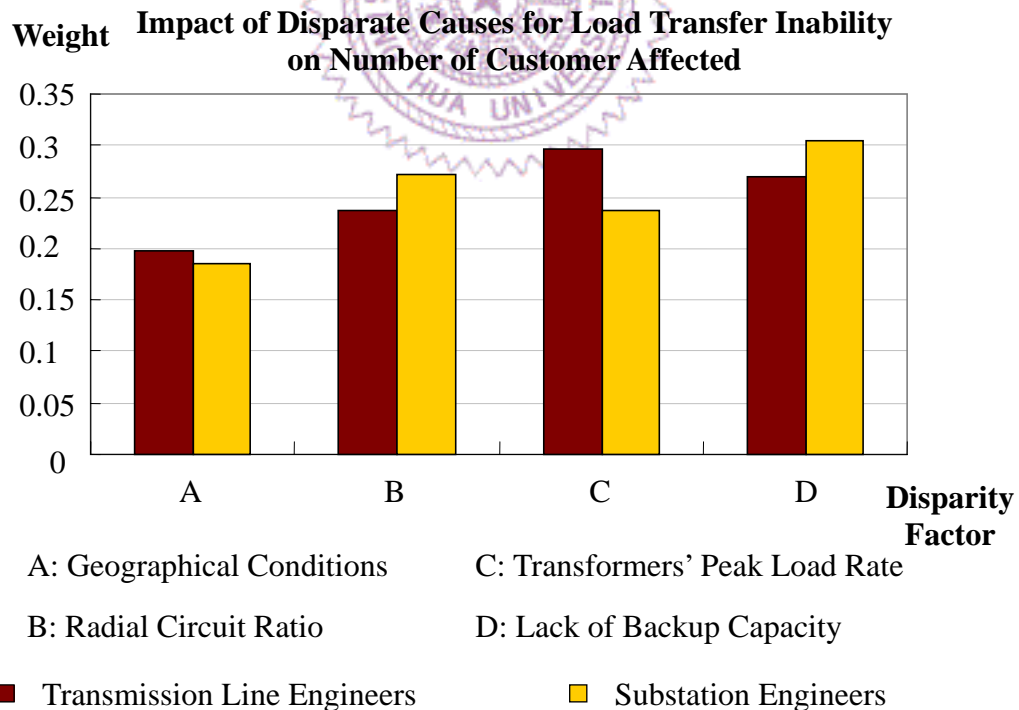
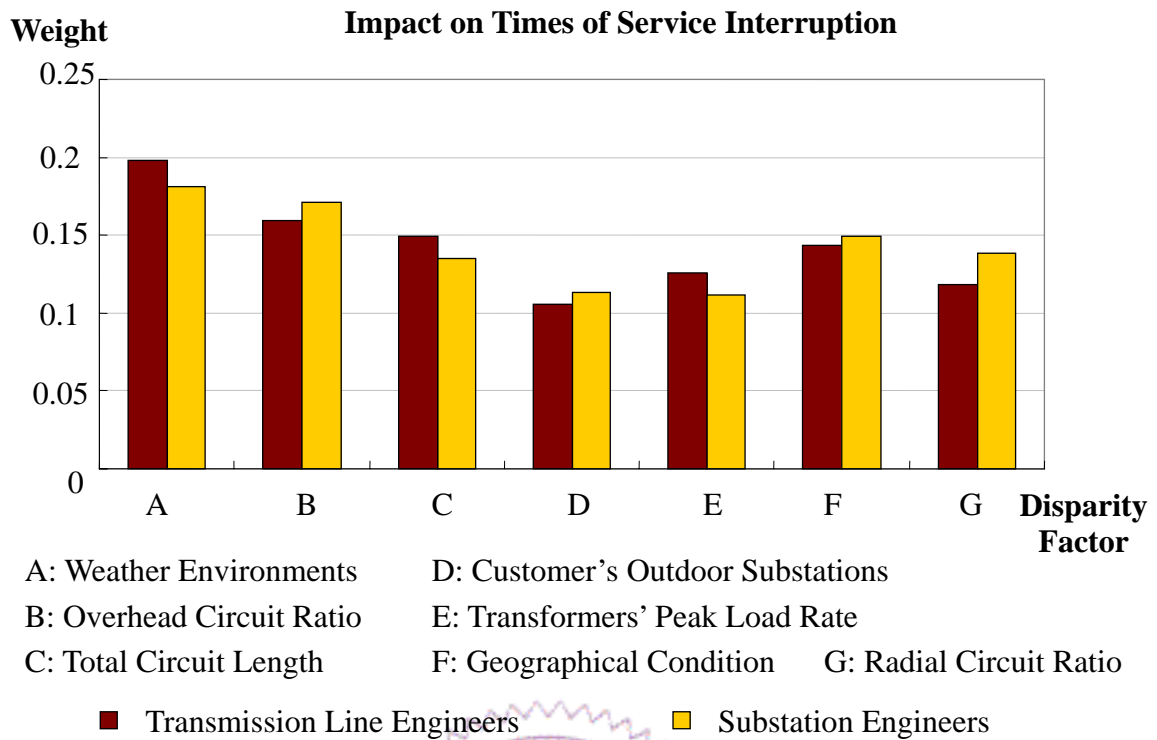


Fig. 5.8 Weights collected from transmission line engineers differ from those collected from substation engineers on : (a) the disparity factors times of service interruption, and (b) the disparate causes for load transfer inability on number of customers affected.

Table 5.2 The Relative Weight of Disparity Factors in 3-Layer Model for Evaluating $V_{j, \text{freq}}$ of Transmission Forced Service Interruption (ref. Fig. 3.1)

Average Times of Service Interruption per Year	Weather Environments (0.187)*	
	Overhead Circuit Ratio (0.167)	
	Total Circuit Length (0.140)	
	Customer's Outdoor Substations (0.111)	
	Transformers' Peak Load Rate (0.117)	
	Radial Circuit Ratio (0.131)	
	Geographical Conditions (0.148)	Urban (0.461)
		Suburb (0.304)
		Mountain (0.236)

*Note: The number in parentheses following each factor is its geometric mean of weights surveyed on 90 engineers of Taipower's 6 regional transmission offices.

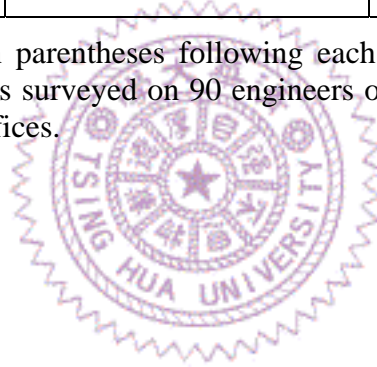


Table 5.3 The Relative Weight of Disparity Factors in 3-Layer Model for Evaluating $V_{j, \text{drt}}$ of Transmission Forced Service Interruption (ref. Fig. 3.2)

Average Duration per Service Interruption	Customers' Ineffective Support (0.250)*	
	Overhead / Underground (0.419)	Overhead (0.288)
		Underground (0.712)
	Geographical Conditions (0.330)	Urban (0.182)
		Suburb (0.287)
		Mountain (0.531)

*Ref. the footnote of Table 5.2.

