CHAPTER 4

DATA ANALYSIS AND SYSTEM DESIGN DEVELOPMENT

The objective of this research was developed a decision support system for plant location selection in case of plastic industry and concrete industry to be used as a guideline for business owners or investors in making plant location decision before setting up a new plant.

4.1 PRELIMINARY SURVEY

In preliminary survey, we found that most investors or business owners are lack of important information in make plant location selection decision. There are some organization provides information to support them but it is not easy and comfort to access or search its information today.

We design and develop decision support system for plant location selection follows the decision support system components that help us to design and develop the system easily.

In design and develop system, we were collected information from the textbooks, researches information, and set the questionnaires to ask business owners or someone in related positions. After collected information, it helps us to understand factors that important in making plant location decision and use it's knowledge to develop the decision support system for plant location selection in case of plastic industry and concrete industry.

We analyze all information by using location factor rating evaluation technique to find the suitable plant location. It is the common and easy method that used to evaluate from any information requirement. This technique helps us to compare from one location alternative to other by using factors related plant location selection. It is suitable for evaluating plant location alternative by compare it to other. It allows the maximum score of one factor to compensate into lower of other factor score by rating and weightings score.

Steps 1: Assign score to x_{ij} factor i for location j such as market location, utilities supply, labour supply and so on. It decides on a common scale for all factors between 0 to 100. We will assign score to all candidate location.

Table 4.1: Standard score used to assign score (out of 100) to each location alternative.

Score	Meaning
90-100	Excellent compare to other location alternative.
80-89	Almost excellent compare to other location alternative
70-79	Very good compare to other location alternative
51-69	Good compare to other location alternative
41-50	Satisfactory compare to other location alternative
30-40	Poor compare to other location alternative
0-29	Very poor compare to other location alternative

Step 2: Assign a weight to each factor that indicates its relative priority of importance factors when compared to all other factors. It is a common scale for all factors in 0.1,0.3,0.5,0.7,0.9 order. For this research, we do not fix the weight in each factor cause of each investor depend on each users requirement that more attractive for their selection.

Table 4.2: Standard weight used to assign weight to each factor.

Weight	Meaning
0.9	Most important factor
0.7	Important factor
0.5	Neutral
0.3	Poor
0.1	Very poor

Step 3: Multiply the factor weight by the score for each factor of all location alternatives, and sum the results for each location alternative. And then select the location alternative with the highest composite score. By using the mathematical following as below:

$$X_j = \sum_{i=1}^{n} w_i x_{ij}$$

$$X_{\text{plant location}} = (W_{F1} * X_{\text{province}}) + (W_{F2} * X_{\text{province}}) + (W_{F3} * X_{\text{province}}) + (W_{F4} * X_{\text{province}}) + (W_{F6} * X_{\text{province}}) + (W_{F7} * X_{\text{province}}) + (W_{F8} * X_{\text{province}})$$

$W_{F(i)}$ is weight of each factor in making plant location selection decision both plastic industry and concrete industry.

W_{F1} = Weight of nearness or accessibility to the source of raw materials factor.

W_{F2} = Weight of nearness or accessibility to market factor

W_{F3} = Weight of availability of labour supply factor

W_{F4} = Weight of BOI investment promotes location factor

W_{F5} = Weight of transportation facilities factor

W_{F6} = Weight of availability and capacity of utilities factor

W_{F7} = Weight of location cost factor

W_{F8} = Weight of plant construction cost factor

$X_{province(i)}$ is score of each location candidate compare with other location

Calculate principle that used to assign score to each factor in several location alternatives.

Calculate for assign each score to x_{ij} factor i for location j such as market location, utilities supply, labour supply and so on. It decides on a common scale for all factors between 0 to 100. We will assign score to all location alternatives.

In this research, we covered province information about 18 provinces in six regions of Thailand (Central Region, Northeastern Region, Northern Region, Western Region, Eastern Region and Southern Region). It allows us know each province information related to any factors in making plant location selection decision such as land cost, wage rate and so on. it helps us to assign and provide the score in each factor to find suitable plant location when compare to other location alternative in Thailand.

In appendix B provides a provinces information for plant location selection in Thailand.

4.1.1 Assign the score of nearness or accessibility to the source of raw materials factor

According to questionnaire result both of plastic industry and concrete industry show that;

Sources of raw materials of plastic industry are located at Bangkok, Rayong, Samutsakhom, Samutprakran, Suphanburi. And Sources of raw materials of

concrete industry are located at Rayong, Saraburi, Chachoengsao, Kranjanaburi and Phetburi

- Located at Bangkok, Rayong, Samutsakhom, Samutprakran, Suphanburi = 95 – 100 scores (for plastic industrial)
- Located at Rayong, Saraburi, Chachoengsao, Kranjanaburi and Phetburi = 95 – 100 scores (for plastic industrial)
- Located near these province and not more than 100 kilometers from Bangkok = 80- 94 scores
- Located about 101 to 300 kilometers from Bangkok = 70-79 scores
- Located about 301 to 700 from Bangkok = 41 – 50 scores
- Located about 701 to 1000 from Bangkok = 30 - 40 scores
- Unless, score is 15

4.1.2 Assign the score of neamess or accessibility to the market factor

According to questionnaire result both of plastic industry and concrete industry show that;

Sources of neamess or accessibility to the market factor of plastic industry are located at Bangkok, Saraburi, Samutsakhom, Samutprakran. And Sources of raw materials of concrete industry are located at Saraburi, Chachoengsao, Kranjanaburi, Nakhomprathom, and Chonburi

- Located at Bangkok, Rayong, Saraburi ,Samutsakhom, Samutprakran = 95 – 100 score (for plastic industry)

- Located at Rayong, Saraburi, Chachoengsao, Kranjanaburi Nakhomprathom, and Chonburi = 95 – 100 score (for concrete industry)
- Located near these province and not more than 100 kilometers from Bangkok = 80- 94 scores
- Located between101 to 300 kilometers from Bangkok = 70-79 scores
- Located between 301 to 700 from Bangkok = 41 – 50 scores
- Located between701 to 1000 from Bangkok = 30 - 40 scores
- Unless, score is 15

4.1.3 Assign the score of availability of labour supply factor

According to National Statistical Office: wage rates are between 130 Baht per day (minimum wage rates around Thailand) to upper and it considers in number of employees in each province.

- Wage rate is 130 Baht and number of employees more than 50,000 = 95 – 100 scores
- Wage rate is 130 Baht and number of employees between 30,000 to 50,000 = 90 – 95 scores
- Wage rate is 133 Baht and number of employees more than 50,000 = 90 – 95 scores
- Wage rate is 133 Baht and number of employees between 30.000 to 50,000 = 80-90 scores
- Wage rate is 133 Baht and number of employees less than 30,000 = 70-75 scores
- Wage rate is 143 Baht and number of employees more than 50,000 = 80-90 scores
- Wage rate is 143 Baht and number of employees between 30,000 to 50,000 = 70-75 scores
- Wage rate is 143 Baht and number of employees less than 30,000 = 60-65 scores

4.1.4 Assign the score of BOI investment promotes location factor

According to BOI investment organization that promoted companies to receive more benefit including tax privileges, project promotion, export promotion and so on.

Zone 1 consists of 6 provinces, Bangkok, Nakhon Pathom, Nonthaburi, Pathum Thani, Samut Prakan, Samut Sakhon.

Zone 2 consists of 12 provinces, Kanchanaburi, Chachoengsao, Chon Buri, Nakhon Nayok, Phra Nakhon Si Ayutthaya, Phuket,Rayong, Ratchaburi, Samut Songkhram, Saraburi, Suphan Buri and Ang Thong.

Zone 3 consists of 58 provinces.

- Located at Zone 3 = 85-95 scores

In provinces located in industrial estate, and industrial promotion location : Krabi, Kamphaeng Phet, Khon Kaen, Lop Buri, Sing Buri, chai Nat, Chanthaburi, Trat, Prachin Buri, Sa

Kaeo, Phetchaburi, Prachuap Khiri Khan, Chiang Mai, Lamphun, Uttaradit, Chiang Rai, Mae Hong Son, Nakhon Sawan, Uthai Thain, Tak, Sukhothai, Phisanulok, Phichit, Phetchabun, Nakhon Ratchasima, Ubon Ratchathani, Chaiyaphum, Udon Thani, Loei, Nong Khai, Mukdahan, Nakhon Si Thammarat, Surat Thani, Ranong, Chumphon, Songkhla, Trang, Phatthalung.

And other provinces such as Phrae, Nan Phayao, Chiang Rai, Buri Ram, Surin, Si Sa Ket, Chaiyaphum, Manat Charoen, Nong Bua Lam Phu, Maha Sarakham, Roi Et Kalasin, Sakon Nakhon, Nakhon Phanom, Satun, Pattani, Yala Narathiwat that provinces is about 98 scores.

