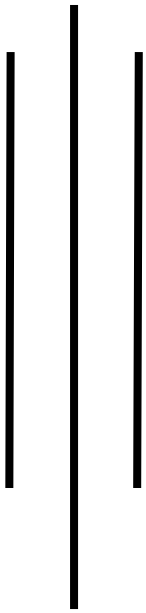
School of Engineering & Technology

Asian Institute of Technology

AT82.04 - Business Intelligence Analysis



Date: 31/03/2023

Assigment Report: 2

Submitted To
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1. Introduction

Multi-Criteria Decision Making (MCDM) is a powerful analytical technique that enables decision-makers to evaluate and prioritize alternatives based on multiple criteria. However, selecting the right MCDM technique is crucial for obtaining good and appropriate results. In the context of location selection for a new convenience store, the Analytic Hierarchy Process (AHP) is a widely used MCDM technique that can be selected for its ability to handle complex decision problems and its flexibility in accommodating different types of criteria.

The AHP methodology can be used to support decision-making for selecting the best location for a new convenience store by breaking down the decision problem into a hierarchy of criteria and sub-criteria. The hierarchy structure allows decision-makers to decompose a complex decision problem into smaller and more manageable parts. The criteria and sub-criteria can then be evaluated through pairwise comparisons based on their relative importance. The resulting weights are used to calculate the overall score for each alternative and rank them according to their suitability for the convenience store.

For example, in selecting the best location for a new convenience store, some of the key criteria that can be considered include accessibility, competition, foot traffic, and rental cost. The sub-criteria for accessibility could include factors such as proximity to public transport, road connectivity, and parking availability. Similarly, the sub-criteria for competition could include the number and proximity of competing stores. By using AHP, decision-makers can assign weights to each criterion and sub-criterion based on their relative importance and calculate the overall score for each location.

Moreover, AHP can also help decision-makers to handle uncertainty and ambiguity in the decision-making process. For instance, in the case of selecting a location for a new convenience store, some criteria may be difficult to quantify or measure objectively, such as the quality of the neighborhood or the level of local support for the store. AHP can help to address such uncertainties by allowing decision-makers to incorporate qualitative factors into the decision-making process.

Because AHP is a powerful MCDM technique that can be selected to support decision-making for selecting the best location for a new convenience store. By breaking down the decision problem into a hierarchy of criteria and sub-criteria and assigning weights based on their relative importance, AHP can provide an objective and transparent decision-making process that considers a range of factors that are important for the success of the convenience store. In this report, we aim to apply the Analytic Hierarchy Process (AHP), a widely used MCDM technique, to support decision-making for selecting the best location for a new convenience store in Ho Chi Minh City,

Vietnam. We will focus on four selected districts in the city, including District 1, District 3, District 4, and District 7, and evaluate them based on a set of criteria and sub-criteria using the AHP approach. The result of this analysis can help decision-makers to make an informed and objective decision on the best location for the convenience store.

2. Objective

This report is aimed to apply Multi Criteria Decision Making (MCDM) Methodology in making decision on selecting the best location for a new convenience store by using analytical hierarchy process (AHP) approach. The specific objective including:

- Generating the creativity essential possible criteria
- Analyzing possible criteria for selecting the best location for a new convenience store.
- Evaluating the system through sensitivity analysis.

3. Methodology

3.1. Case description

Table 1 presents the population, population density, and income per capita of four districts in Ho Chi Minh City, Vietnam, as well as the total figures for the city. The selected districts are District 1, District 3, District 4, and District 7, which are some of the most prominent and populous districts in the city.

The table includes four columns: District, Population, Density (per km^2), and Income (per capita). The district column lists the names of the four districts as well as the total figure for Ho Chi Minh City. The Population column shows the estimated population of each district as well as the total population of the city. District 7 has the highest population with 340,967 residents, while District 1 has the lowest with 204,899 residents. The total population of Ho Chi Minh City in 2022 was estimated to be 9,363,588.

Table 1. Total population, population density, and income per capita for Ho Chi Minh City as well as the selected districts

District	Population	Density (per km^2)	Income (per capital)
1	204,899	25,967	$11,105
3	199,920	42,932	$10,312
4	207,453	45,091	$9,642
7	207,453	8,756	$12,998
Ho Chi Minh City	9,363,588	4,597	$6,581

The Density (per km^2) column indicates the population density of each district, measured in people per square kilometer. District 4 has the highest population density

with 45,091 people per square kilometer, while District 7 has the lowest with 8,756 people per square kilometer. The total population density of Ho Chi Minh City in 2022 was estimated to be 4,597 people per square kilometer.

The Income (per capita) column displays the average income per person in each district, measured in Dollar (USD) per year. District 7 has the highest income per capita with 12,998 USD, while District 4 has the lowest with 9,642 USD. The average income per capita for Ho Chi Minh City in 2022 was estimated to be 6,581 USD.

This table provides valuable information about the demographic and economic characteristics of some of the most populous districts in Ho Chi Minh City, as well as the overall situation in the city. The data suggests that District 7 has a relatively low population density but a high income per capita, while District 4 has a high population density but a low income per capita. District 1 and District 3 are both relatively well-off in terms of income per capita but have different population densities. The total figures for Ho Chi Minh City provide a broader perspective on the city's population and economy, highlighting its large size and relatively low income per capita compared to the selected districts.

3.2. Methods

AHP is a decision-making tool that is used to handle complex and multi-criteria problems. It is widely applied in many fields, including engineering, business, and management. AHP allows decision-makers to identify and assess the relative importance of different criteria or factors that contribute to a decision. It helps to establish priorities amongst decision factors by breaking down complex problems into smaller components and analyzing them in a structured manner.