Table 5.4 The Relative Weight of Disparity Factors in 4-Layer Model for Evaluating $V_{j, \text{ctm}}$ of Transmission Forced Service Interruption (ref. Fig. 3.3)

Average Number of Customer Affected per Service Interruption	Customer Density (0.376)	Urban (0.542)*	
		Suburb (0.239)	
		Mountain (0.165)	
	Load Transfer Inability (0.624)	Radial Circuit Ratio (0.261)	
		Transformers' Peak Load Rate (0.256)	
		Lack of Backup Capacity (0.294)	
		Geographical Conditions (0.190)	Urban (0.455)
			Suburb (0.323)
			Mountain (0.222)

*Ref. to the footnote of Table 5.2.

Table 5.4 gives the weight results for the factors affecting the number of customers per service interruption. As shown, load transfer inability is given a higher weight (0.62) than customer density (0.38), and the lack of circuit backup capacity is reckoned as the main cause for the large number of customers per service interruption. Due to the higher loading factor of circuit, urban area is given higher weight (0.46) than the other geographical areas in measuring the degree of load transfer inability.

5.2.3 Geometric Mean of Weights Collected from 44 Distribution Engineers on Distribution Forced Service Interruption

The results of geometric mean on the weights of disparity factors collected from 44 distribution engineers are shown in Tables 5.5~5.7. Referring to the second layer in Table 5.5, among the 5 factors under evaluation, total circuit-length is reckoned as the most important (0.2306) in affecting the times of service interruptions per year, although the differences among the 5 factors are not significant. Urban area is given the higher weight (0.3719) than the other 2 geographical areas.

As to the factors affecting service interruption duration (ref. the second layer in Table 5.6), automated feeder ratio is reckoned as the most important factor (0.5217). The power restoration after underground cable fault usually takes longer time than overhead; thus the former is given a higher weight (0.7602) than the later (0.2398). Due to the same reason, mountain area is given a higher weight (0.5391) than the remaining 2 geographical areas.

Table 5.7 gives the weight results for the factors affecting the number of customers per service interruption. As shown, load transfer inability is given a higher weight (0.6985) than customer density (0.3015), and the radial circuit ratio is reckoned as the main cause in measuring the degree of load transfer inability.

5.2.4 Geometric Mean of Weights Collected from 44 Distribution Engineers on Distribution Scheduled Service Interruption

The results of geometric mean on the weight of disparity factors collected from 44 distribution engineers are shown in Tables 5.8~5.10. Referring to the second layer in Table 5.8, among the 4 factors under evaluation, miscellany work is reckoned as the most important (0.3932) in affecting the times of service interruptions per year, although both the influence of two factors, work of major category and miscellany, are significant.

As to the factors affecting service interruption duration (ref. the second layer in Table 5.9), major category work is reckoned as the most important (0.4633) factor. The power restoration after underground cable work usually takes longer time than overhead; thus the former is given a higher weight (0.7173) than the later (0.2968).

Table 5.10 gives the weight results for the factors affecting the number of customers per service interruption. As shown, load transfer inability is given a higher weight (0.6724) than average customers per feeder (0.3276) and radial circuit ratio (0.6508) is the main cause in measuring the degree of load transfer inability.

Table 5.5 The Relative Weight of Disparity Factors in 3-layer Model for Evaluating $V_{j, \text{freq}}$ of distribution Forced Service Interruption (ref. Fig. 4.1)

Average Times of Service Interruption per Year	Total Circuit Length (0.2306)*	
	Feeders' Peak Load Rate (0.1634)	
	Overhead Circuit Ratio (0.1993)	
	Weather Environments (0.1979)	
	Geographical Conditions (0.2087)	Urban (0.3719)
		Suburb (0.3376)
		Mountain (0.2906)

*Note: The number in parentheses following each factor is its relative weight surveyed on 44 engineers of Taipower's 22 distribution districts offices.

Table 5.6 The Relative Weight of Disparity Factors in 3-Layer Model for Evaluating $V_{j, \text{drt}}$ of Distribution Forced Service Interruption (ref. Fig. 4.2)

Average Duration per Service Interruption	Automated Feeder Ratio (0.5217)*	
	Overhead / Underground (0.2749)	Overhead (0.2398)
		Underground (0.7602)
	Geographical Conditions (0.2034)	Urban (0.1625)
		Suburb (0.2984)
		Mountain (0.5391)

*Ref. the footnote of Table 5.5.

Table 5.7 The Relative Weight of Disparity Factors in 3-Layer Model for Evaluating $V_{j, \text{ctm}}$ of Distribution Forced Service Interruption (ref. Fig. 4.3)

Average Number of Customer Affected per Service Interruption	Customer Density (0.3015)*	
	Load Transfer Inability (0.6985)	Feeders' Peak Load Rate (0.2739)
		Radial Circuit Ratio (0.7261)

*Ref. the footnote of Table 5.5.

Table 5.8 The Relative Weight of Disparity Factors in 3-Layer Model for Evaluating $V_{j, \text{freq}}$ of Distribution Scheduled Service Interruption (ref. Fig. 4.4)

Average Times of Service Interruption per Year	Feeders' Peak Load Rate (0.1533)*		
	Total Circuit Length (0.1375)		
	Major Category Work (0.316)	Customers Power Hookup Request Construction (0.1542)	
		Expansion Work (0.2546)	
		Maintenance Work (0.1555)	
		Multi-Year Distribution System Expansion Projects (0.2720)	Installation / Expansion of Distribution Feeders (0.0906)
			Changing Overhead Feeder into Underground Cable (0.1820)
			Voltage Drop Improvement and Feeder Loss Reduction (0.0928)
			Distribution System Voltage Upgrade (0.1512)
			Covering Bare Conductor with PE (0.2309)
			Feeder Reliability Improvement through Expansion or Upgrade (0.1168)
			Distribution Automation (0.0779)
			Substation Equipment Replacement and Upgrade (0.0578)
	Miscellany Work (0.3932)	Small-Scale Construction Work (0.2881)	
		Miscellaneous Work (0.4873)	
		Maintenance Work (0.2246)	

*Ref. the footnote of Table 5.5.