- Located at Zone 2 = 80-95 scores
- Located at Zone 1 = 75-80 scores

4.1.5 Assign the score of transportation facilities factor

- Province that provides all of transportation facilitates, railroad transportation, automobile transportation (more than five routes), airway transportation and waterway transportation = 95-100 scores
- Province that provides all of transportation facilitates, railroad transportation, automobile transportation (less than five routes), airway transportation and water way transportation = 80-85 scores
- Province that provides transportation facilitates, railroad transportation, automobile transportation (more than five routes), and waterway transportation = 90-95 scores
- Province that provides transportation facilitates, railroad transportation, automobile transportation (less than five routes), and waterway transportation = 75-80 scores
- Province that provides transportation facilitates, railroad transportation, automobile transportation (more than five routes), airway transportation = 80-85 scores
- Province that provides transportation facilitates, railroad transportation, automobile transportation (less than five routes), airway transportation = 60-65 scores of plastic industry (for concrete industry = 50-55 scores)
- Province that provides both railroad transportation or waterway transportation and automobile transportation (more than five routes) = 70-75 scores

- Province that provides both railroad transportation or waterway transportation and automobile transportation (less than five routes) = 60-65 scores

4.1.6 Assign the score of availability and capacity of utilities factor

According to Electricity Generating Authority of Thailand provides information about overall productivity for each province. Waterworks office provides information about capacity of water producing in each province. Provincial Telephone Office provides information of total of telephone lines for service, number of subscription and number of public phones.

- Province provides all utilities facilitates, electricity (more than 300 million kilowatts/hours), waterworks (more than 100,000 cubic meters), telephone (more than 50,000 telephone line for service), post and telegraph service (more than 20 post office service) = 95-100 scores
- Province provides all utilities facilitates, electricity (less than 300 million kilowatts/hours), waterworks (less than 100,000 cubic meters), telephone (less than 50,000 telephone line for service), post and telegraph service (less than 20 post office service) = 80-85 scores
- Province provides good for utilities facilitates, electricity (more than 300 million kilowatts/hours), not good of waterworks service, telephone (more than 50,000 telephone line for service), post and telegraph service (more than 20 post office service) = 60-65 scores

4.1.7 Assign the score of location cost factor

- location cost less than 50 Baht/m^2 = 95 -100 score
- location cost between 50 to 100 Baht/m^2 = 90-94 score
- location cost between 100 to 150 Baht/m^2 = 85-89 score
- location cost between 151 to 300 Baht/m^2 = 70-75 score
- location cost between 301- to 500 Baht/m^2 = 60-65 score
- location cost more than 500 Baht/m^2 = 50-55 score

4.1.8 Assign the score of plant construction cost factor

- Industrial factor cost less than 3,000 Baht/m^2 and construction wages less than 30,000 Baht/per year = 95 – 100 score
- Industrial factor cost about 3,001 to 4,000 Baht/m^2 and construction wages less than 30,000 Baht/per year = 85-94 score
- Industrial factor cost between 3,001 to 4,000 Baht/m^2 and construction wages more than 30,000 Baht/per year = 75-84 score
- Industrial factor cost between 4,000 to 4,350 Baht/m^2 and construction wages less than 30,000 Baht/per year = 70-74 score
- Industrial factor cost more than 4,350 Baht/m^2 and construction wages more than 30,000 Baht/per year = 55-60 score

4.2 DECISION SUPPORT SYSTEM COMPONENTS:

4.2.1 The data management module

We design and develop the database system of decision support system for plant location selection. It consists of province information, important factors, statistical information that related in making plant location selection decision in case of plastic industrial and concrete industrial.

Table 4.3: Database system of plant location selection.

Field	Description
Province	Table of province detail
Factor	Table factor
FP_Score	Table of score of plastic industry factors in each location
FC_Score	Table of score of concrete industry factors in each location
FP_newscore	Table of new score of plastic industry factors
FC_newscore	Table of new score of concrete industry factors
SumScore	Table of sums score of both plastic and concrete industry factors table.

Plantlocation.mdb is database file of plant location selection, including all information used in the system.

4.2.1.1 Province Table: it consists of province name, province description, income per head, wage rates, utilities facilities, BOI investment promotion zone, number of employees.

Table 4.4: Province Table

Field	Type	Description
P_ID	Text	Province code/ id
P_Name	Text	Province name
P_Description	Text	Province description
P_Income	Number	Income per head in each province
P_Utilities	Text	Utilities supply in each province
P_Employment	Number	Number of employment in each province
P_Wage	Number	Number of wage rates in each province
P_Promotion	Text	Province promotion description by BOI

4.2.1.2 Factor: Table of factor that including factor detail, factor id.

Table 4.5: Factor

Field	Type	description
F_ID	Number	Factor ID
Factor	Text	Factor name

4.2.1.3 FP_Score Table: it consists of plastic industry factors in each location alternative.

Table 4.6: FP_Score Table

Field	Type	Description
F_ID	Number	Factor ID
N1_Score	Number	Chiangmai score
N2_Score	Number	Lamphum score
N3_Score	Number	Lampang score
NE1_Score	Number	Udonthani score
NE2_Score	Number	Khonkaen score
NE3_Score	Number	Mukdahan score
NE4_Score	Number	Roi Et score
NE5_Score	Number	Ubonratchathani score
NE6__Score	Number	Nakhonratchasima score
E1_Score	Number	Chachoengsao score
E2_Score	Number	Chonburi score
E3_Score	Number	Rayong score
S1_Score	Number	Surathani score
S2_Score	Number	Nakhonsithammarat score
S3_Score	Number	Trang score
S4_Score	Number	Songkhla score
S5_Score	Number	Pattani score

4.2.1.4 FP_newscore Table: it consists of new score of plastic industry after multiply the factor weight by the score for each factor.

Table 4.7: FP_newscore Table

Field	Type	Description
F_ID	Number	Factor ID
N1_Score	Number	Chiangmai newscore
N2_Score	Number	Lamphum newscore
N3_Score	Number	Lampang newscore
NE1_Score	Number	Udonthani newscore
NE2_Score	Number	Khonkaen newscore
NE3_Score	Number	Mukdahan newscore
NE4_Score	Number	Roi Et newscore
NE5_Score	Number	Ubonratchathani newscore
NE6__Score	Number	Nakhonratchasima newscore
E1_Score	Number	Chachoengsao newscore
E2_Score	Number	Chonburi newscore
E3_Score	Number	Rayong newscore
S1_Score	Number	Surathani newscore
S2_Score	Number	Nakhonsithammarat newscore
S3_Score	Number	Trang newscore
S4_Score	Number	Songkhla newscore
S5_Score	Number	Pattani newscore

4.2.1.5 FC_Score Table: it consists of concrete industry factors in each location alternative.

Table 4.8 : FC_Score Table

Field	Type	Description
F_ID	Number	Factor ID
N1_Score	Number	Chiangmai score
N2_Score	Number	Lamphum score
N3_Score	Number	Lampang score
NE1_Score	Number	Udonthani score
NE2_Score	Number	Khonkaen score
NE3_Score	Number	Mukdahan score
NE4_Score	Number	Roi Et score
NE5_Score	Number	Ubonratchathani score
NE6__Score	Number	Nakhonratchasima score
E1_Score	Number	Chachoengsao score
E2_Score	Number	Chonburi score
E3_Score	Number	Rayong score
S1_Score	Number	Surathani score
S2_Score	Number	Nakhonsithammarat score
S3_Score	Number	Trang score
S4_Score	Number	Songkhla score
S5_Score	Number	Pattani score

4.2.1.6 FC_newscore Table: it consists of new scores of concrete industry after multiply the factor weight by the score for each factor.

Table 4.9 : FC_newscore Table

Field	Type	Description
F_ID	Number	Factor ID
N1_Score	Number	Chiangmai newscore
N2_Score	Number	Lamphum newscore
N3_Score	Number	Lampang newscore
NE1_Score	Number	Udonthani newscore
NE2_Score	Number	Khonkaen newscore
NE3_Score	Number	Mukdahan newscore
NE4_Score	Number	Roi Et newscore
NE5_Score	Number	Ubonratchathani newscore
NE6__Score	Number	Nakhonratchasima newscore
E1_Score	Number	Chachoengsao newscore
E2_Score	Number	Chonburi newscore
E3_Score	Number	Rayong newscore
S1_Score	Number	Surathani newscore
S2_Score	Number	Nakhonsithammarat newscore
S3_Score	Number	Trang newscore
S4_Score	Number	Songkhla newscore
S5_Score	Number	Pattani newscore

4.2.1.7 SumScore Table: it consists of new score of both plastic industry and concrete industry by sum the total weight score for each location alternative. The highest composite score is suitable plant location in making plant location selection decision.