The AHP process involves six steps. The first step is to define the problem and criteria, including sub-criteria if applicable. This step requires a clear understanding of the decision context and the factors that need to be considered. The second step is to identify and define the alternatives that are available for the decision-maker.

Once the criteria and alternatives have been established, the third step is to establish priorities amongst the criteria and alternatives using pairwise comparison. Pairwise comparison involves comparing each criterion or alternative to every other criterion or alternative and assessing the relative importance of each pair. This step allows decision-makers to determine the relative importance of each factor in the decision-making process.

The fourth step is to check for consistency amongst the pairwise comparisons. Consistency ensures that the decision-maker's choices are rational and free from contradictions. The consistency ratio is calculated by comparing the largest eigenvalue

to the number of criteria or alternatives being compared. If the consistency ratio exceeds a certain threshold, the pairwise comparisons need to be revised.

The fifth step is to evaluate the relative weights from the pairwise comparisons and calculate the overall priorities for the alternatives. This step involves the use of mathematical models to derive the weights and priorities for the criteria and alternatives.

The final step is to perform sensitivity analysis to test the robustness of the decision-making process. Sensitivity analysis involves testing the impact of changes in the input data on the final decision. This step helps decision-makers to understand the implications of their choices and identify potential areas of uncertainty..

4. Results and findings

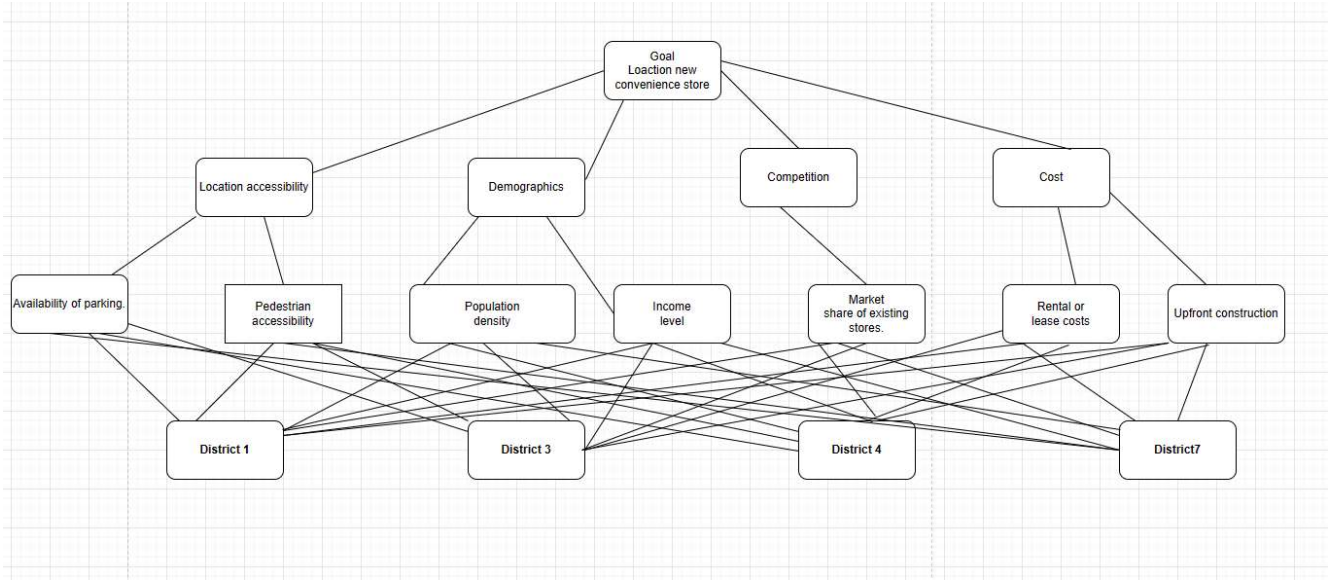
4.1. Criteria and sub-criteria for selecting the best location for a new convenience *store.*

I will choose scenario1: Selecting the best location for a new convenience store.

Criteria	Sub- Criteria
Location accessibility	1. Availability of parking. 2. Pedestrian accessibility.
Demographics	1. Population density. 2. Income level.
Competition	1. Market share of existing stores.
Cost	1. Rental or lease costs. 2. Upfront construction

- Building AHP Models in a Super Decisions Case Study

Choose the best location (District)



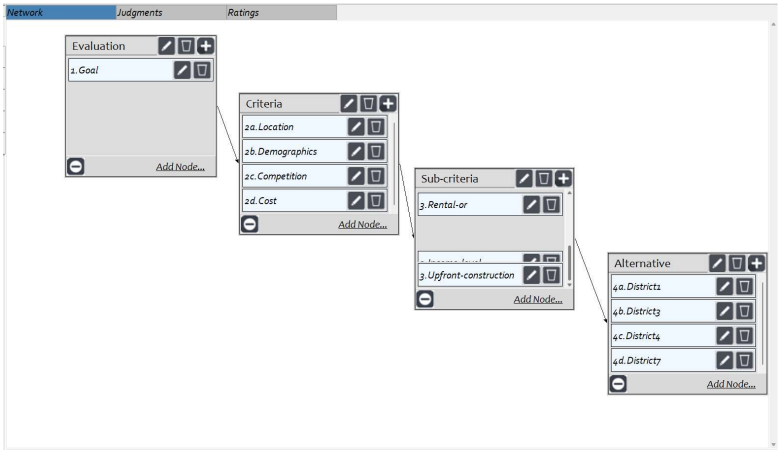
When we look at the picture above, we will see that the AHP decision-making process that the analyst is using aims to select the best location for a new convenience store. This process involves a hierarchical tree structure with four levels. The first level is the main goal of the analysis, which is to identify the most suitable location for the convenience store. The second level is composed of four main criteria: Location accessibility, Demographics, Competition, and Cost. These criteria are used to evaluate and compare different options for the convenience store location. The third level consists of sub-criteria that further break down each main criterion into more specific factors. For example, Location accessibility is broken down into two sub-criteria: Availability of parking and Pedestrian accessibility, while Demographics is divided into two sub-criteria: Population density and Income level. The Competition criterion is evaluated based on the Market share of existing stores, while Cost is evaluated based on two sub-criteria: Rental or lease costs and Upfront construction. The fourth level represents the options or alternatives that are being evaluated and compared. In this case, the options are four different districts: District 1, District 3, District 4, and District 7. All of the sub-criteria from the third level are connected to each district option, indicating that each sub-criterion needs to be evaluated for every option in order to select the best location for the new convenience store.