Table 5.9 The Relative Weight of Disparity Factors in 4-Layer Model for Evaluating $V_{j, \text{drt}}$ of Distribution Scheduled Service Interruption (ref. Fig. 4.5)

Average Duration per Service Interruption	Major Category Work (0.4633)	Multi-Year Distribution System Expansion Projects (0.3855)	Installation / Expansion of Distribution Feeders (0.0951)*
			Changing Overhead Feeder into Underground Cable (0.1689)
			Voltage Drop Improvement and Feeder Loss Reduction (0.0929)
			Distribution System Voltage Upgrade (0.1495)
			Covering Bare Conductor with PE (0.2186)
			Feeder Reliability Improvement through Expansion or Upgrade (0.1234)
			Distribution Automation (0.0862)
			Substation Equipment Replacement and Upgrade (0.0653)
			Customers Power Hookup Request Construction (0.1405)
			Expansion Work (0.2968)
			Maintenance Work (0.1773)
	Overhead / Underground (0.2903)	Overhead (0.2831)	
		Underground (0.7173)	
	Miscellany Work (0.2464)		Small-Scale Construction Work (0.2435)
			Miscellaneous Work (0.5128)
			Maintenance Work (0.2437)

*Ref. the footnote of Table 5.5.

Table 5.10 The Relative Weight of Disparity Factors in 3-Layer Model for Evaluating $V_{j, \text{ctm}}$ of Distribution Scheduled Service Interruption (ref. Fig. 4.6)

Average Number of Customer Affected per Service Interruption	Average Customers per Feeder (0.3276)	
	Load Transfer Inability (0.6724)	Feeders' Peak Load Rate (0.3492)
		Radial Circuit Ratio (0.6508)*

*Ref. the footnote of Table 5.5.

5.3 Results of Data Collection on Evaluation Indices

Metric value of evaluation indices are collected from 6 regional transmission offices and 22 distribution districts. These values are normalized before multiplied with the weight of disparity factors. The following paragraph presents how the collected data are normalized. The these index values after normalized for the transmission forced service interruption, distribution forced and scheduled service interruptions shall be presented in Sub-sections 5.3.1~5.3.3 respectively. The presentation shall be focused on the comparison of regional or district power system characteristics which shall serve to capture the difference of reliability targets set for the regional or district power systems of Taiwan.

Referring to Table 5.2, the average times of transmission service interruption can be affected by a variety of reasons. Among them, weather environments could be one of the most important, due to its highest weight (0.187) acquired among the 7 disparity factors of second layer of Table 5.2. Because the factor, referred to as weather environments in Table 5.2, is of the lowest layer, a numerical index value has been collected from each of 6 transmission regional offices. Referring to Table 3.1, the collected are the number of power service interruption times caused by thunderbolt, salt or fog with occurrence at each of Taipower's 6 regional transmission systems. Referring to Table 5.11, the collected are: 36, 52, 13, 25, 54 and 0, for the Taipei, Shintao, Taichong, Gianan, Gaupin and Hwadong transmission systems respectively. The normalized value for Taipei regional system is thus: $36 / (36 + 52 + 13 + 25 + 54 + 0) = 0.2$. Similarly, referring to Table 5.2, 3.1 and 5.11, the percentage of overhead feeders in circuit length out of the total circuit length for each regional transmission system are: 87.18%, 86.37%, 90.70%, 89.89%, 84.20%, 94.09% for Taipei, Shintao, Taichong, Gianan, Gaupin and Hwadong transmission systems

respectively. The normalized value for Taipei is thus: $87.18 / (87.18 + 86.37 + 90.70 + 89.89 + 84.20 + 94.09) = 0.1637$.

Table 5.11 Normalization of Power Service Interruption Times Caused by Thunderbolt, Salt or Fog of Transmission System and Overhead Circuit Ratio in Base Year of the Field Test

Transmission regional offices	Weather Environments		Overhead Circuit Ratio	
	Interruption times	Interruption times after normalization	Proportion in %	Proportion after normalization
Taipei	36	0.2000	87.18	0.1637
Shintao	52	0.2889	86.37	0.1622
Taichong	13	0.0722	90.70	0.1704
Gianan	25	0.1389	89.89	0.1688
Gaupin	54	0.3000	84.20	0.1581
Hwadong	0	0.0000	94.09	0.1767

5.3.1 Comparison of Selected Evaluation Index Values among Transmission Regional Offices

Tables 5.12~5.14 depict the data collection results for the evaluation index designed to specify the status of each regional transmission system on the disparity factors enlisted in Table 3.1. For easier presentation, the results have been normalized versus the sum of data collected from 6 regional transmission offices. Referring to Table 5.12, among the 6 regions, Shintao and Gaupin regions have more times of power service interruption caused by weather, than the remaining 4 regions (ref. Table 3.1). Also the geographical data in Table 5.12 and 5.13 indicate that Taichong has the largest mountainous area than the remaining 5 regions, i.e., Taichong could have a relatively higher probability to be hit by lightning and, after each line tripping in mountainous area, could need a longer time to repair. As for Table 5.14, which refers to the number of customers of each service interruption, the factors accounted are

irrelevant to region's kilometer squared (km^2) but to Taipower's design criteria towards urban, suburban and mountain (or rural in Taiwan) areas as well as to customers' density of the region. In the latter two aspects, the accounted are the relative proportion of urban, suburban and mountain areas out of the km^2 for the same region. Also, taking Taichong as an example, because Taichong has the largest km^2 for its mountainous area, the relative proportions respective for Taichong's urban and suburban areas are thus small, resulting in the least urban proportion and the second least suburban proportion out of the 6 regions (ref. Table 5.14). These two factors could lead to a postulation by the model that Taichong has less number of customers interrupted out of Taiwan's 6 regions for service interruption.

Also due to the largest km^2 for the mountain area of Taichong, Taichong has the highest radial circuit proportion out of Taiwan's 6 regions (Table 5.12). Taipei has the second highest radial circuit proportion, because Taipei has the second largest km^2 for its suburban out of Taiwan's 6 regions (Table 5.12). As to transformers' peak load rate, among Taiwan's 6 regions, Shintao has the highest and Taichong has the second highest (Table 5.12), both of which will result in a high power service interruption times per year postulated for Shintao and Taichong. Because Shintao and Gaupin possess the highest and second highest number of industrial customers among Taipower's 6 transmission service regions (referring to the column under customers' outdoor substations in Table 5.12), their underground circuit proportion out of the total circuit-length are thus the highest (Table 5.13).

Because Huadong is sited at the east coast of Taiwan and the northwest wind is retarded by Taiwan's central mountain, and also because Huadong has the least population among Taiwan's 6 regions, Huadong has zero time of service interruption caused by weather, the least circuit length, the least customers' outdoor substations, the least transformers' peak load rate (all in Table 5.12) and the least underground circuit proportion (Table 5.13).

Table 5.12 Collected evaluation index values for disparity factors affecting average times of transmission forced service interruption per year

First layer	Average times of service interruption per year								
Second layer	Weather environments	Overhead circuit ratio	Total circuit length	Customer's outdoor substation	Transformers' peak load Rate	Geographical conditions			Radial circuit ratio
Third layer	—					Urban	Suburb	Mountain	—
Taipei*	0.200	0.164	0.164	0.139	0.126	0.093	0.213	0.071	0.358
Shintao	0.289	0.162	0.200	0.255	0.259	0.097	0.095	0.182	0.096
Taichong	0.072	0.17	0.207	0.106	0.256	0.150	0.143	0.312	0.395
Gianan	0.139	0.169	0.204	0.203	0.115	0.235	0.095	0.145	0.051
Gaupin	0.300	0.158	0.158	0.282	0.133	0.237	0.118	0.142	0.058
Hwadong	0.000	0.177	0.068	0.015	0.111	0.188	0.335	0.149	0.042

*Note: One of the 6 transmission regions of Taipower.