Table 4.10: SumScore Table

Field	Type	Description
P_ID	Text	Province ID
Sum	Number	Sum score both of plastic industrial and concrete industrial

Table relationship:

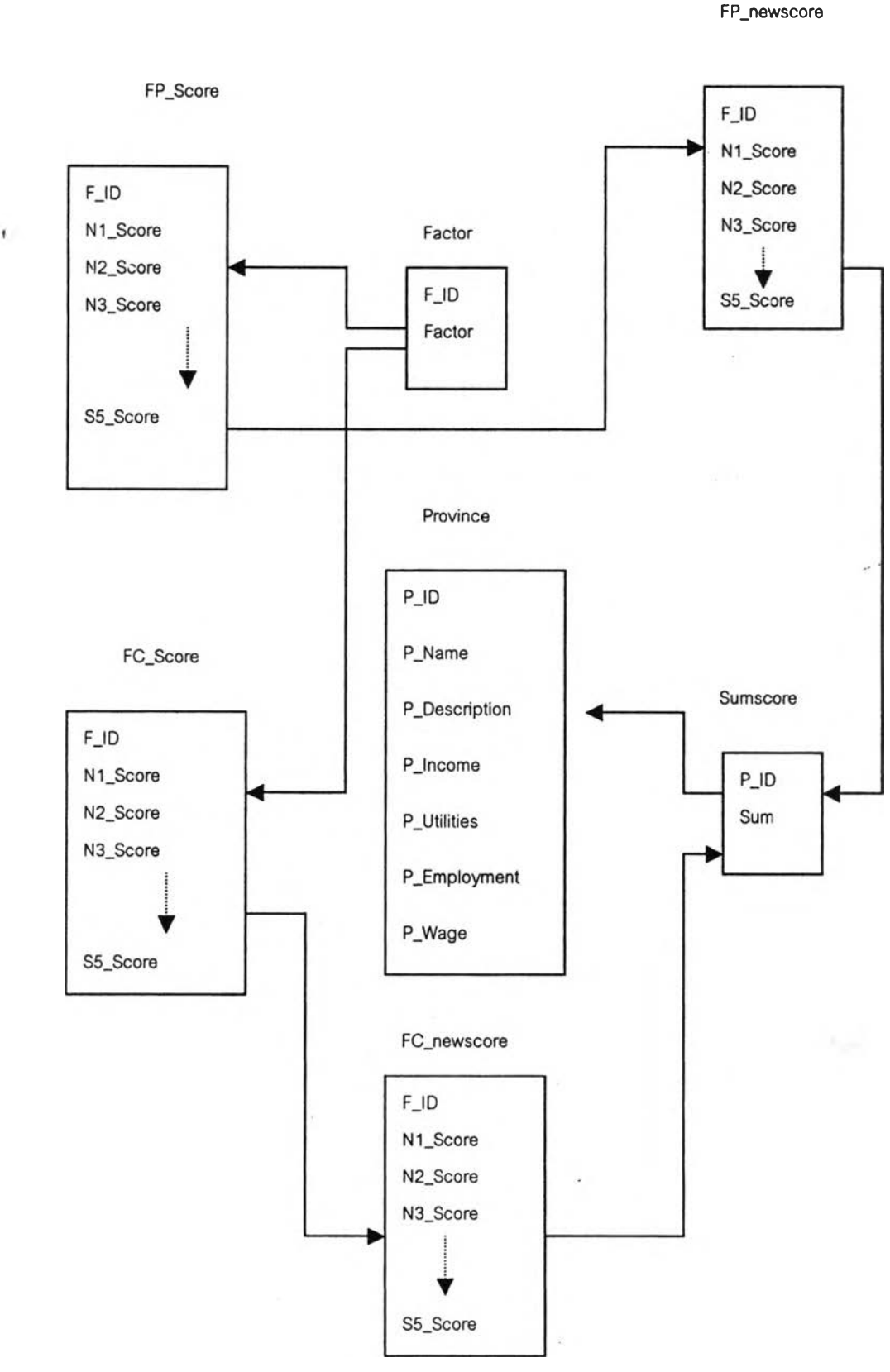

Figure 4.1:Table relationship of decision support system for plant location selection.

4.2.2 The model management module

There is several information factors that related in make plant location selection decision so we choose visual basic program and database system help us for design and develop decision support system for plant location selection

However, decision support system for plant location selection is the system that provide information meet users requirement based on important factors related in making decision both of plastic industry location and concrete industry location.

Questionnaire:

Questionnaire: it is a simply list of questions for receiving business owner's opinions and their requirement factors related in making decision for plant location selection. In questionnaire answer, it allows us understand and know important factors related in the system.

In this research, we developed questionnaires following as the text book (marketing research) and research or thesis related to plant location selection. According to the theory consideration and literature survey in chapter 2, enhances us to develop and design questionnaires to business owners or someone who related in positions to ask question and get information which factors that they used in making plant location selection decision.

In questionnaire, we would like to know which factors that influence for them and what is relative priority of important factors in making plant location selection decision in each industry; where is the market location? ; Which is important of their raw materials type used in production and where is supplier location?; Which type of manufacturing

transportation; What do they want to expand or change the manufacturing site in the future?. The questionnaires form located at appendix A.

We were distributed this questionnaires into business owners and someone who have more power in making decision for plant location selection about 50 letters.

It consists of 40 letters in plastic industry and other in concrete industry (It covered company that promoted by the government).

Finally, it was responded 15 letters in plastic industry and 5 letters in concrete industry. It allows us know and understand relative priority of important factors such as market location, transportation type, raw materials location, employee's education, trend to expand or change factory site of both industries. In Figure 4.2 and Figure 4.3 show the result of questionnaire answer of business owners and someone in related positions in both industries.

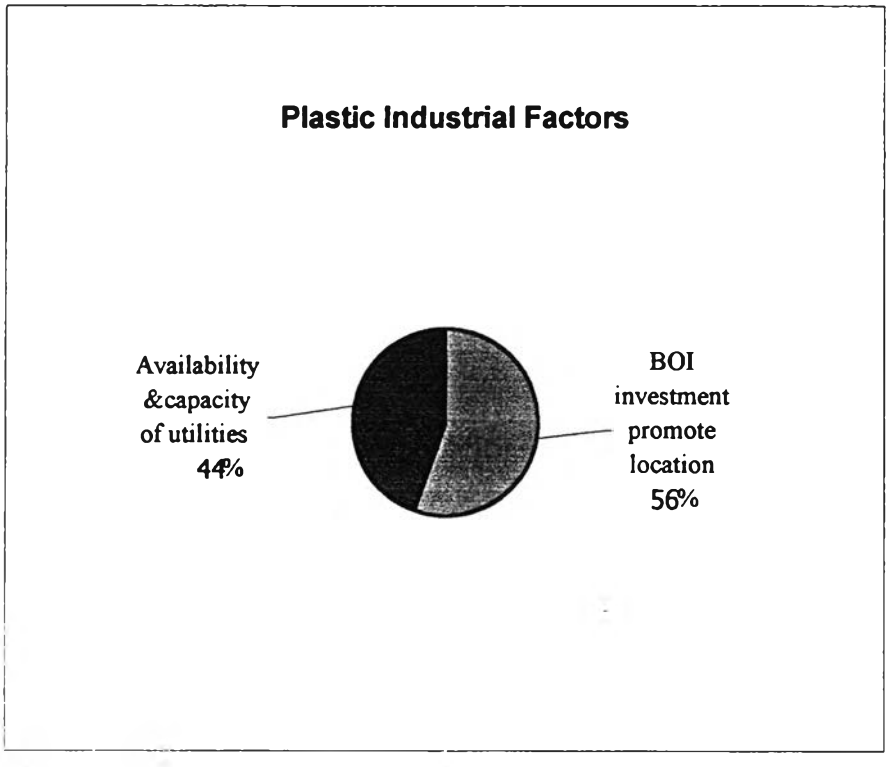

Figure 4.2: Result of questionnaire for plastic industry factor

From Figure 4.2, it is about 56% of BOI investment promote location and 44% of availability and capacity of utilities. It shows most business owners or someone related in positions are more consider in BOI investment promotion location at first cause they would like to gain about tax privileges (reduce about 20% for import raw materials). Second important factor is availability and capacity of utilities, (electricity supply, water supply and communication service) which helps them in production.

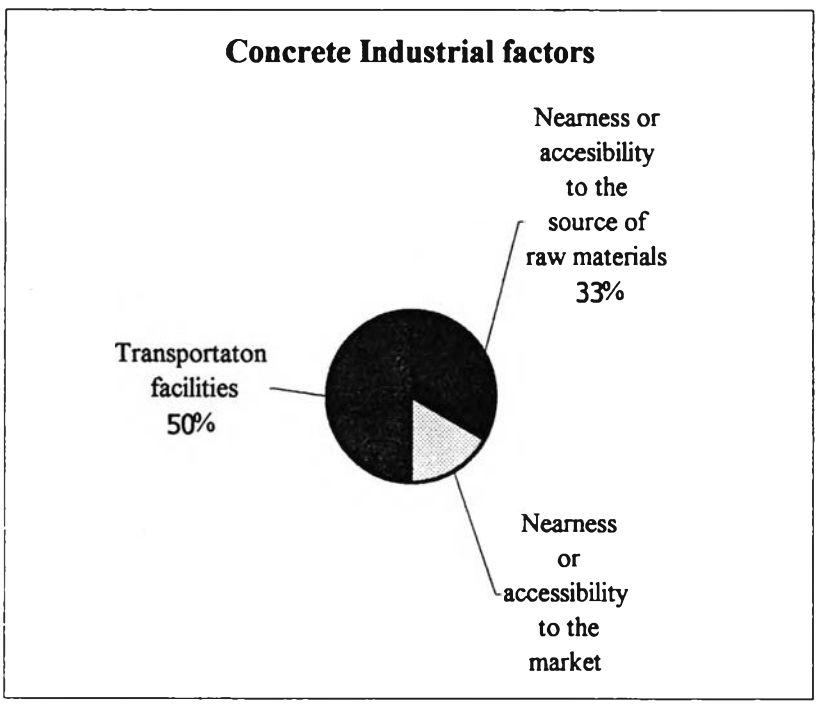

Figure 4.3: The result of questionnaire for concrete industry factor

From Figure 4.3, it is about 50% of transportation facilities, 33% of neamess or accessibility to the source of raw materials and 17% of neamess or accessibility to the market. It shows most of business owners and someone related in positions are more consider in transportation facilities at first because of this industry is heavy. Neamess or accessibility to the source of raw materials factor is second important factor for them in making plant location selection decision that helps to save cost and time in manufacturing operation. Neamess or accessibility to the market is third helps factory to

connect to customer quickly. Transportation is important for them to delivery goods to the customer and raw materials to factory. Most of transportation type in concrete industry is truck transportation.