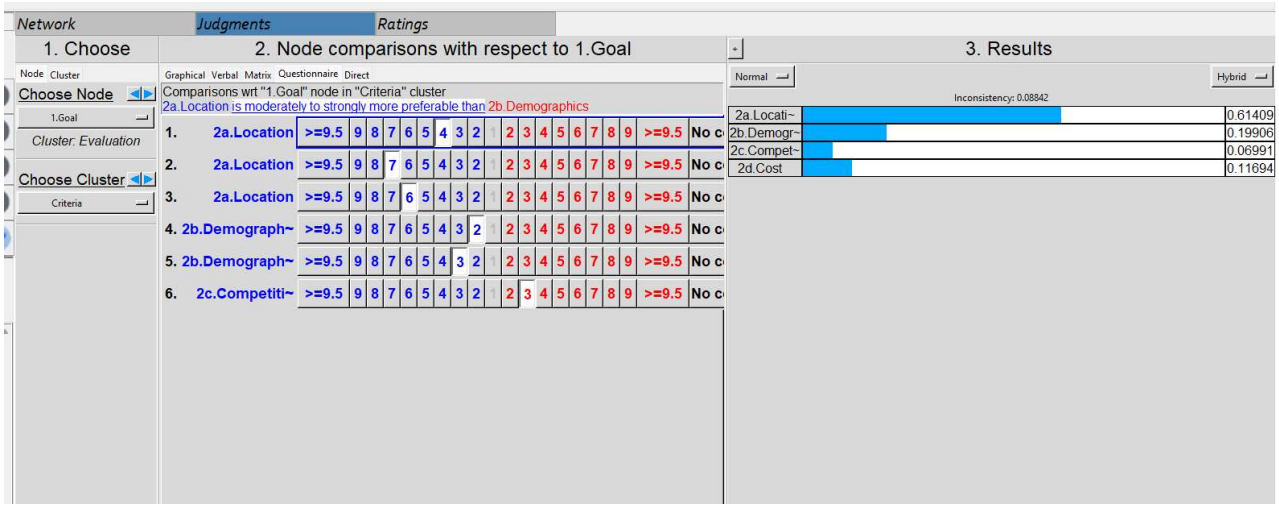
4.2. Results of AHP analysis

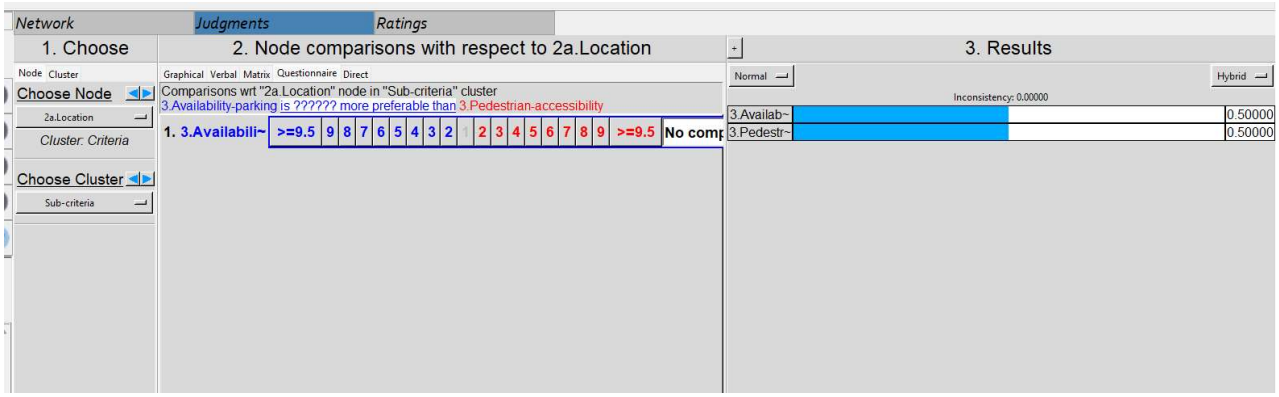
For my analysis of potential locations for a new convenience store in Ho Chi Minh City, I utilized the Analytic Hierarchy Process (AHP) model using the SuperDecisions software. SuperDecisions is a software program that enables users to apply the AHP model to complex decision-making problems, providing a user-friendly interface for creating and analyzing decision hierarchies. In my analysis, I used SuperDecisions to