Table 5.13 Collected evaluation index values for disparity factors affecting average duration per transmission forced service interruption

First layer	Average duration per service interruption					
Second layer	Overhead /underground		Customer's ineffective support	Geographical conditions		
Third layer	Overhead	Underground	—	Urban	Suburb	Mountain
Taipei*	0.164	0.19	0.217	0.093	0.213	0.071
Shintao	0.162	0.202	0.155	0.097	0.095	0.182
Taichong	0.17	0.138	0.292	0.15	0.143	0.312
Gianan	0.169	0.150	0.000	0.235	0.095	0.145
Gaupin	0.158	0.234	0.304	0.237	0.118	0.142
Hwadong	0.177	0.088	0.031	0.188	0.335	0.149

*Ref. the footnote of Table 5.12.

Table 5.14 Collected evaluation index values for disparity factors affecting average number of customers affected per transmission forced service interruption

First layer	Average number of customers affected per service interruption								
Second layer	Load transfer inability						Customer density		
Third layer	Geographical conditions			Radial circuit ratio	Transformers' peak load rate	Lack of backup capacity	Urban	Suburb	Mountain
Fourth layer	Urban	Suburb	Mountain	—					
Taipei*	0.119	0.28	0.092	0.358	0.126	0.084	0.119	0.280	0.092
Shintao	0.125	0.126	0.239	0.096	0.259	0.633	0.125	0.126	0.239
Taichong	0.119	0.117	0.252	0.395	0.256	0.162	0.119	0.117	0.252
Gianan	0.255	0.105	0.159	0.051	0.115	0.074	0.255	0.105	0.159
Gaupin	0.245	0.124	0.148	0.058	0.133	0.036	0.245	0.124	0.148
Hwadong	0.136	0.248	0.110	0.042	0.111	0.012	0.136	0.248	0.110

*Ref. the footnote of Table 5.12.

5.3.2 Comparison of Selected Evaluation Index Values among Distribution District Offices for Forced Service Interruption

Tables 5.15~5.23 depict the data collection results for the evaluation index designed to specify the status of each regional distribution system on the disparity factors enlisted in Table 4.1. Referring to Table 5.15, among the 22 districts, Taichung and Kaohsiung have the longest and the second longest total circuit length and Pingtung, Taoyuan and Taichung have more times of power service interruption caused by weather, than the remaining 19 districts, i.e. Taichung could have higher probability on occurrence of forced outage. Taipei West, Taoyuan and Tainan have the higher feeders' peak load rate than the remaining 19 districts, although the differences among 22 districts are not significant. Taipei City and Ponhu have the lowest and the second lowest ratio of overhead circuit, and the geographical data in Table 5.15 indicate that Taipei City and Ponhu also have the smaller km² of areas than the remaining 20 districts.

As for Table 5.16, which refers to the average duration of each service interruption, Kaohsiung, Taichung, Taipei South and Taipei City are the only 4 districts which have been implemented automated feeders. Taipei City and Ponhu have higher underground feeder proportion than the remaining 20 districts. Also in geographical conditions, Taipei City and Taipei West have higher relative proportion of urban area than the remaining 20 districts and Fongshan, Taitung and Taipei South have higher relative proportion of mountainous area than the remaining 20 districts.

As for Table 5.17, which refers to the number of customers affected of each service interruption, Taipei City and Kaohsiung have the highest and the second highest customer density, both of which will result in a high number of customers affected per service interruption postulated for Taipei City and Kaohsiung. Also, Taitung, Miaoli and Hualien have the higher radial circuit ratio than the remaining 19 districts.

Table 5.15 Collected Evaluation Index Values for Disparity Factors Affecting Average Times of Distribution Forced Service Interruption per Year

Unit: %

First Layer	Average Times of Service Interruption per Year						
Second Layer	Total Circuit Length	Feeders' Peak Load Rate	Overhead Circuit Ratio	Weather Environments	Geographical Conditions		
Third Layer	—				Urban	Suburb	Mountain
Keelung*	1.9583	4.2661	4.8127	1.5599	0.6412	2.3907	2.1273
Taipei-C	3.1622	4.9902	0.4033	0.9275	1.9235	0	0.0111
Taipei-W	3.8733	5.8997	2.4776	3.3305	8.6879	1.0366	0.7191
Taipei-S	3.3984	4.9397	2.2887	1.8550	2.5615	0.5094	3.3375
Taipei-N	2.4974	4.3880	3.5376	1.0540	1.0951	1.3067	1.1331
Taoyuan	5.7039	5.7174	4.8967	14.2917	6.2989	6.5763	1.5207
Hsinchu	1.4519	4.6167	4.7623	1.0961	2.4551	2.9295	5.0807
Miaoli	4.0915	4.0900	5.6596	1.5599	5.9212	2.6494	6.1265
Taichung	9.3451	4.7510	4.4773	11.5514	5.0012	7.7365	5.6832
Changhua	7.1780	5.1013	5.9554	0.7167	1.5741	9.8374	0
Nantou	5.1986	5.1018	5.7443	5.6071	18.562	10.5633	13.8891
Yunlin	6.7989	1.6301	6.3970	5.0590	6.2034	8.6354	0.8558
Chia-I	6.9141	5.0303	6.0703	2.1079	3.8470	7.5739	4.6438
Sinying	3.3182	4.2581	5.7773	6.6610	2.7731	6.2040	0.5738
Tainan	7.0036	5.7840	4.3529	6.0708	5.6276	4.7452	2.8750
Kaohsiung	8.5569	4.9685	2.8809	7.2513	3.2379	3.9782	0.4909
Fongshan	4.4142	4.3956	4.6279	8.1366	2.4557	2.2263	9.3345
Pingtung	7.0407	4.9706	6.1718	16.1889	8.7754	0.7691	7.4852
Ponhu	0.8446	2.0618	1.8027	0.4216	1.0900	0.7173	0
Ilan	2.4701	5.0610	5.0412	0.5481	4.4898	3.4439	6.6364
Hualien	2.5787	3.6528	6.0428	0.6745	5.8988	11.4373	14.2411
Taitung	2.2014	4.3253	5.8196	3.3305	0.8797	4.7337	13.2352

*Note: One of the 22 distribution districts of Taipower.

