Portland State University
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ETM 530/630 – Decision Making
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Individual Project Paper

Traveling from Hillsboro, Milwaukie, Gresham and Tigard to Portland State University

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1. Abstract:

The problem chose for this decision making project is a question about what type of transportation would be best to use to get from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University to be taken by students.

The methodology that is used for this project is a Hierarchical Decision Model (HDM). The model used is abbreviated as (MOGSA) which stands for Mission, Objectives, Goals, Strategies, and Actions. A five decision criteria were used: Cost, Time, Safety, Comfort and Flexibility. These criteria were evaluated using a pairwise comparison method. Four transportation alternatives were considered for the project: Personal Car, Trimet Max, Bus and Taxi/Cab. To measure the judgments, a group of experts were lumped together to help compare and contrast the results from those who were measuring judgments according to the HDM mode. The group of experts composed of students who travel from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University on a daily basis. The Inconsistency ranged from 0.01 to 0.03. The disagreement for the experts was 0.024.

Even though some evaluators chose other options individually, the final results indicated that traveling with Trimet Max was the preferred method if evaluated using the criteria that were selected for the decision problem. The HDM proved to be useful in helping neutralize an individual preferences to make this complex decision. This method of decision making is recommended for any group of individuals with a complex decision to make.

2. Introduction:

A Portland State University student wanted to choose the best way to commute from Hillsboro to Portland State University. He was undecided as to which mode of transportation he should choose. Many possible decision problems were discussed such as what would be the timings of classes, whether to buy a car or use a public transit, how much will it cost a student to commute. After a lot of discussion without any results it was decided to use HDM. As HDM would help to solve the problem in a better way. While going through the whole process it was observed that many students do not live on-campus. There are lots of students who stay in Hillsboro, Gresham, Milwaukie and Tigard. Instead of using the HDM for just one student it was decided that it could help lots of students who live in the mentioned area to decide whether to use a Personal Car, Trimet Max, Bus or Taxi/Cab. The goal was to get the most for the money. Based on the discussion, it was also decided that the following would be the constraints: cost, time, safety, flexibility and comfort.

A couple of assumptions were made while building the Hierarchical Decision Model.

1) Students live within a 5-10 minutes of walk from the Max stations or Bus stops available in Hillsboro, Gresham, Milwaukie and Tigard.
2) All the students are registered for nine credits in a given term.

The reason students should be enrolled for nine credits is because to get a Carpool permit or a Full Time General permit a student should be registered for minimum nine credits in regular terms and one credit in the summer term.

To make the Hierarchical Decision Model and research more vigorous, it was decided to enhance the panel of experts to eleven Students who would give in their valued assessment.

3. Methodology:

The methodology that has been used in this project is the Hierarchical Decision Model (HDM) which was developed by Cleland and Kocaoglu. For any hierarchical decision model, the basic structure of the hierarchy is presented in the MOGSA form [2]. This model consists of five levels which are mission, objectives, goals, strategies, and actions. Each level of these levels has a specific function for the model [1]. Nevertheless, it is not at all essential to have all of these levels in a model. Any model needs to have at least three levels, which are mission, objectives (criteria), and actions (decisions).

A brief definition for each level is introduced below:

Mission: What project are we in? What business are we interested in?

Objectives: What criteria should we add in order to success in our project?

Goals: What are the targets to reach in order to fulfill our objectives?

Strategies: What pathways should we follow in order to meet our goals?

Actions: What projects should we have in order to develop our strategies?