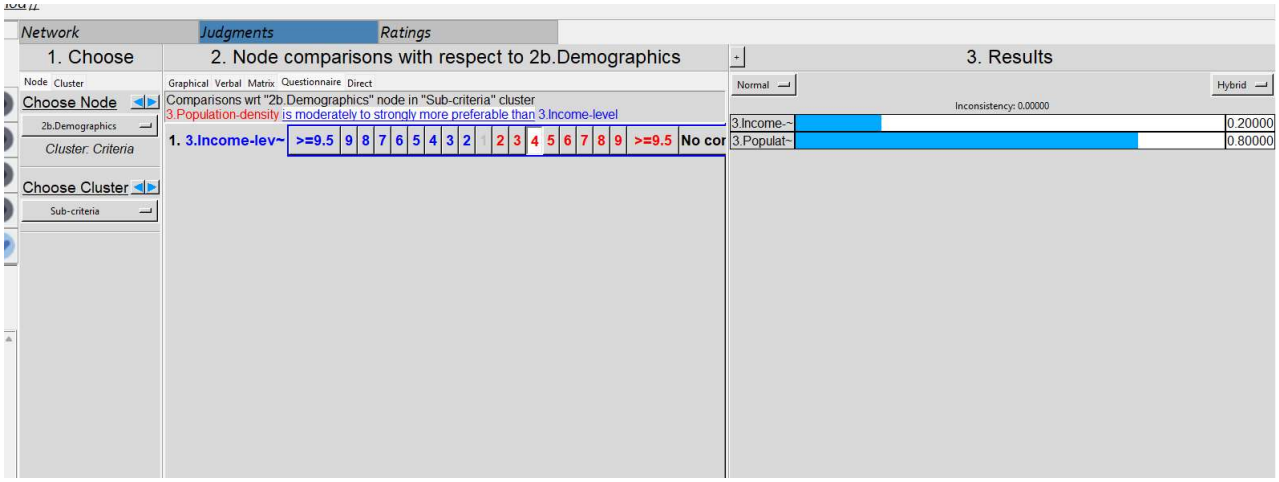
carefully evaluate each potential location based on the criteria evaluated and generate a prioritized list of the most suitable locations for opening a new convenience store in Ho Chi Minh City.

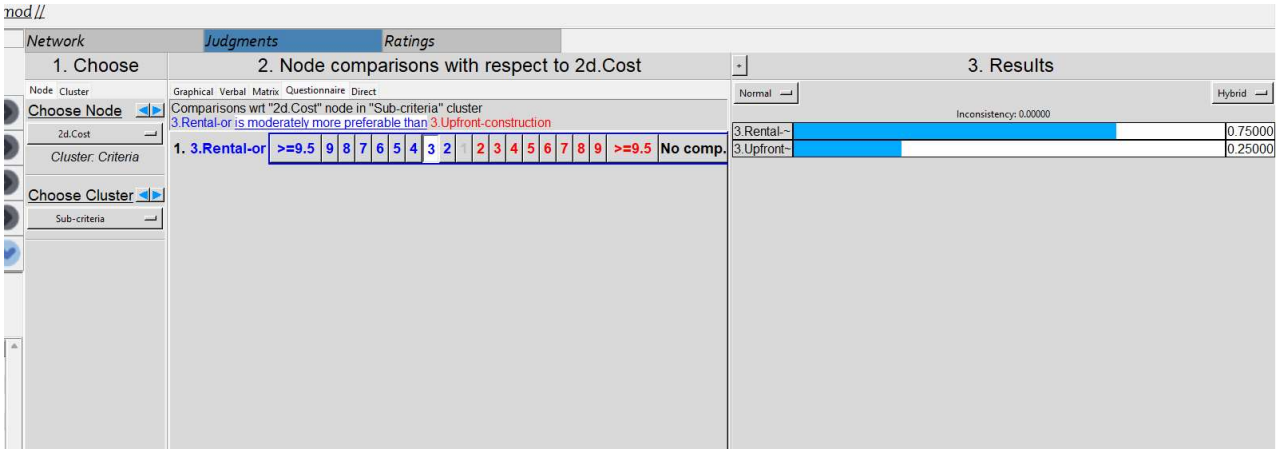
Here are the photos of the AHP model building and the results:

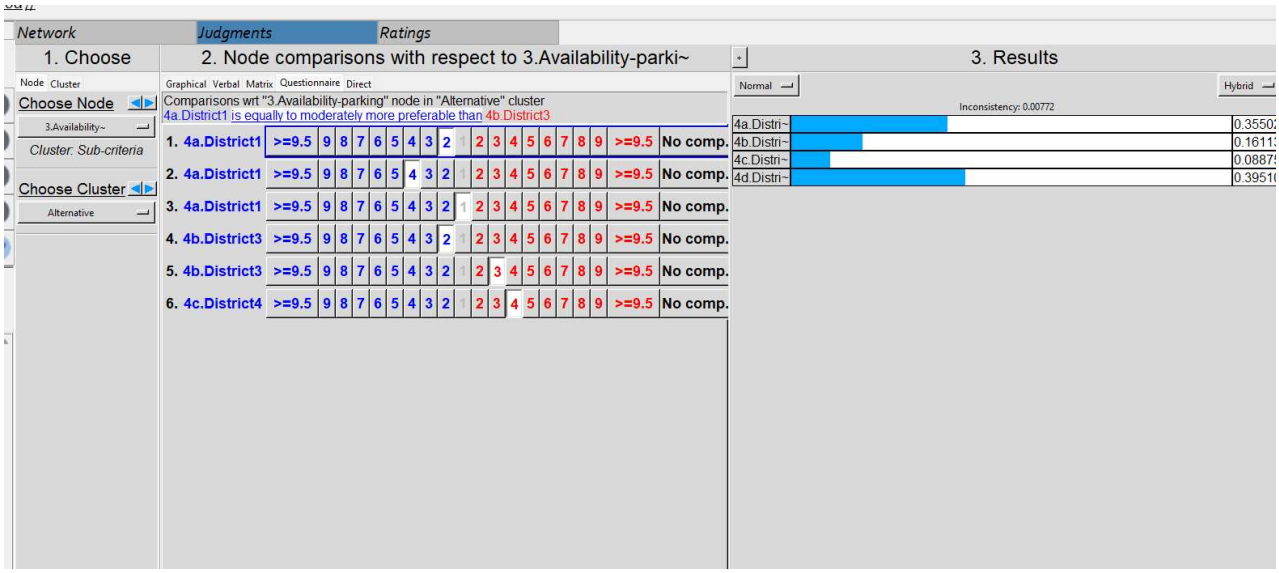


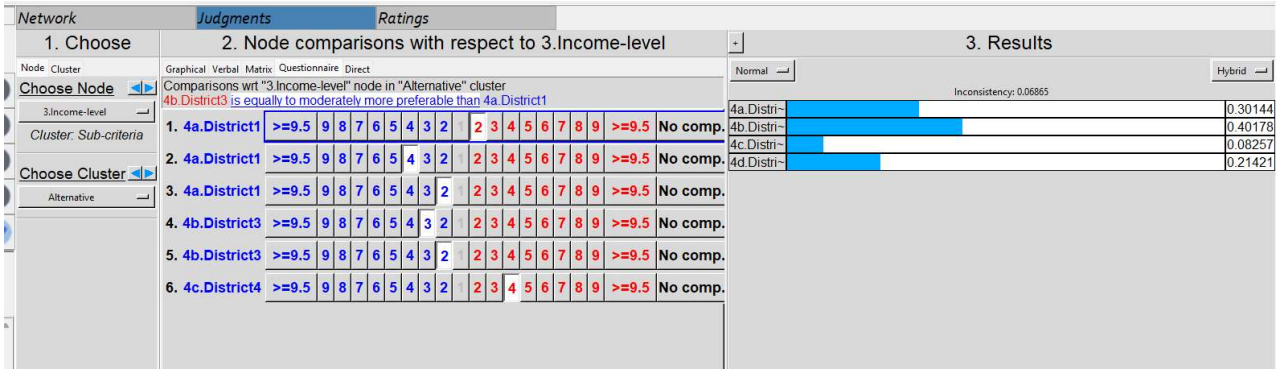


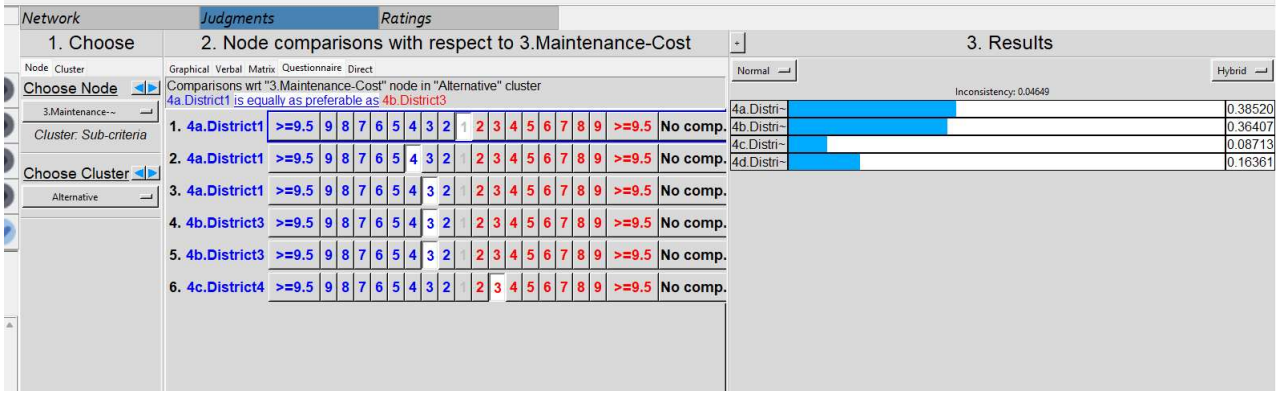

Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 2a.Location
3. Results
Node Cluster
Choose Node
2a.Location
Cluster: Criteria
Choose Cluster
Sub-criteria
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "2a.Location" node in "Sub-criteria" cluster
3.Availability-parking is ?????? more preferable than 3.Pedestrian-accessibility
1. 3.Availabili~
>=9.5 9 8 7 6 5 4 3 2 2 3 4 5 6 7 8 9 >=9.5
No comp
Normal
Hybrid
Inconsistency: 0.00000
3.Availab~ 0.50000
3.Pedestr~ 0.50000

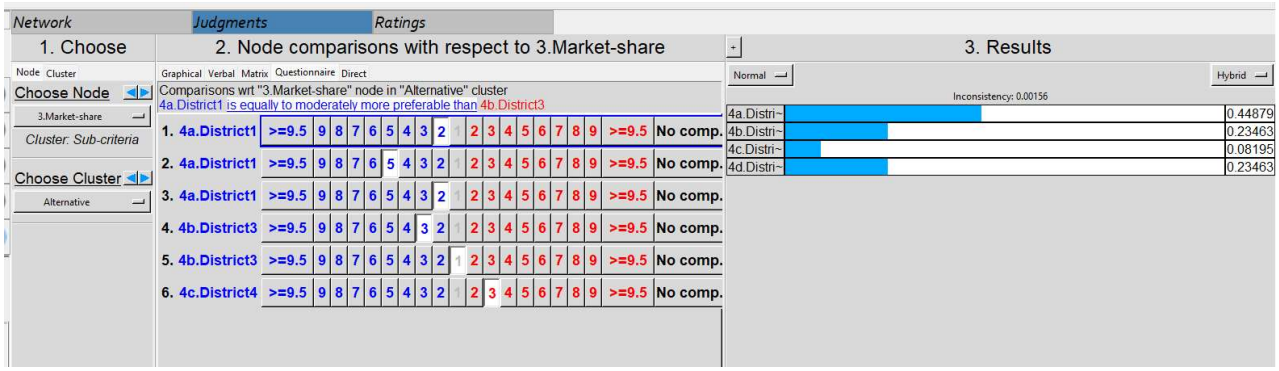

Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 2b.Demographics
3. Results
Node Cluster
Choose Node
2b.Demographics
Cluster: Criteria
Choose Cluster
Sub-criteria
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "2b.Demographics" node in "Sub-criteria" cluster
3.Population-density is moderately to strongly more preferable than 3.Income-level
1. 3.Income-lev~
>=9.5 9 8 7 6 5 4 3 2 2 3 4 5 6 7 8 9 >=9.5
No cor
Normal
Hybrid
Inconsistency: 0.00000
3.Income-~ 0.20000
3.Populat~ 0.80000