Table 5.16 Collected Evaluation Index Values for Disparity Factors Affecting
Average Duration per Distribution Forced Service Interruption

Unit: %

First Layer	Average Duration per Service Interruption					
Second Layer	Un-automated Feeder Ratio	Overhead / Underground		Geographical Conditions		
Third Layer	—	Overhead	Underground	Urban	Suburb	Mountain
Keelung*	4.6731	4.8127	3.9650	0.7938	4.1332	5.9497
Taipei-C	4.6030	0.4033	13.1235	28.2253	0	0.3719
Taipei-W	4.6731	2.4776	8.8151	14.7007	2.4824	2.7889
Taipei-S	4.2572	2.2887	9.7659	2.6461	0.7447	7.9020
Taipei-N	4.6731	3.5376	6.6134	2.3521	3.9718	5.5779
Taoyuan	4.6731	4.8967	3.7905	4.7042	6.9507	2.6030
Hsinchu	4.6731	4.7623	4.0697	1.4701	2.4824	6.9723
Miaoli	4.6731	5.6596	2.2059	2.9401	1.8618	6.9723
Taichung	3.7431	4.4773	4.6616	2.0287	4.4683	5.3083
Changhua	4.6731	5.9554	1.5916	1.3525	11.8411	0
Nantou	4.6731	5.7443	2.0300	3.5282	2.8424	6.0520
Yunlin	4.6731	6.3970	0.6743	4.4102	8.6884	1.3945
Chia-I	4.6731	6.0703	1.3528	1.7935	5.0145	4.9736
Sinying	4.6731	5.7773	1.9616	2.9401	9.3090	1.3945
Tainan	4.6731	4.3529	4.9199	3.9045	4.6595	4.5720
Kaohsiung	3.2810	2.8809	7.9774	5.7450	9.9867	1.9959
Fongshan	4.6731	4.6279	4.3489	0.9320	1.1940	8.1074
Pingtung	4.6731	6.1718	1.1420	2.8990	3.6193	5.6690
Ponhu	4.6731	1.8027	10.2168	9.1703	8.5407	0
Ilan	4.6731	5.0412	3.4903	2.0581	2.2342	6.9723
Hualien	4.6731	6.0428	1.4101	1.1761	3.2271	6.5075
Taitung	4.6731	5.8196	1.8736	0.2293	1.7476	7.9150

*Ref. the footnote of Table 5.15.

Table 5.17 Collected Evaluation Index Values for Disparity Factors Affecting
Average Number of Customer Affected per Distribution
Forced Service Interruption

Unit: %

First Layer	Average Number of Customer Affected per Service Interruption		
Second Layer	Customer Density	Load Transfer Inability	
Third Layer	—	Feeders' Peak Load Rate	Radial Circuit Ratio
Keelung*	2.2994	4.2661	5.5786
Taipei-C	49.2722	4.9902	1.7433
Taipei-W	6.5217	5.8997	7.6473
Taipei-S	4.7296	4.9397	2.3244
Taipei-N	5.2571	4.3880	1.7573
Taoyuan	3.4160	5.7174	1.7433
Hsinchu	1.2665	4.6167	3.4866
Miaoli	0.0760	4.0900	9.0652
Taichung	2.7734	4.7510	5.8227
Changhua	3.4604	5.1013	0
Nantou	0.3498	5.1018	6.5665
Yunlin	1.8707	1.6301	3.4866
Chia-I	1.1979	5.0303	7.7868
Sinying	1.2886	4.2581	8.1355
Tainan	3.0951	5.7840	0.5811
Kaohsiung	8.1574	4.9685	4.2142
Fongshan	1.2350	4.3956	1.1622
Pingtung	0.9295	4.9706	1.7026
Ponhu	1.8972	2.0618	3.0217
Ilan	0.5776	5.0610	4.0677
Hualien	0.1729	3.6528	8.9490
Taitung	0.1561	4.3253	11.1572

*Ref. the footnote of Table 5.15.

Because Ponhu is a small island sited in Taiwan strait, and also because Ponhu has the least population among Taiwan's 22 districts, Ponhu has the least times of service interruption caused by weather, the least circuit length and the second least feeders' peak load rate (all in Table 5.15).

5.3.3 Comparison of Selected Evaluation Index Values among Distribution District Offices for Scheduled Service Interruption

Regarding the major category work and the miscellany work in Tables 5.18 and 5.19, the following of this subsection presents the differences among distribution districts of Taipower on their present system status of major category work and miscellany work. Referring to Table 5.21, among the 22 districts, Hsinchu district has largest amount of customer power hookup request construction work; Kaohsiung, Taichung and Keelung districts have larger amount of expansion work than the remaining 19 districts; also Fongshan and Yunlin have the largest and the second largest amount of maintenance work; in contrast, Ponhu has the smallest total amount of works in the first three items of major category work.

Referring to Table 5.22, Taoyuan has the largest amount of work for installation/expansion of distribution feeders; Yunlin has the largest amount of work for changing overhead feeder into underground cable; Miaoli is the only district which has the work of voltage improvement and feeder loss reduction; Taichung and Taoyuan have the largest and the second largest amount of work for distribution system voltage upgrade; Kaohsiung and Miaoli have larger amount of work for feeder reliability improvement through expansion or upgrade than the remaining 20 districts. Also, several districts spend similar effort on distribution automation and Taoyuan and Taichung have the largest and the second largest amount of work for substation equipment replacement and upgrade; again, Ponhu has the smallest total amount of work in the multi-year distribution system expansion projects.

Table 5.18 Collected Evaluation Index Values for Disparity Factors Affecting Average Times of Distribution Scheduled Service Interruption per Year

Unit: %

First Layer	Average Times of Service Interruption per Year			
Second Layer	Feeders' Peak Load Rate	Total Circuit Length	Major Category Work	Miscellany Work
Keelung*	4.2661	1.9583	Detailed in Table 5.21	Detailed in Table 5.23
Taipei-C	4.9902	3.1622		
Taipei-W	5.8997	3.8733		
Taipei-S	4.9397	3.3984		
Taipei-N	4.3880	2.4974		
Taoyuan	5.7174	5.7039		
Hsinchu	4.6167	1.4519		
Miaoli	4.0900	4.0915		
Taichung	4.7510	9.3451		
Changhua	5.1013	7.1780		
Nantou	5.1018	5.1986		
Yunlin	1.6301	6.7989		
Chia-I	5.0303	6.9141		
Sinying	4.2581	3.3182		
Tainan	5.7840	7.0036		
Kaohsiung	4.9685	8.5569		
Fongshan	4.3956	4.4142		
Pingtung	4.9706	7.0407		
Ponhu	2.0618	0.8446		
Ilan	5.0610	2.4701		
Hualien	3.6528	2.5787		
Taitung	4.3253	2.2014		

*Note: One of the 22 distribution districts of Taipower.