In questionnaire result shows that there are different relative priorities of importance in each factor between plastic industry and concrete industry. Plastic industry consider in BOI promote location and utilities facilities to receive tax privileges (reduce about 20% for import raw materials) and facilities in electricity, water supply and communication to support them in manufacturing operation. For concrete industry consider in transportation facilities, nearness or accessibility to the source of raw materials and nearness or accessibility to the market. Because of concrete industry is heavy manufacturing. A transportation facility has more important for them to transport goods to customers and raw materials into factory.

4.2.3 The dialog management module

The dialog management module is user interface system. This system provide easily way to interact between user and the computer program. It consists of various texts, tabular, and graphical displays that help users to choose and make decision easily and attractively. There are command forms, pull down menus, icons, dialog boxes, graphical displays and any other functions on the display screen to individual users can choose.

We design and develop user interface systems base on important factors that influence in making plant location selection decision.

4.3 DESIGN AND DEVELOPMENT PROGRAM

In design and develop decision support system for plant locatoin selection, we used Microsoft Visual Studio version 6.0 (VB6) and Microsoft Access version 2000 developed the database system, design the user interface and form & module to allow users to access to the system and show the system result on the display.

4.3.1 Hardware and software requirement;

Table 4.11: Hardware and software requirement.

Hardware and software requirement	Description
CPU	Pentium 166 MHz up
Hard disk	provide hard disk space more than 1.2 GB
RAM	32 Megabyte up
Operation system	Windows 95, Windows 98, Window Me, Windows NI 4.0 Workstation, Windows 2000, and Window XP
Database system	Microsoft Access 2000
Monitor	-
Keyboard	-
Mouse	-

4.3.2. Program Flow Diagram

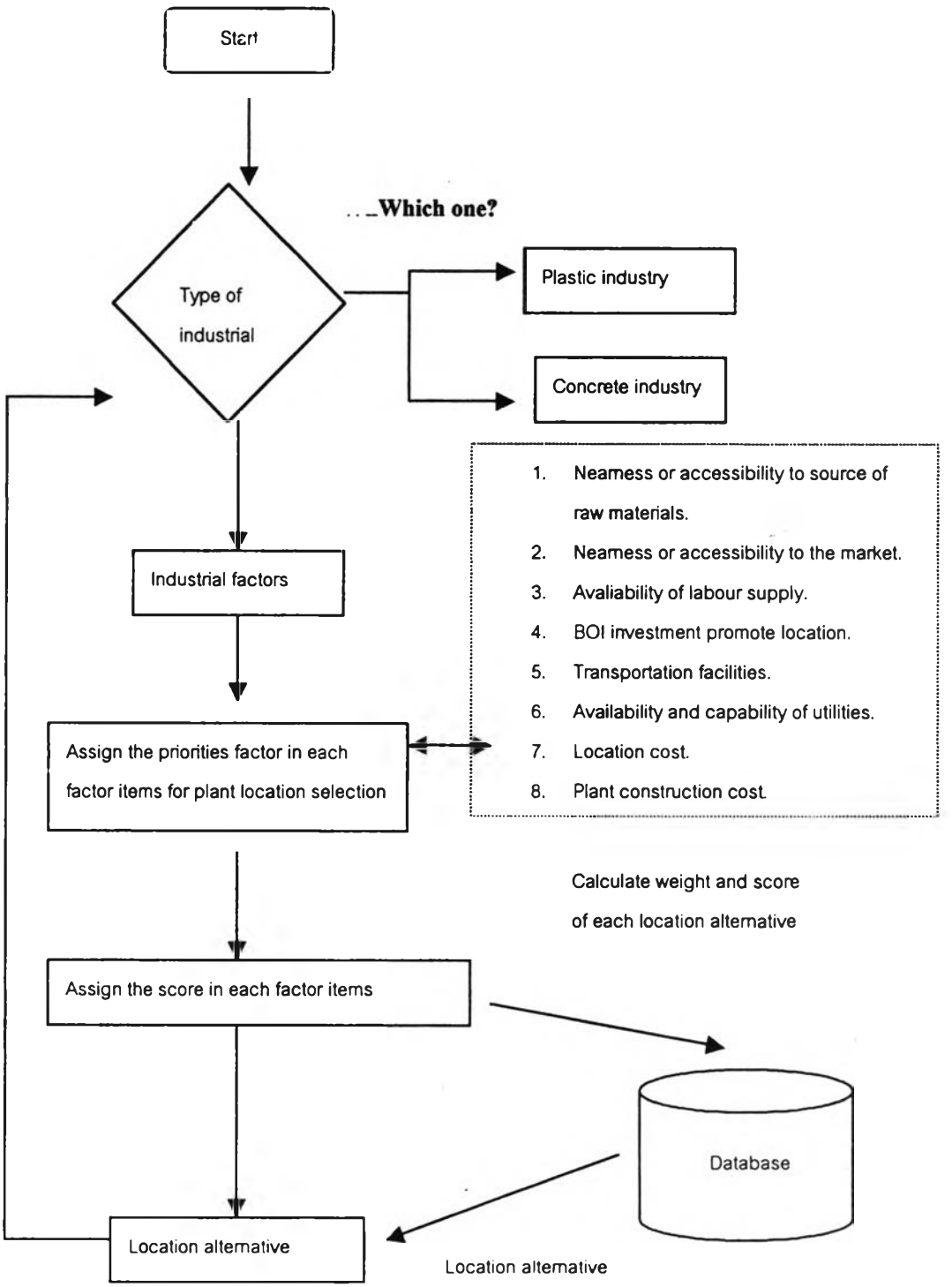

Figure 4.4: Flow chart of the decision support system for plant location selection

4.3.3 Decision support system for plant location selection display

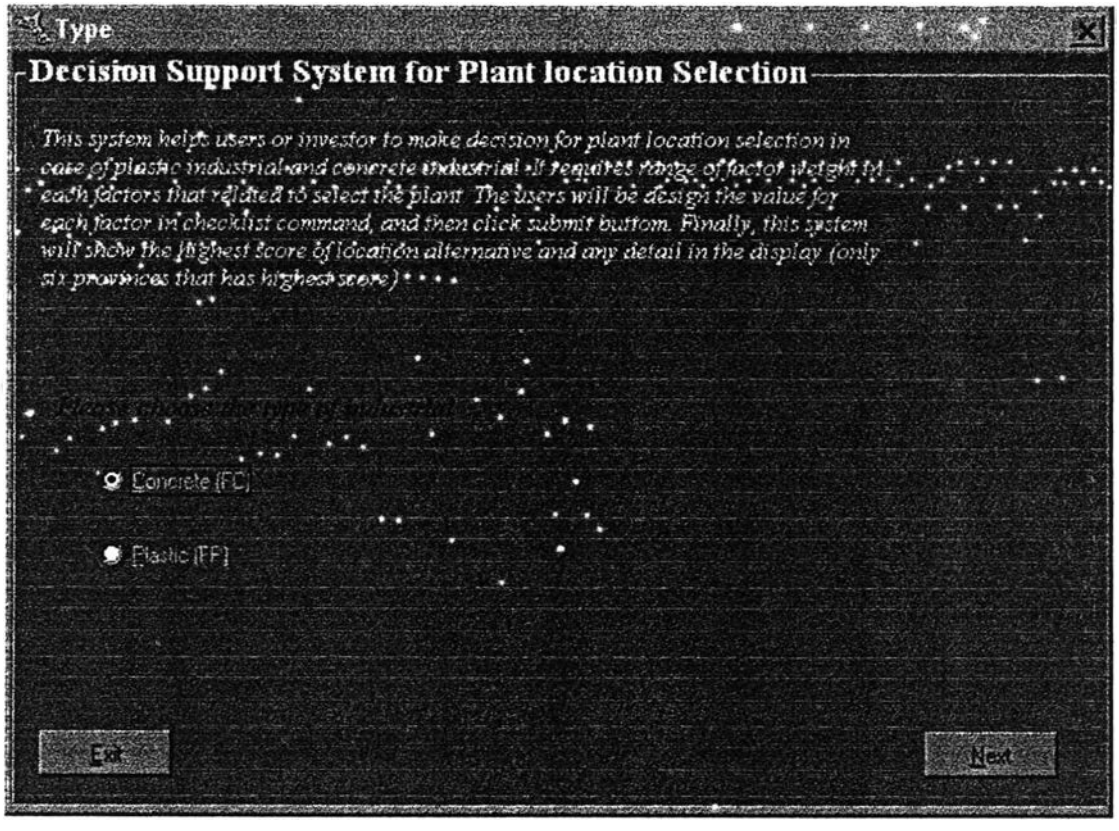

Figure 4.5: First display of the decision support system for plant location selection

First display, it is first display of the system. First step, users have to select the type of industry and then select the next button to go to the system..