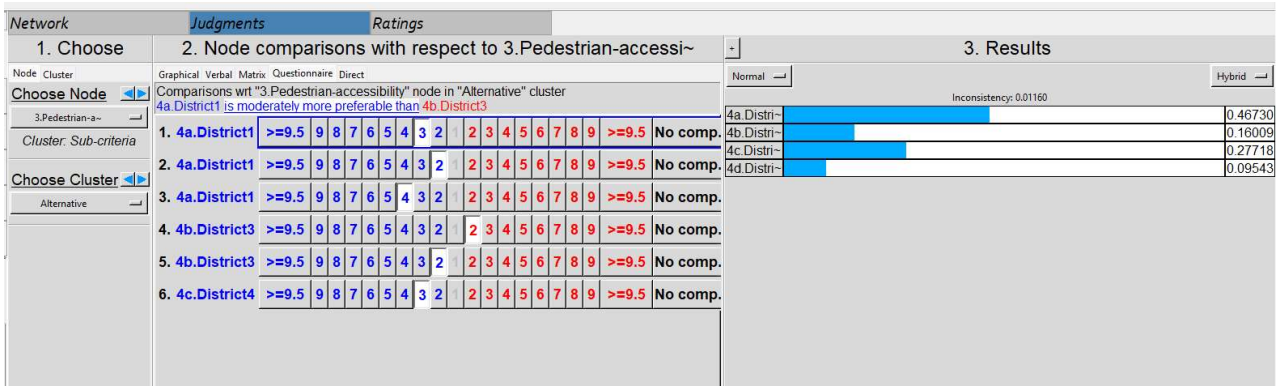

Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 2d.Cost
3. Results
Node Cluster
Choose Node
2d.Cost
Cluster: Criteria
Choose Cluster
Sub-criteria
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "2d.Cost" node in "Sub-criteria" cluster
3.Rental-or is moderately more preferable than 3.Upfront-construction
1. 3.Rental-or
>=9.5 9 8 7 6 5 4 3 2 2 3 4 5 6 7 8 9 >=9.5
No comp.
Normal
Hybrid
Inconsistency: 0.00000
3.Rental-~ 0.75000
3.Upfront~ 0.25000

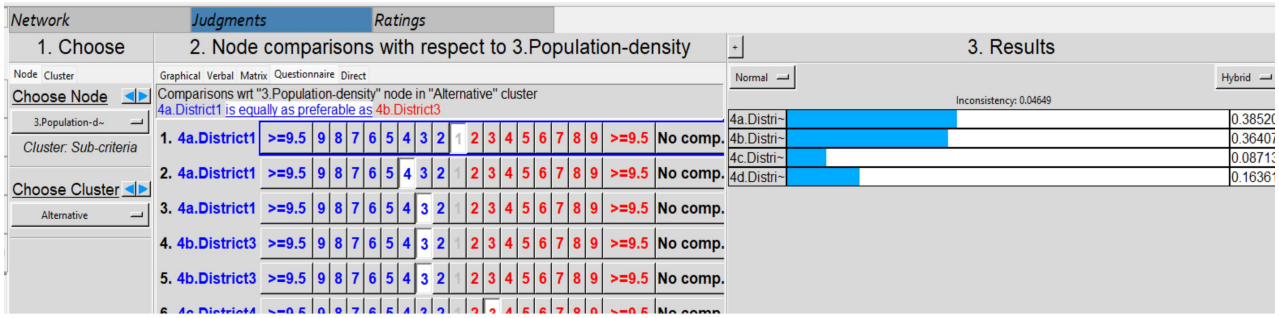

Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 3.Availability-parki~
3. Results
Node Cluster
Choose Node
3.Availability~
Cluster: Sub-criteria
Choose Cluster
Alternative
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "3.Availability-parking" node in "Alternative" cluster
4a.District1 is equally to moderately more preferable than 4b.District3
1. 4a.District1
2. 4a.District1
3. 4a.District1
4. 4b.District3
5. 4b.District3
6. 4c.District4
>=9.5 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 >=9.5
No comp.
Normal
Hybrid
Inconsistency: 0.00772
4a.Distri~
4b.Distri~
4c.Distri~
4d.Distri~
0.3550
0.1611
0.0887
0.3951