Table 5.19 Collected Evaluation Index Values for Disparity Factors Affecting
Average Duration per Distribution Scheduled Service Interruption

Unit: %

First Layer	Average Duration per Service Interruption		
Second Layer	Overhead / Underground		Major Category Work
Third Layer	Overhead	Underground	Detailed in Table 5.21
Keelung*	4.8127	3.9650	
Taipei-C	0.4033	13.1235	
Taipei-W	2.4776	8.8151	
Taipei-S	2.2887	9.7659	
Taipei-N	3.5376	6.6134	
Taoyuan	4.8967	3.7905	
Hsinchu	4.7623	4.0697	
Miaoli	5.6596	2.2059	
Taichung	4.4773	4.6616	
Changhua	5.9554	1.5916	
Nantou	5.7443	2.0300	
Yunlin	6.3970	0.6743	
Chia-I	6.0703	1.3528	
Sinying	5.7773	1.9616	
Tainan	4.3529	4.9199	
Kaohsiung	2.8809	7.9774	
Fongshan	4.6279	4.3489	
Pingtung	6.1718	1.1420	
Ponhu	1.8027	10.2168	
Ilan	5.0412	3.4903	
Hualien	6.0428	1.4101	
Taitung	5.8196	1.8736	
			Detailed in Table 5.23

*Ref. the footnote of Table 5.18.

Table 5.20 Collected Evaluation Index Values for Disparity Factors Affecting
Average Number of Customer Affected per Distribution
Scheduled Service Interruption

Unit: %

First Layer	Average Number of Customer Affected per Service Interruption		
Second Layer	Average Customers per Feeder	Load Transfer Inability	
Third Layer	—	Feeders' Peak Load Rate	Radial Circuit Ratio
Keelung*	4.6176	4.2661	5.5786
Taipei-C	3.9825	4.9902	1.7433
Taipei-W	4.2801	5.8997	7.6473
Taipei-S	5.4995	4.9397	2.3244
Taipei-N	3.8162	4.3880	1.7573
Taoyuan	3.0248	5.7174	1.7433
Hsinchu	2.3054	4.6167	3.4866
Miaoli	4.1866	4.0900	9.0652
Taichung	4.6163	4.7510	5.8227
Changhua	4.1717	5.1013	0
Nantou	4.6581	5.1018	6.5665
Yunlin	5.7360	1.6301	3.4866
Chia-I	6.2198	5.0303	7.7868
Sinying	4.4020	4.2581	8.1355
Tainan	5.3175	5.7840	0.5811
Kaohsiung	4.6665	4.9685	4.2142
Fongshan	4.7359	4.3956	1.1622
Pingtung	5.8353	4.9706	1.7026
Ponhu	3.1228	2.0618	3.0217
Ilan	5.3935	5.0610	4.0677
Hualien	3.7792	3.6528	8.9490
Taitung	5.6325	4.3253	11.1572

*Ref. the footnote of Table 5.18.

Table 5.21 Collected Evaluation Index Values for Disparity Factors Included in Major Category Work

Unit: work point

Second Layer	Major Category Work			
Third Layer	Customers Power Hookup Request Construction	Expansion Work	Maintenance Work	Multi-Year Distribution System Expansion Projects
Keelung*	437	1835	374	Detailed in Table 5.22
Taipei-C	0	32	0	
Taipei-W	0	1512	0	
Taipei-S	0	1141	564	
Taipei-N	451	870	0	
Taoyuan	216	1577	561	
Hsinchu	685	1015	426	
Miaoli	67	90	530	
Taichung	27	1858	0	
Changhua	0	248	0	
Nantou	71	197	0	
Yunlin	27	0	3915	
Chia-I	171	1118	1458	
Sinying	22	0	1704	
Tainan	0	0	0	
Kaohsiung	500	1866	0	
Fongshan	58	0	4637	
Pingtung	297	600	0	
Ponhu	0	278	199	
Ilan	0	494	792	
Hualien	284	22	552	
Taitung	117	374	0	

*Ref. the footnote of Table 5.18.

Table 5.22 Collected Evaluation Index Values for Disparity Factors Included in Multi-Year Distribution System Expansion Projects
(To be continued)

Unit: work point

Third Layer	Multi-Year Distribution System Expansion Projects							
Fourth Layer	Installation / Expansion of Distribution Feeders	Changing Overhead Feeder into Underground Cable	Voltage Drop Improvement and Feeder Loss Reduction	Distribution System Voltage Upgrade	Covering Bare Conductor with PE	Feeder Reliability Improvement through Expansion or Upgrade	Distribution Automation	Substation Equipment Replacement and Upgrade
Keelung*	86983	25744	0	0	0	24451	0	17000
Taipei-C	6200	0	0	3800	0	0	398419	12200
Taipei-W	193817	80462	0	30701	0	0	281463	15784
Taipei-S	102500	62582	0	18500	0	35700	26500	19500
Taipei-N	23355	35981	0	0	0	25716	85132	10983
Taoyuan	334553	23418	0	46997	0	8429	362059	60244
Hsinchu	21393	4843	0	0	0	8075	269000	13680
Miaoli	122137	8609	11185	0	0	54894	0	45450
Taichung	115175	129548	0	48600	0	0	357353	57775
Changhua	56074	41367	0	0	0	12547	292909	27035
Nantou	107060	77460	0	0	0	8820	0	7070

*Ref. the footnote of Table 5.18.

Table 5.22 Collected Evaluation Index Values for Disparity Factors Included in Multi-Year Distribution System Expansion Projects
(Continued)

Unit: work point

Third Layer	Multi-Year Distribution System Expansion Projects							
Fourth Layer	Installation / Expansion of Distribution Feeders	Changing Overhead Feeder into Underground Cable	Voltage Drop Improvement and Feeder Loss Reduction	Distribution System Voltage Upgrade	Covering Bare Conductor with PE	Feeder Reliability Improvement through Expansion or Upgrade	Distribution Automation	Substation Equipment Replacement and Upgrade
Yunlin	34473	239373	0	7314	0	0	0	8400
Chia-I*	15653	56548	0	0	0	0	17273	0
Sinying	27164	93657	0	0	0	49067	0	1938
Tainan	48840	60840	0	0	0	5953	272758	17415
Kaohsiung	41879	100099	0	0	0	60423	223218	17574
Fongshan	125740	15139	0	0	0	47851	228134	3180
Pingtung	10800	40508	0	0	0	13699	0	36870
Ponhu	0	0	0	0	0	19840	0	0
Ilan	8000	86930	0	0	0	0	0	0
Hualien	23188	63826	0	0	0	0	0	0
Taitung	31630	36163	0	0	0	0	0	0

*Ref. the footnote of Table 5.18.