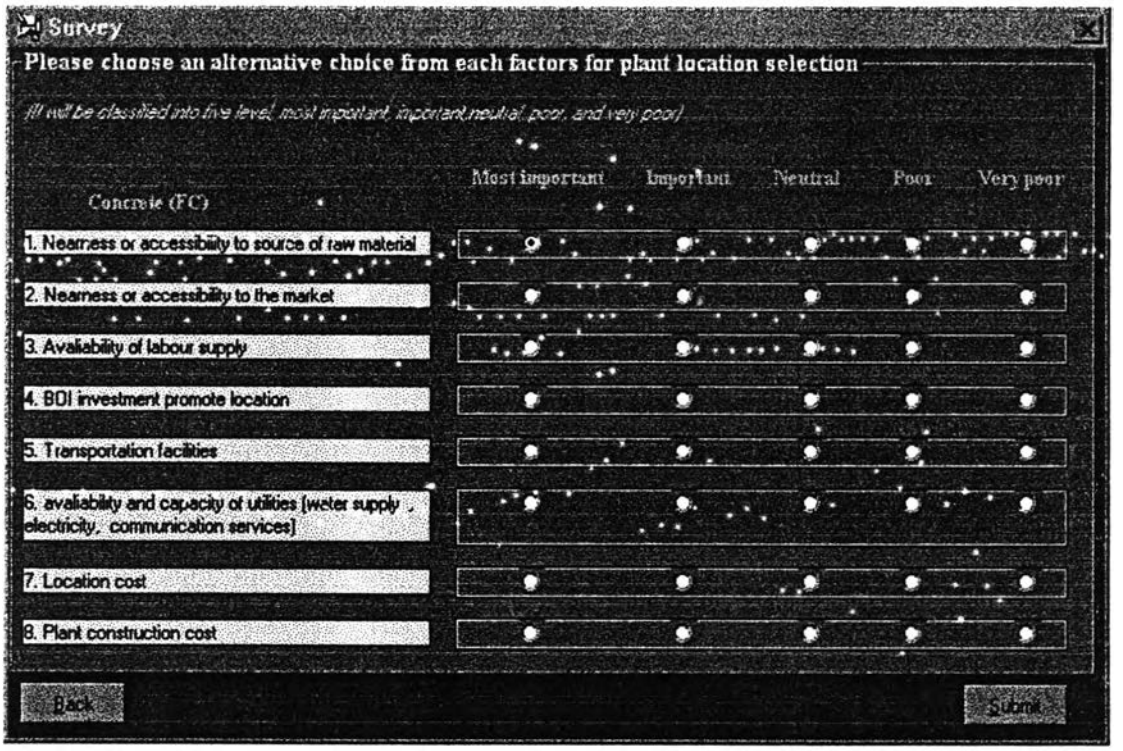

Figure 4.6: Second display of the decision support system for plant location selection

In second display, there are several factors of plant location selection checklists availability. Users have to assign the value into each factor item depend on each factor that more attractive for users selection and requirement in making plant location selection decision. The checklists is put a check mark at the right control box of each factor item in the list that it is major importance that need evaluate of decision support system for plant location selection both of plastic industry and concrete industry.

After users assign the value into each factor item finished then click submit button. The system will provide suitable location alternative result at the highest score compare with other.

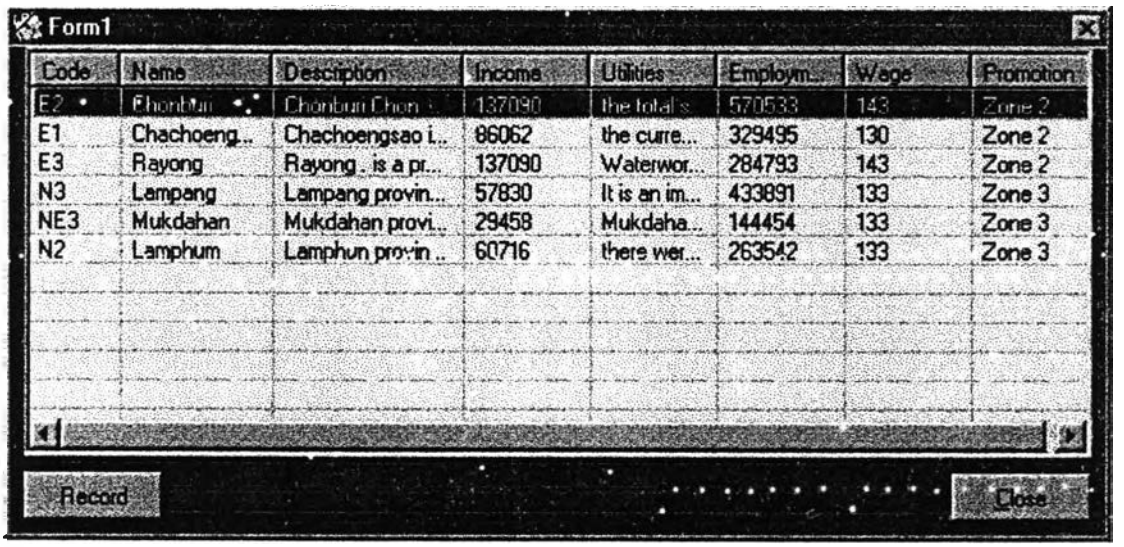

Figure 4.7: Output display of the decision support system for plant location selection

Output display, it shows location alternative result after users assign the relative priority of important factors influence for them in making plant location selection decision in each factor item. So, the system will multiple factor weight by the score of each factor, and sum the results for each location alternative into the database. Finally, it shows the plant location that has a highest score (only six provinces) compare to other location alternatives. Users can be able to see more detail in each province by select the detail button. (Show in Figure 4.8)

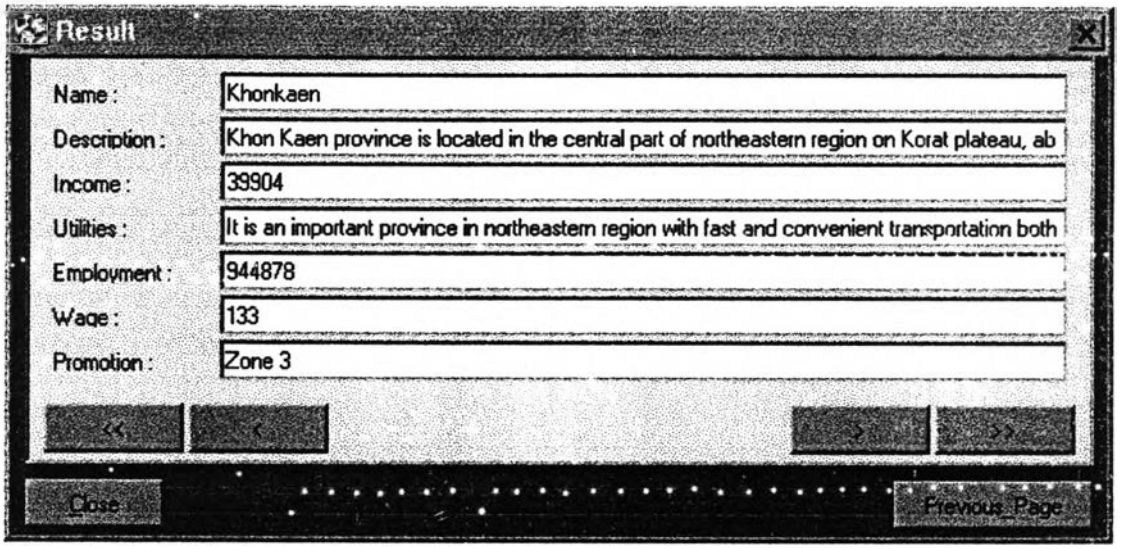

Figure 4.8: Detail display of each province

The detail display, it shows detail of each province, the province name, province description, income per head of this province, utilities of this province, the amount of employment, the minimum wage rate per day, and BOI investment promotion zone.

- Previous Page: allow user go to the previous page show as the Figure 4.7
- Close: allow users go to the first page of this program that show as the Figure 4.5.
- >: Show the next province information page
- <: Show the previous province information page
- >>: Show the last province information alternatives result page
- <<: Show the first province information alternative result page

If users select > button it shows the next province information page show in Figure 4.9.

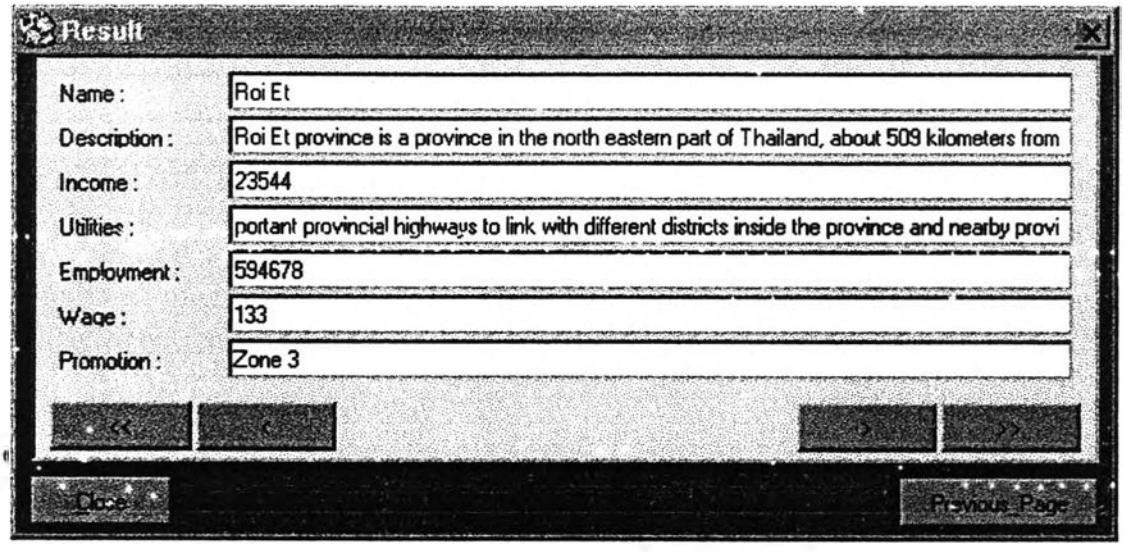

Figure 4.9: Detail of Roi Et province after using selecting > button.