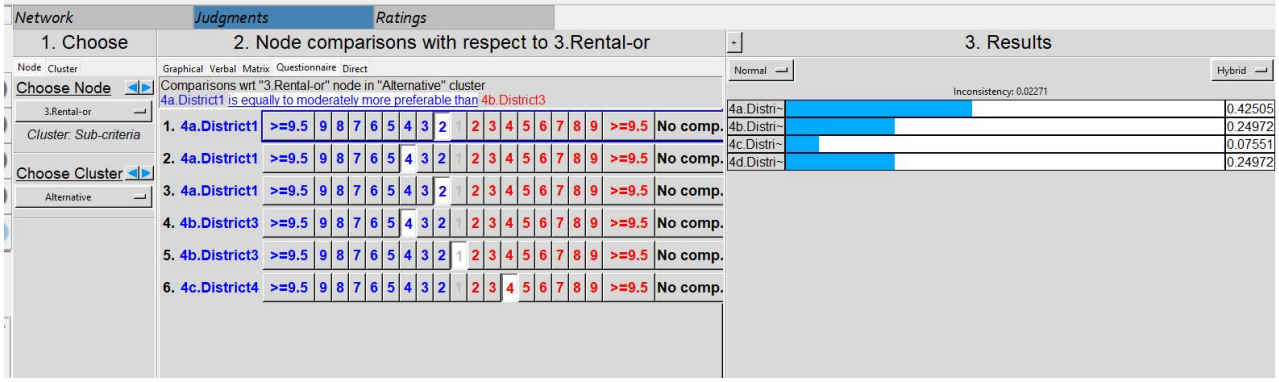

Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 3.Income-level
3. Results
Node Cluster
Choose Node
3.Income-level
Cluster: Sub-criteria
Choose Cluster
Alternative
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "3.Income-level" node in "Alternative" cluster
4b.District3 is equally to moderately more preferable than 4a.District1
1. 4a.District1
2. 4a.District1
3. 4a.District1
4. 4b.District3
5. 4b.District3
6. 4c.District4
>=9.5 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 >=9.5
No comp.
Normal
Hybrid
Inconsistency: 0.06865
4a.Distri~
4b.Distri~
4c.Distri~
4d.Distri~
0.30144
0.40178
0.08257
0.21421

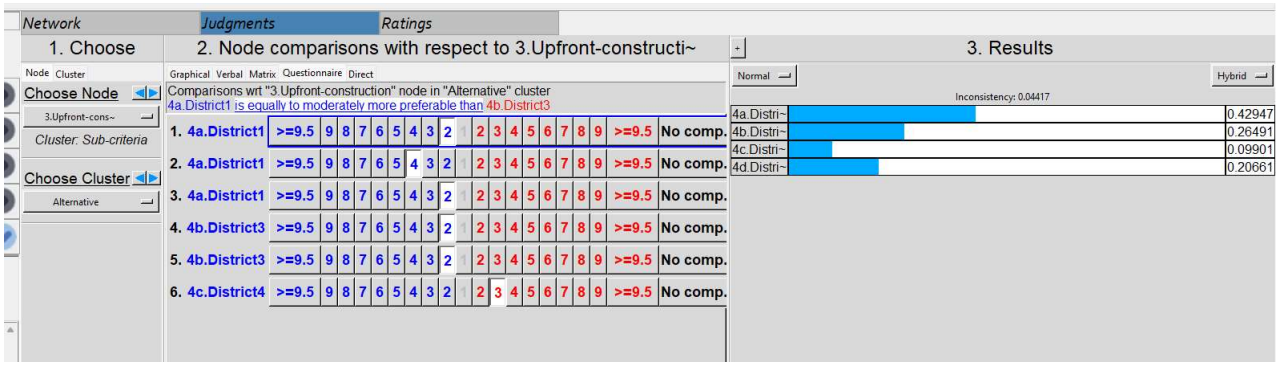

Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 3.Maintenance-Cost
3. Results
Node Cluster
Choose Node
3.Maintenance-~
Cluster: Sub-criteria
Choose Cluster
Alternative
Graphical Verbal Matrix Questionnaire Direct
Comparisons wrt "3.Maintenance-Cost" node in "Alternative" cluster
4a.District1 is equally as preferable as 4b.District3
1. 4a.District1
2. 4a.District1
3. 4a.District1
4. 4b.District3
5. 4b.District3
6. 4c.District4
>=9.5 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 >=9.5
No comp.
Normal
Hybrid
Inconsistency: 0.04649
4a.Distri~
4b.Distri~
4c.Distri~
4d.Distri~
0.38520
0.36407
0.08713
0.16361


Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 3.Market-share
3. Results
Choose Node
3.Market-share
Cluster: Sub-criteria
Choose Cluster
Alternative
Comparisons wrt "3.Market-share" node in "Alternative" cluster
4a.District1 is equally to moderately more preferable than 4b.District3
1. 4a.District1
2. 4a.District1
3. 4a.District1
4. 4b.District3
5. 4b.District3
6. 4c.District4
No comp.
Inconsistency: 0.00156
4a.Distri~ 0.44879
4b.Distri~ 0.23463
4c.Distri~ 0.08195
4d.Distri~ 0.23463