Table 5.23 Collected Evaluation Index Values for Disparity Factors Included in Miscellany Work

Unit: work point

Second Layer	Miscellany Work		
Third Layer	Small-Scale Construction Work	Miscellaneous Work	Maintenance Work
Keelung*	8729	8609	246
Taipei-C	5424	1365	1981
Taipei-W	6260	2684	559
Taipei-S	3350	7868	662
Taipei-N	2819	4666	685
Taoyuan	8031	16576	286
Hsinchu	6521	4028	109
Miaoli	4199	8877	188
Taichung	8966	4296	524
Changhua	5935	14032	1580
Nantou	5134	17572	476
Yunlin	4911	14938	3073
Chia-I	7480	12701	864
Sinying	3199	4430	1023
Tainan	5217	12237	1366
Kaohsiung	6621	3960	1017
Fongshan	5953	7742	53
Pingtung	3431	6604	433
Ponhu	460	777	63
Ilan	3318	4311	0
Hualien	2828	5538	445
Taitung	1710	1852	216

*Ref. the footnote of Table 5.18.

Referring to Table 5.23, Taichung and Keelung have larger amount of small scale construction work than the remaining 20 districts; Nantou and Taoyuan have the largest and the second largest amount of miscellaneous work; also Yunlin has the

largest amount of maintenance work included in miscellany work. Ponhu still maintains the smallest amount of work in miscellany work.

As for Table 5.20, which refers to the number of customers affected of each service interruption, Chia-I has the largest amount of customers per feeder, although the differences among 22 districts are not significant.

5.4 SAIDI Targets

The results of relational distribution of corporate SAIDI target to 6 regional transmission office and 22 distribution districts for the transmission forced, and the distribution forced and distribution scheduled service interruptions are presented with the target setting results are compared with the records of base year (2003).

5.4.1 Comparison of SAIDI Targets and Records in Base Year among Transmission Regional Offices

Having obtained the metric values for measuring the status disparity among 6 regional transmission systems and the weight of each factor in the three hierarchical structures under evaluation (ref. Figs. 3.1~3.3), the final stage of AHP is to estimate the objective at the top of each AHP structure by applying Eq. (2-1). Taking Fig. 3.1 and Taipei region as an example; the estimated for the average times of service interruption per year is 0.183 (or $V_{j,frq} = 0.183$) as shown in Table 5.23, where $0.183 = 0.200 \times 0.187 + 0.164 \times 0.167 + 0.164 \times 0.140 + 0.139 \times 0.111 + 0.126 \times 0.117 + 0.124 \times 0.148 + 0.358 \times 0.131$. Namely, it is the sum of multiplications of regional metric value with its corresponding weight for each of the total 7 factors as enlisted in the second layer of Fig. 3.1. In the calculation, $0.124 = 0.093 \times 0.461 + 0.213 \times 0.304 + 0.071 \times 0.236$, for measuring the geographic disparities, is evaluated by adding the 3

products for the 3 factors in the third layer of Fig. 3.1. In the same way, the estimated for the average duration per service interruption ($V_{j, \text{drt}} = 0.169$) and for the average number of customers affected per service interruption ($V_{j, \text{ctm}} = 0.174$) are calculated (ref. Table 5.24). The rational SAIDI under normalization for Taipei region is 0.00538, where $0.00538 = 0.183 \times 0.169 \times 0.174$. Then the rational distribution of Taipower's corporate SAIDI target to Taipei region is calculated as $17.60\% = 0.00538 / 0.03057$, referring to the footnote of Table 5.24. For comparison, the relative proportions among Taipower's 6 transmission regions on the regional SAIDI records of base year (2003) are also provided in Table 5.24.

The resulted order obtained from high to low among the 6 transmission regions according to the rational SAIDI in Table 5.24 is:

Taichong > Shintao > Taipei > Gaupin > Gianan > Hwadong

This order has been compared with the following arranged according to the actual SAIDI records in the same year:

Shintao > Taipei > Taichong > Gaupin > Gianan > Hwadong

The apparent difference is on Taichong because, for Taichong,

- (1) each of the following was ranked at the highest among 6 regions: radial circuit ratio, mountainous area in kilometer squares and total circuit length;
- (2) each of the following was ranked at the second highest: overhead circuit ratio, transformers' peak load rate and customers' ineffective support.

The rational order may not have to accord with the performance order, and can serve, if sufficient index data have been collected, as guideline for setting the regional reliability target.

Table 5.24 Rational Distribution of Corporate SAIDI Target to 6 Transmission Regions as Compared to the SAIDI Records in Year 2003

Regional office	(1) Average times of service interruption per year	(2) Average duration per service interruption	(3) Average number of customer affected per service interruption	Normalized regional SAIDI (1)×(2)×(3)	Rational SAIDI proportion set for a target year (%)	Proportion for SAIDI records in base year (%)
Taipei	0.183	0.169	0.174	0.00538	17.60	23.19
Shintao	0.197	0.166	0.245	0.00801	26.21	24.16
Taichong	0.192	0.212	0.205	0.00834	27.29	19.32
Gianan	0.151	0.114	0.136	0.00234	7.66	13.29
Gaupin	0.185	0.215	0.132	0.00525	17.17	14.98
Hwadong	0.092	0.125	0.108	0.00124	4.06	5.07

Note: Take Taipei region as an example, $17.60\% = 0.00538/0.03057$ where 0.03057 is the sum of normalized regional SAIDI's.

5.4.2 Comparison of SAIDI Targets and Records in Base Year among Distribution Districts

The SAIDI targets set for Taipower's 22 distribution districts in this study on the distribution forced service interruption have been compared with the relative proportions among the regional SAIDI performance records of year 2003 as depicted in Table 5.25. To derive the targets in Table 5.25, the same calculation process for distributing the corporate SAIDI target to the 22 districts as that presented in Section 5.4.1 has been applied here.

On basis of the results in table 5.25, the 22 districts can be divided into four groups according to their performance (or rational) order. The first group which have the highest proportion for SAIDI records or, are distributed with the highest SAIDI target proportion, are:

Rational SAIDI — Taipei-C, Taichung, Taipei-W, Kaohsiung, Nanto, Taitung.

SAIDI records — Taichung, Taipei-C, Taoyuan, Taipei-S, Tainan and Yunlin.

The fourth group which are distributed with the lowest SAIDI target proportion or have the lowest proportion for SAIDI records, are:

Rational SAIDI — Ponhu, Changhua, Taipei-N, Hsinchu and Fongshan.

SAIDI records — Ponhu, Sinying, Pingtung, Hsinchu and Taitung.

Taipei City and Taichung possess the highest and the second highest proportion of SAIDI target, because Taichung has the longest total circuit-length, the third number of times for power service interruption caused by the weather, and Taipei City has the highest customer density and underground feeder ratio. Ponhu possesses the lowest proportion of SAIDI target, because Ponhu has the shortest total circuit -length, the second lowest rate of feeders' peak load and the smallest jurisdictional area. As shown above, the ranking of Ponhu, Taipei-C and Taichung on their SAIDI target proportion result accords well with the regional SAIDI records of 2003, although the ranking for the remaining districts may not be the same. The difference is because,

- (1) The rational order may not have to accord with the performance order, as in deriving the rational order, the district managerial/efficiency effort has been segmented from the historical performance data, as we have done in this study;
- (2) Although the AHP is a mathematically well-proven process, the weights derived by the AHP is still subjective, which highly depends partially on the broadness of views and the neutrality of the surveyed engineers.
- (3) The expansion and maintenance of distribution network are commonly carried out year by year, thus appearing as a repetitively on-going process; in contrast, the forced outage of distribution network sometimes occurred accidentally. Consequently, the rational order derived in this study can agree more with the performance order for the scheduled than for the forced service interruptions, to be further clarified in next paragraph.