The detail display consists of province name, province description, income per head, utilities facilities, the amount of employment, the minimum wage rate per day, and BOI investment promotion zone of Roi Et province.

4.3.4 Case study

To contribute the system that we purpose, we have created decision support system (DSS) to show how the system assists the investor when they need some advise for new plant location according to their requirement. We invite a director for the industrial to test the program and prove our system. This company has established since May 1996 at Chachoengsao province that produce the prestreeed concrete (PC concrete)

Step1: To select the type of industry

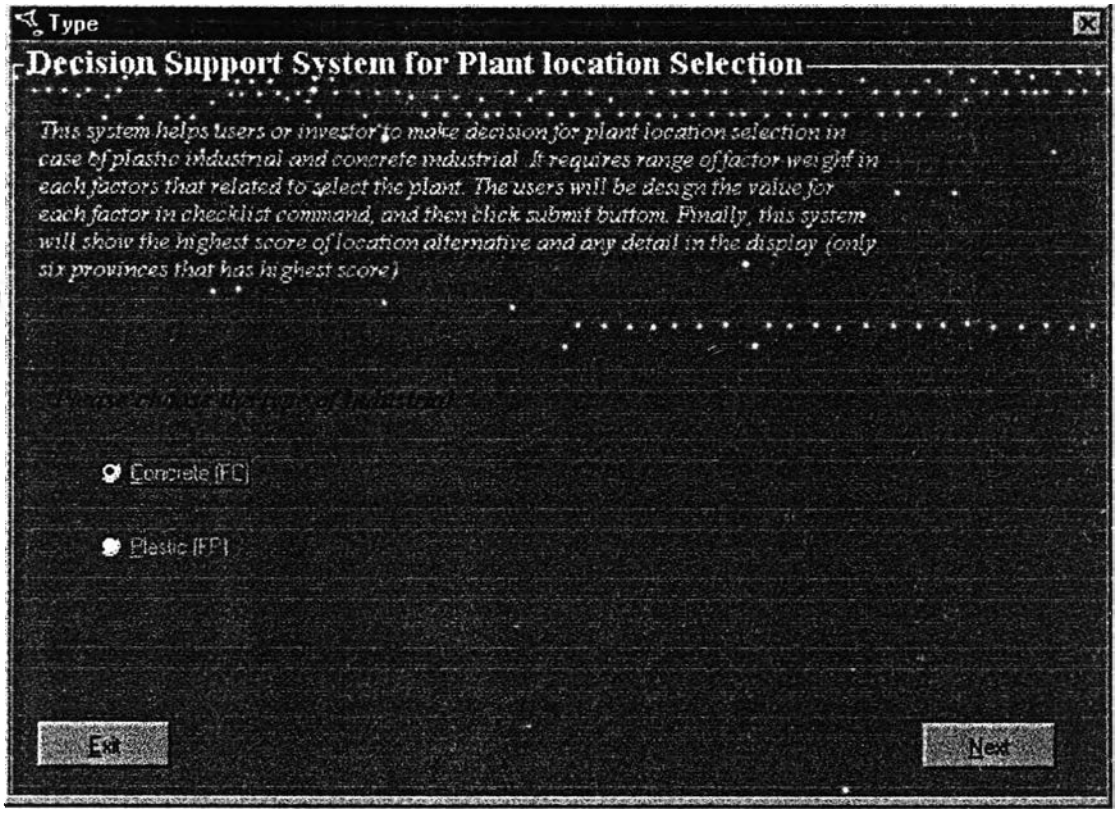

Figure 4.10: The picture after select the type of industrial

In step 1, users have to select the type of industry because of each type has different factors and weight score in making plant location selection decision. He selects the concrete industry (FC) show Figure 4.10.

Step 2: To assign the value into each factor item depend on each factor that more attractive for users requirement.

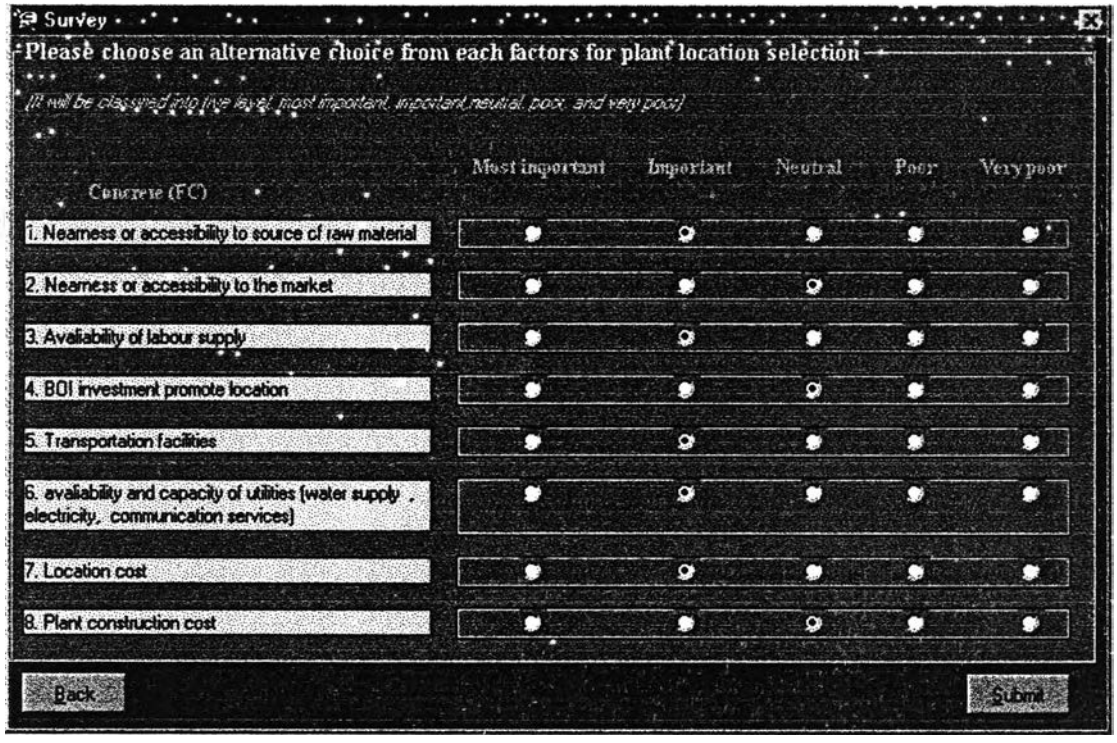

Figure 4.11: The picture after he assigned the value into each factor items.

There are several factors of plant location selection checklists available from various sources. The factors are more important for investors or users in making plant location selection decision.

He has to assign the value into each factor item and then select the submit button to see the province alternative result. He assigns in ordering as neamess or accessibility to the raw materials is important factor, neamess or accessibilities to the market is neutral, availability of labour supply is important, BOI investment promote location is neutral, transportation facilities is important, avaliability and capacity of utilities is important, location cost is important and plant construction cost is neutral show in Figure 4.11.

And then he click submit to see the location alternative result, at the highest score compare with other location alternatives in the database that show in Figure 4.12.

Step 3: To show provinces alternative result (six provinces)

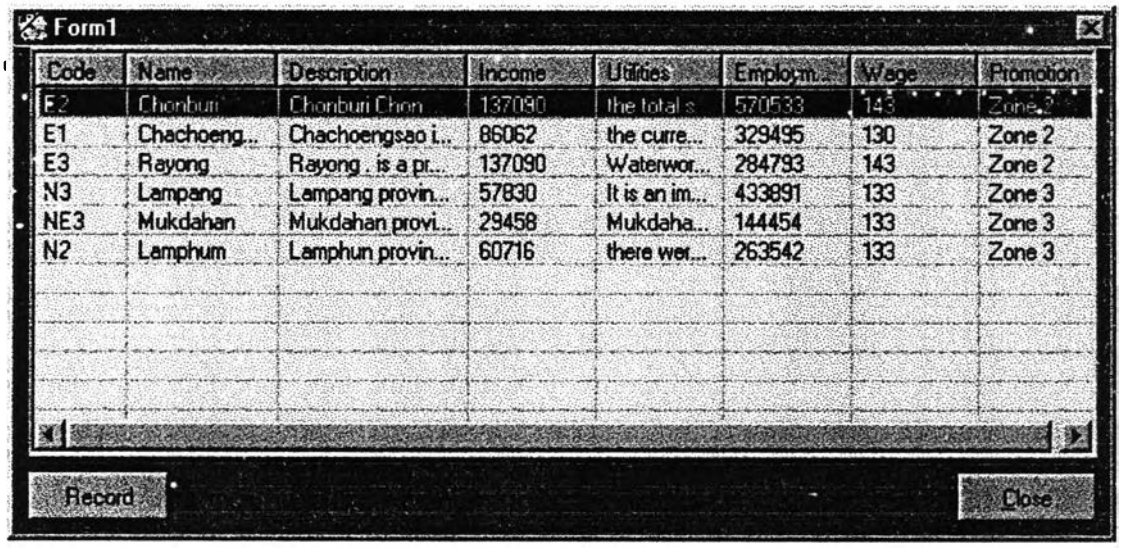

Figure 4.12 : Result of case study

Figure 4.12 shows the province alternative results after he assigned the score relative priority of each factor item in making plant location selection decision. This display shows six alternative provinces that have highest score compare other province alternatives into the database.