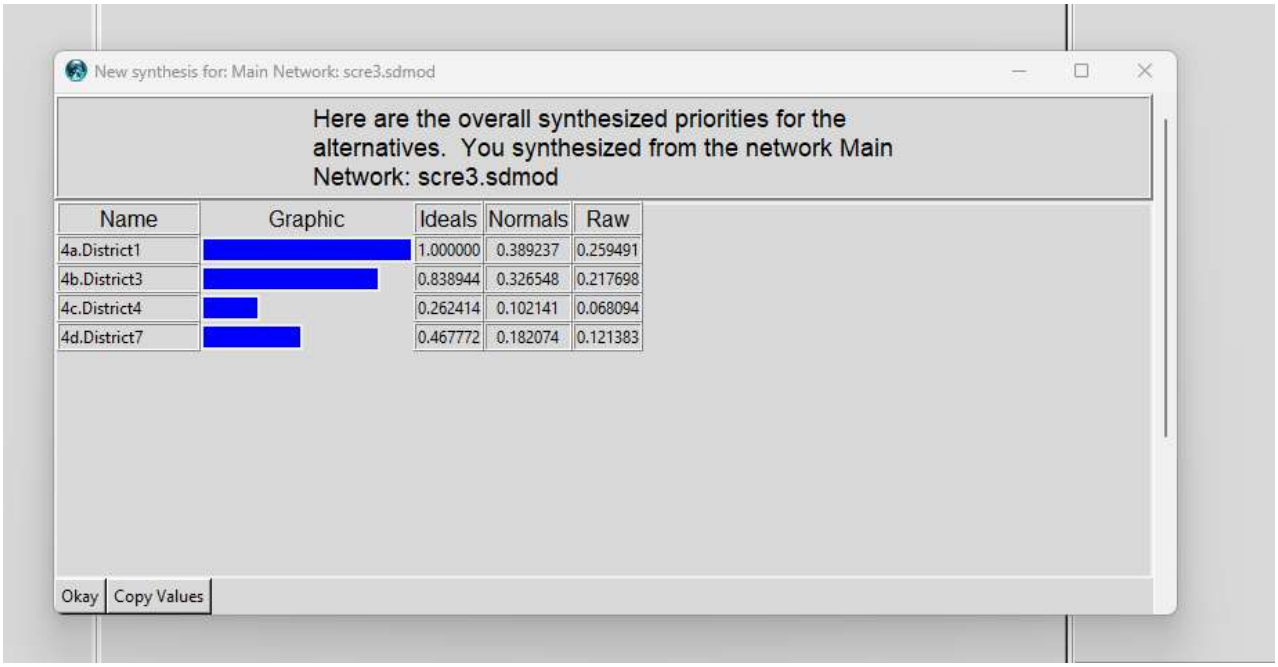

Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 3.Pedestrian-accessi~
3. Results
Choose Node
3.Pedestrian-a~
Cluster: Sub-criteria
Choose Cluster
Alternative
Comparisons wrt "3.Pedestrian-accessibility" node in "Alternative" cluster
4a.District1 is moderately more preferable than 4b.District3
1. 4a.District1
2. 4a.District1
3. 4a.District1
4. 4b.District3
5. 4b.District3
6. 4c.District4
No comp.
Inconsistency: 0.01160
4a.Distri~ 0.46730
4b.Distri~ 0.16009
4c.Distri~ 0.27718
4d.Distri~ 0.09543


Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 3.Population-density
3. Results
Choose Node
3.Population-d~
Cluster: Sub-criteria
Choose Cluster
Alternative
Comparisons wrt "3.Population-density" node in "Alternative" cluster
4a.District1 is equally as preferable as 4b.District3
1. 4a.District1
2. 4a.District1
3. 4a.District1
4. 4b.District3
5. 4b.District3
No comp.
Inconsistency: 0.04649
4a.Distri~ 0.38520
4b.Distri~ 0.36407
4c.Distri~ 0.08713
4d.Distri~ 0.16361


Network
Judgments
Ratings
1. Choose
2. Node comparisons with respect to 3.Rental-or
3. Results
Choose Node
3.Rental-or
Cluster: Sub-criteria
Choose Cluster
Alternative
Comparisons wrt "3.Rental-or" node in "Alternative" cluster
4a.District1 is equally to moderately more preferable than 4b.District3
1. 4a.District1
2. 4a.District1
3. 4a.District1
4. 4b.District3
5. 4b.District3
6. 4c.District4
No comp.
Inconsistency: 0.02271
4a.Distri~ 0.42505
4b.Distri~ 0.24972
4c.Distri~ 0.07551
4d.Distri~ 0.24972



This is result :



Based on the results obtained using the AHP model, the ideal district for opening a new convenience store would be District 1, followed by District 3, District 7, and District 4. This is because District 1 has the highest score among all the districts, indicating that it is the most suitable location for opening a new convenience store. District 3 also has a high score and can be considered a good alternative to District 1. District 7 and District 4 have lower scores compared to District 1 and 3, indicating that they are less suitable locations for opening a new convenience store.

The criteria used to evaluate the districts include location accessibility, demographics, competition, and cost. Location accessibility is evaluated based on the availability of parking and pedestrian accessibility, while demographics are evaluated based on population density and income level. Competition is evaluated based on the market share of existing stores, while cost is evaluated based on rental or lease costs and upfront construction.

District 1 is an ideal location for opening a new convenience store due to its high population density, high income level, and excellent accessibility for both pedestrians and vehicles. Additionally, District 1 is the central district of Ho Chi Minh City, which means it is a high traffic area with significant foot traffic. District 3 is also a good location for a new convenience store due to its high population density, high income level, and good accessibility. However, it has slightly lower scores than District 1 due to its slightly lower pedestrian accessibility and higher competition from existing stores.

5. Conclusion

The Analytic Hierarchy Process (AHP) model is a powerful tool that can be used to evaluate and prioritize potential locations for opening a new convenience store. This model is designed to consider multiple criteria that are important for making informed decisions about the most suitable location, such as demographics, accessibility, competition, and cost. Using AHP, I was able to carefully evaluate each potential location based on these criteria and generate a prioritized list of the most suitable locations for opening a new convenience store in Ho Chi Minh City. The results of this analysis indicate that District 1 and District 3 are the most suitable locations for a new convenience store, due to their favorable demographic characteristics, accessibility, and lower levels of competition. The results obtained from this model can help decision-makers to make informed decisions regarding the most suitable location for a new convenience store. In this case, District 1 and District 3 are identified as the most suitable locations for opening a new convenience store in Ho Chi Minh City.

Sincere thanks to Professor Vatcharaporn and TA Sakib Bin Alam for giving me an interesting and informative exercise.

REFERCENCE

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. International Journal of Services Sciences, 1(1), 83-98.

Chen, Y., Wei, Y., & Xu, L. D. (2015). A decision-making framework for location selection of distribution centers in a global supply chain. International Journal of Production Economics, 159, 128-139.

Yang, L., Li, Y., Li, Z., & Zhang, J. (2019). A multi-criteria decision-making approach for location selection of data centers. Future Generation Computer Systems, 91, 485-493.