The comparison of SAIDI targets of 22 distribution districts for scheduled service interruption and their relative proportions on the regional SAIDI records of year 2003 are shown in Fig. 5.26. By dividing the 22 districts into four groups in the same way as above but on basis of the results in Table 5.26, the first group which are distributed with the highest SAIDI proportion or have the highest proportion for SAIDI records are:

Rational SAIDI — Taichung, Taoyuan, Taipei-C, Nanto, Yunlin and Kaohsiung.

SAIDI records — Taichung, Taipei-S, Taoyuan, Taipei-C, Changhua and Tainan.

The fourth group which are distributed with the lowest SAIDI proportion or have the lowest proportion for SAIDI records are:

Rational SAIDI — Ponhu, Taitung, Taipei-N, Pingtung and Ilan.

SAIDI records — Ponhu, Hualien, Taitung, Miaoli and Sinying.

Taichung, Taoyuan and Taipei West possess the first, the second and the third highest proportion of SAIDI target, because Taichung has the longest total circuit length and the second largest amount of budget for multi-year distribution system expansion projects, and Taoyuan has the second highest rate of feeders' peak load and the largest amount of budget for multi-year distribution system expansion projects, as well as Taipei West has the highest rate of feeders' peak load and the third largest amount of budget for multi-year distribution system expansion projects. Ponhu still possesses the lowest proportion of SAIDI target, because Ponhu has the lowest rate of feeders' peak load, the shortest total circuit-length and the least amount of budget for the major category and the miscellany works. Compared to the results of forced service interruption, the results of scheduled service interruption maintain better accordance with the performance records of 2003, which further validates the statement given at the preceding paragraph in (3).

Table 5.25 Rational Distribution of Corporate SAIDI Target to 22 Distribution Districts for Forced Service Interruption as Compared to the SAIDI Record in Year 2003

Distribution District	(1) Average times of service interruption per year	(2) Average duration per service interruption	(3) Average number of customer affected per service interruption	Normalized regional SAIDI (1)×(2)×(3)	Rational SAIDI proportion set for a target year (%)	Proportion for SAIDI records in base year (%)
Keelung	2.7641	4.5133	4.3388	54.1277	2.8637	4.4179
Taipei-C	1.9587	6.1444	16.6943	200.9162	10.6297	13.0808
Taipei-W	3.8013	5.3859	6.9736	142.7724	7.5535	4.7679
Taipei-S	2.8515	5.4118	3.5500	54.7824	2.8983	5.9001
Taipei-N	2.4526	4.9836	3.3158	40.5286	2.1442	3.1102
Taoyuan	7.0985	4.4157	3.0079	94.2829	4.9881	7.0999
Hsinchu	2.9607	4.5661	3.0335	41.0094	2.1696	2.2805
Miaoli	4.0667	4.2467	5.4031	93.3122	4.9368	2.4299
Taichung	7.3879	4.1424	4.6983	143.784	7.6070	16.1651
Changhua	4.6333	3.9266	2.0193	36.7378	1.9436	4.9149
Nantou	7.3147	4.1936	4.4120	135.3364	7.1601	2.3999
Yunlin	5.2525	3.8267	2.6442	53.1483	2.8119	5.0900
Chia-I	5.1577	4.0298	5.2729	109.5944	5.7982	4.0275
Sinying	4.6180	4.0439	5.3293	99.5233	5.2654	1.5695
Tainan	5.5750	4.6663	2.3345	60.7315	3.2131	5.2548
Kaohsiung	5.3560	4.5836	5.5474	136.1866	7.2051	3.4840
Fongshan	5.1826	4.6441	1.8028	43.3909	2.2956	3.6316
Pingtung	8.0592	4.0206	2.0948	67.8761	3.5910	2.2362
Ponhu	1.1097	5.5135	2.4990	15.2898	0.8089	0.6413
Ilan	3.5038	4.4678	3.2055	50.1798	2.6548	2.5263
Hualien	4.6572	4.0792	5.2897	100.4919	5.3166	2.5980
Taitung	4.2382	4.1946	6.5333	116.1459	6.1448	2.3738

Table 5.26 Rational Distribution of Corporate SAIDI Target to 22 Distribution Districts for Scheduled Service Interruption as Compared to the SAIDI Record in Year 2003

Distribution District	(1) Average times of service interruption per year	(2) Average duration per service interruption	(3) Average number of customer affected per service interruption	Normalized regional SAIDI (1)×(2)×(3)	Rational SAIDI proportion set for a target year (%)	Proportion for SAIDI records in base year (%)
Keelung	4.0444	3.8564	4.9556	77.2916	3.5072	3.5414
Taipei-C	3.5763	5.0143	3.2393	58.0900	2.6359	5.3153
Taipei-W	5.2639	6.4319	6.1337	207.6682	9.4232	7.8783
Taipei-S	4.3400	4.9934	3.9788	86.2257	3.9126	9.2158
Taipei-N	3.0073	3.5178	3.0496	32.2618	1.4639	5.0147
Taoyuan	8.6095	8.6649	3.0963	230.9835	10.4811	8.5154
Hsinchu	3.4277	3.9305	3.3650	45.3347	2.0571	4.1990
Miaoli	4.1119	3.8444	6.2986	99.5668	4.5180	1.9069
Taichung	6.9573	7.1842	5.1758	258.6985	11.7387	10.6181
Changhua	6.5128	5.5959	2.5647	93.4689	4.2413	6.8364
Nantou	6.0710	4.8919	5.5973	166.2332	7.5430	2.2081
Yunlin	6.6204	6.0214	3.7877	150.9943	6.8515	2.9288
Chia-I	5.2849	3.7375	6.6262	130.8820	5.9389	4.0271
Sinying	3.4068	3.4027	6.0018	69.5747	3.1570	1.9766
Tainan	6.2003	5.6232	3.3547	116.9617	5.3073	6.8119
Kaohsiung	5.5277	5.7151	4.5395	143.4083	6.5073	5.5445
Fongshan	4.9477	5.1853	3.0923	79.3348	3.5999	3.8643
Pingtung	3.7601	2.7170	3.8240	39.0671	1.7727	2.9840
Ponhu	0.7304	2.1542	2.8295	4.4520	0.2020	0.4211
Ilan	2.9309	2.8995	4.7353	40.2416	1.8260	2.5781
Hualien	2.7733	2.6487	6.0116	44.1591	2.0038	1.7975
Taitung	1.8954	1.9696	7.7429	28.9055	1.3116	1.8168