Chonburi province as first, Chachoengsao province as second, Rayong province as third, Lampang province as forth, Mukdahan province as fifth and Lamphum province as last location alternatives.

Users select the detail button that system will provide each province detail that show in Figure 4.13.

Step 2: To assign the value into each factor item depend on each factor that more attractive for users requirement.

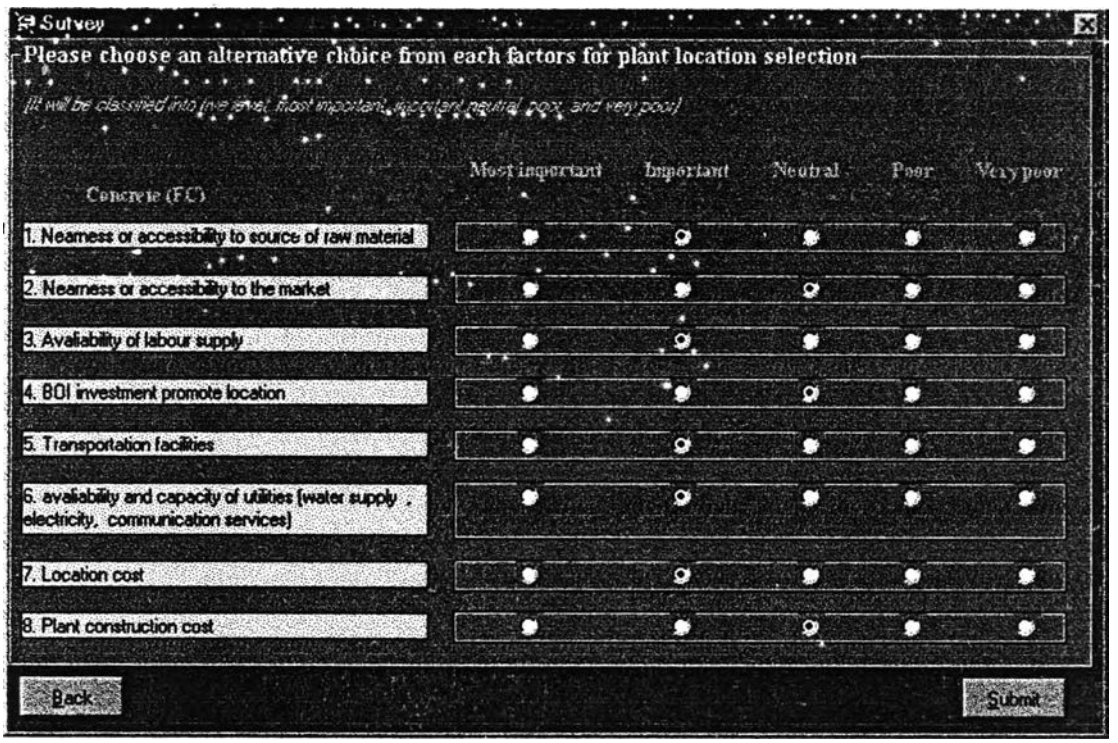

Figure 4.11: The picture after he assigned the value into each factor items.

There are several factors of plant location selection checklists available from various sources. The factors are more important for investors or users in making plant location selection decision.

He has to assign the value into each factor item and then select the submit button to see the province alternative result. He assigns in ordering as neamess or accessibility to the raw materials is important factor, neamess or accessibilities to the market is neutral, availability of labour supply is important, BOI investment promote location is neutral, transportation facilities is important, availability and capacity of utilities is important, location cost is important and plant construction cost is neutral show in Figure 4.11.

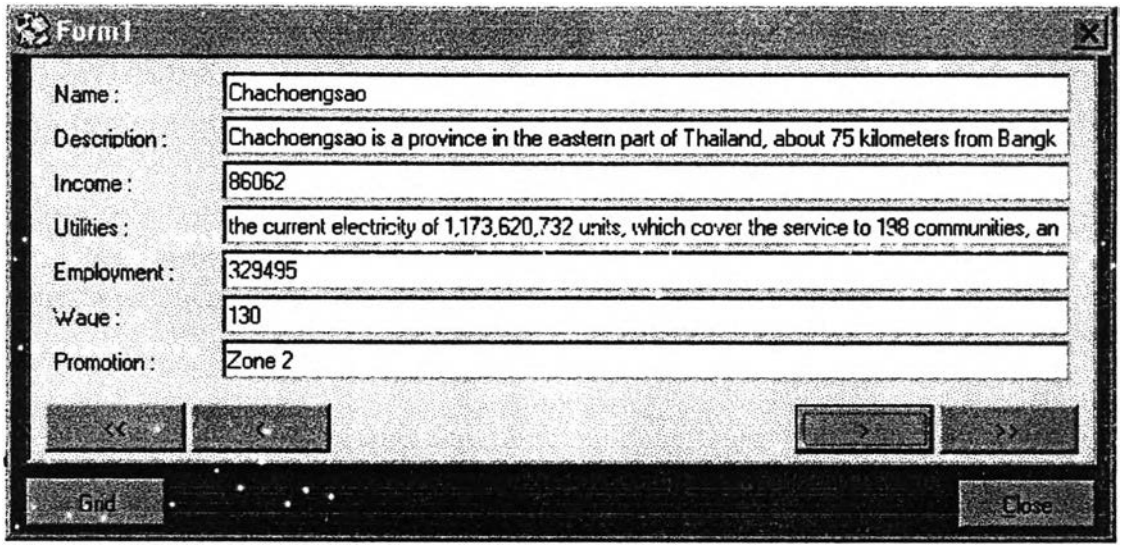

Figure 4.14 : Detail of Chachoengsao province

Chachoengsao province is second province alternative result for him to establish plant location. According to questionnaire result, most customer of concrete industrial is located at Chonburi and Rayong and sources of raw materials of concrete industrial are located at Rayong, Saraburi, Chachoengsao, Kranjanaburi and Phetburi. Chachoengsao is located nearness to Chonburi and Rayong, so it helps his factory to save cost and reduce time to transportation raw materials to factory and provide goods to the customer. Chachoengsao has low salary wages about 130 and number of employees about 329,495 persons. It has power to produce the current electricity of 1,173,620,732 units, which cover the service to 198 communities, and 1,630 villages. Chachoengsao located at zone 2 that provides of 50 percent reduction of import duty on machinery that is subject to import duty of not less than 10 percent, corporate income tax exemption for 3 years, increased to 5 years for projects located within industrial estates or promoted industrial zones, provided that such a project with capital investment of 10 million Baht or more (excluding cost of land and working capital obtains ISO 9000 or similar international standard certification within 2 years from its start-up date, otherwise the corporate income tax exemption will be reduced by 1 year.

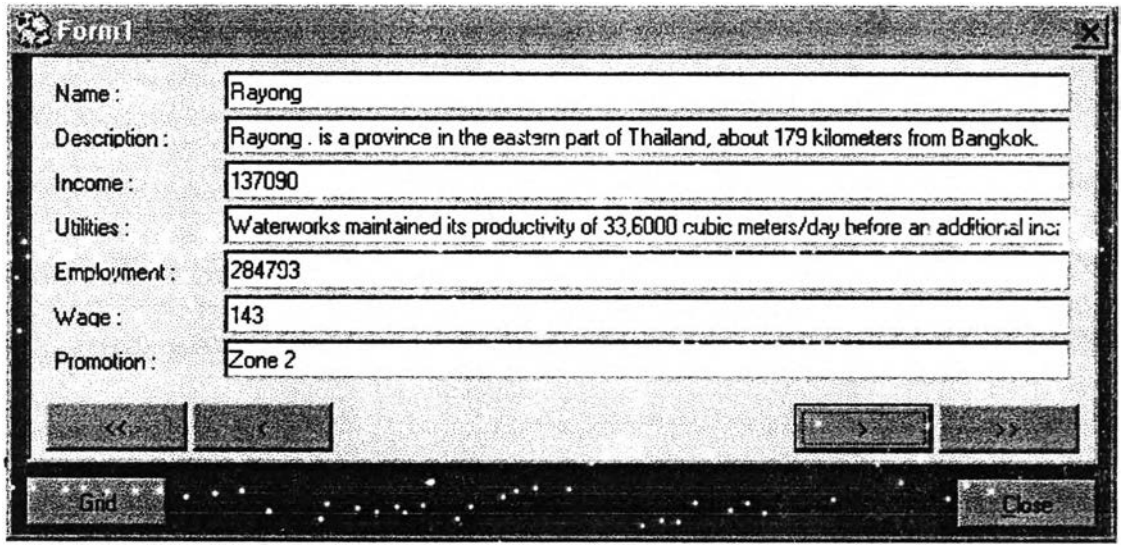

Figure 4.15 : Detail of Rayong province

Rayong province is third province alternative result for him to establish plant location. The market location and source of raw materials location located at Rayong.

The salary wage is about 143 expensive than chachoengsao province and the number of employees is about 284,793 persons.

Rayong is located at Zone 2. It generates electricity of 1,200 megawatts/hours and water of 33,6000 cubic meters/day before an additional increase of 12,000 cubic meters/day to the total productivity in 1999 of 45,600 cubic meters/day, with real productivity of 38,4000 cubic meters/day.

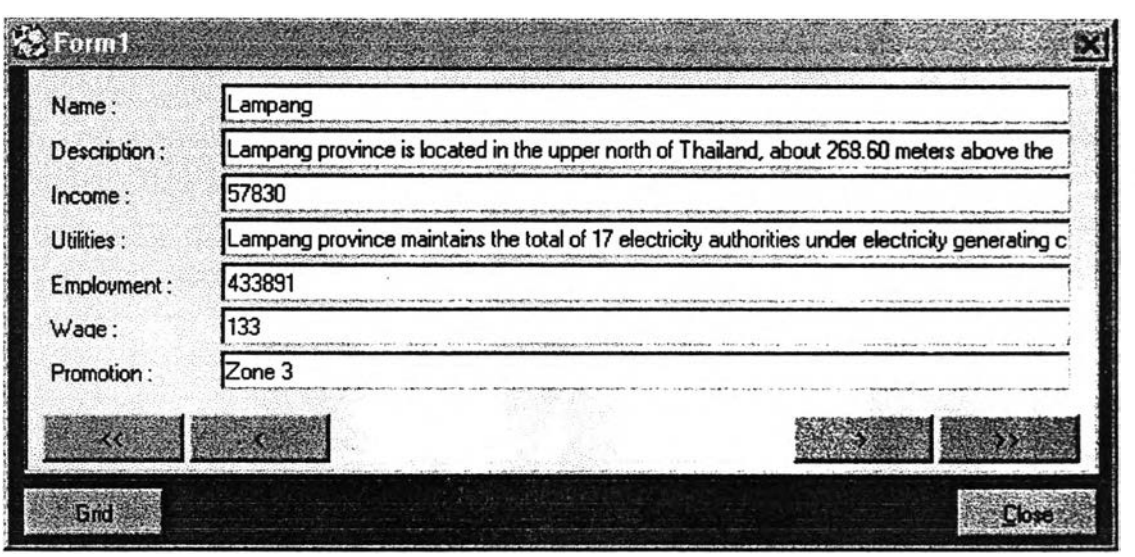

Figure 4.16 : Detail of Lampang province

Lampang province is forth province alternative result for him to establish plant location. It is not good for him in term of neamess or accessibility to the source of raw materials and market locaton. However, Lampang is low salary wage about 133 Baht per day compare to other location alternatives and number of employees is about 433,891 persons. It maintains the total of 17 electricity authorities under electricity generating capacity of 491,773,335 million units for overall users of 201,360 persons in 9 villages. The production capacity was 13,913,040 cubic meters for the total 31,944 users, with overall tap water supply of 7,176,452 cubic meters. Lampang located at zone 3 help his factory to gain the tax privilege, 50 percent reduction of corporate income tax for 5 years after the exemption period, Double deduction from taxable income of transportation, electricity and water costs for 10 years from the date of first revenue derived from promoted activity and For a project located outside industrial estates or promoted industrial zones, a deduction can be made from net profit of 25 percent of the project's infrastructure installation or construction cost for 10 years from the date of first sales, and net profit for one or more years of any year can be chosen for such deduction. The deduction is additional to normal depreciation.

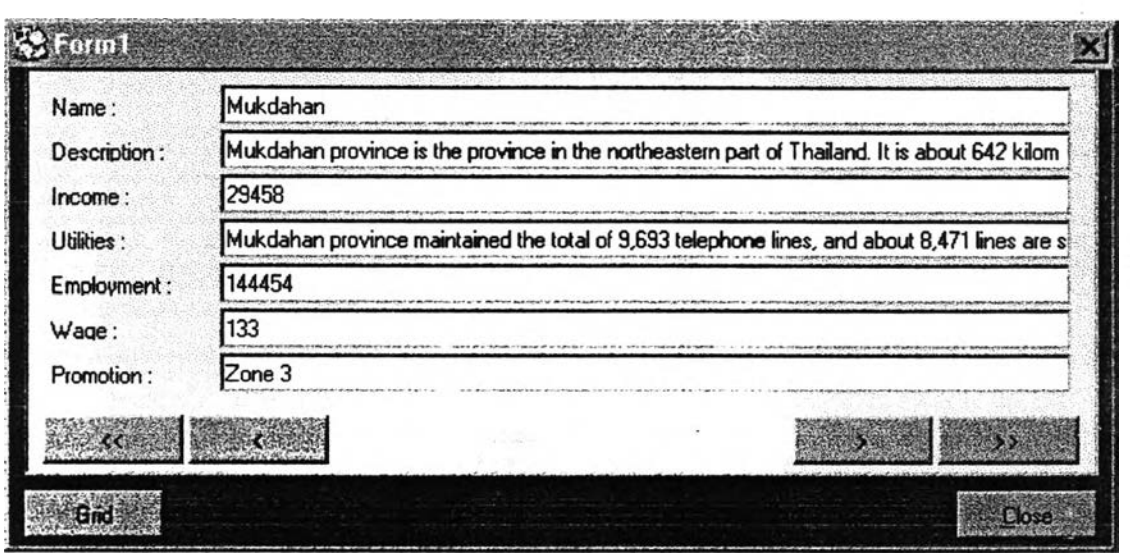

Figure 4.17 : Detail of Mukdahan province

Mukdahan province is fifth province alternative result for him to establish plant location. It is not good for his factory about source of raw materials factor and market locaton factor. Because of Mukdahan located far away from source of raw materials location and market location.However, Mukdahan is low salary wage about 133 Baht per day compare to other location alternatives. It has a small number of employees about 144,454 persons. Mukhahan located at zone 3. Iis province maintained the overall electricity supply of 80,678,170.58 kilowatt/hour for the total of 56,600 users and the overall water production of 2,428,146 cubic meters for the total of 8,318 users.

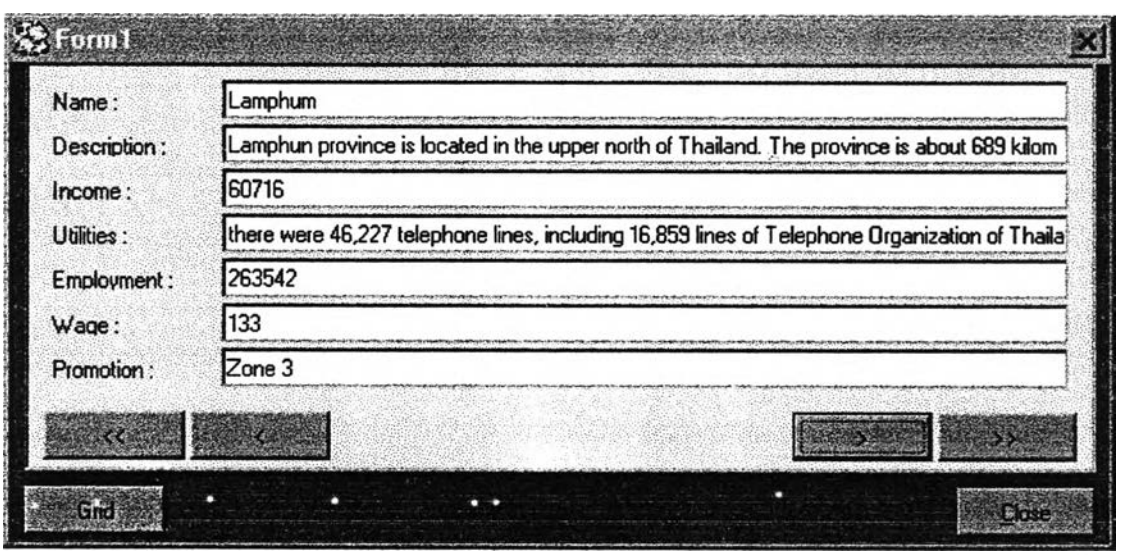

Figure 4.18 : Detail of Lamphum province

Lamphum province is last province alternative result for him. It is not good for his factory about source of raw materials factor and market location factor. Because of Lamphum located far away from source of raw materials location and market location. However, Lamphum is low salary wage about 133 Baht per day compare to other location alternatives and number of employees about 263,542 persons. Mukhahan located at zone 3. It provides the total electricity generating of 474.60 million units for 117,971 households from the total of 125,990 households or about 93.63%. There are the totals of 7,332 users with the productivity of 2,021,295 cubic meters/hour for the water supply of 1,626,983 cubic meters/hour.

In case study, it found that the result of this system matches most users requirements. According to he's requirement in each factor item, important in nearness or accessibility to the raw materials, neutral in nearness or accessibilities to the market, important in availability of labour supply, important in BOI investment promote location, important in avaliability and capacity of utilities, important in location cost and neutral in plant construction cost show in Figure 4.11. It shows that Chonburi province as first, Chachoengsao province as second, Rayong province as third, Lampang province as forth, Mukdahan province as fifth and Lamphum province as the last province alternative. Chonburi is suitable location alternative compare to other because of most customers and market location of concrete industrial located nearness or located at this province. However, salary wage is expensive but there are high amount of employees number in this province.

It provides a good service of utility factilities. It located at zone 2 that help his factory to gain benefit of tax privileges.

After, he knows information related in making plant location decision in each location alternative result. Chachoengsao is second location alternative province that suitable for him for plant location decision. In concrete industrial, the source of raw materials located at this province that meet his requirement, and its province also located near market location. However, this province is not good about raw materials location compare to Chonburi province. But its salary wage is lower. The result of this system has match in the real case (this company established in Chachoengsao province). It also provides related information and select the suitable location alternative that user requirement depend on each factor that more attractive for users selection and requirement as a final result.