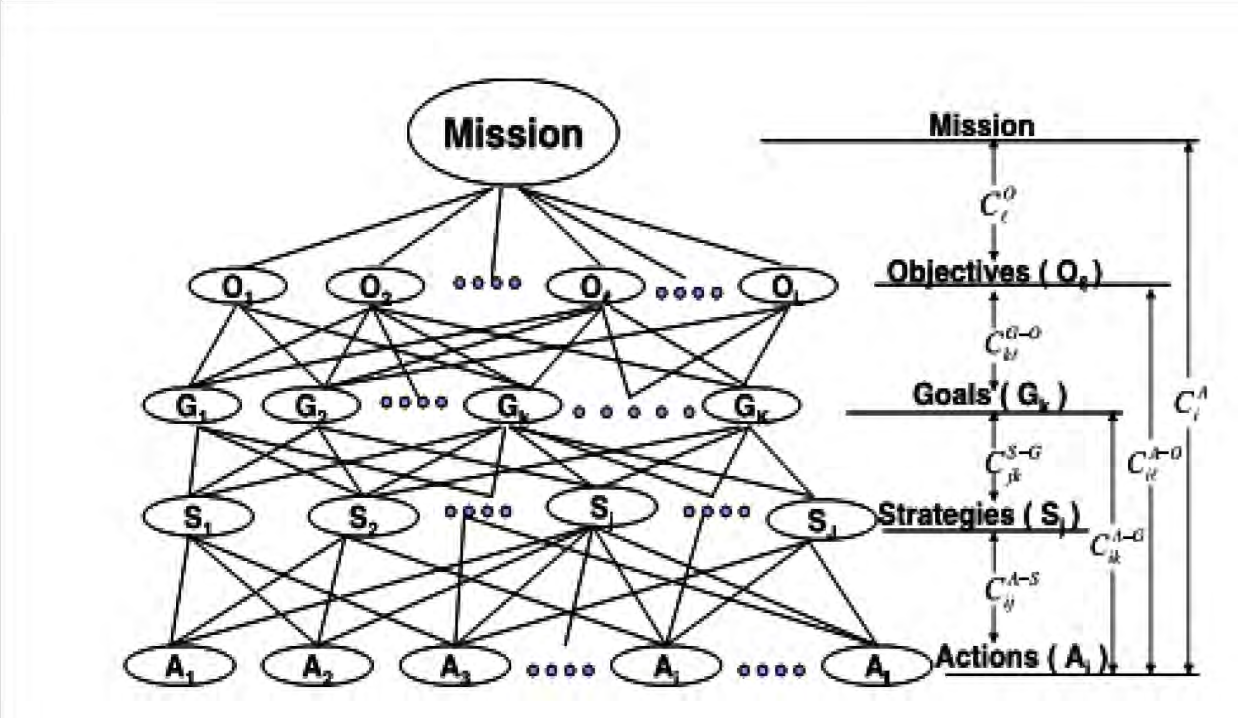


Figure: MOGSA Decision Hierarchy (Source: **Mahmood, Adnan.** ***ADVISOR: DR. HONGYI CHEN December 2011*****. Diss. UNIVERSITY OF MINNESOTA, 2011.)**

"Where Ol is the lth objective and l = 1, 2, 3…

Gk is the kth goal and k = 1, 2, 3…

Sj is the jth strategy and j = 1, 2, 3…

Ai is the ith action and i = 1, 2, 3…" [1].

4. Hierarchical Decision Model (HDM):

The hierarchical decision model is a multilayered method for studying complex decisions. HDM was developed by Prof. Dundar F. Kocaoglu in 1979 with similar concept as the Analytical Hierarchy Process methodology, but using a different pairwise comparison

scale and judgmental quantification technique [5]. Depending on how simple or complex the decision making problem is, the number of hierarchical levels is determined.

HDM is a method by which a complex problem is broken into sub-problems. In the hierarchical decision process, the problem is considered as a network of relationships among three most important levels of decision hierarchies: impact level, target level, and operational level [4]. Each level of the hierarchy consists of multifaceted and conflicting decision elements [4]. The top level, which is the objective, leads to benefits. The bottom level which is the alternative, results from multiple actions. Each decision element at every level has an impact on different elements at the next higher level. A hierarchy can be determined as a completed hierarchy if all the elements in a given level are evaluated as in terms of all the elements in the upper level. Or else, it can be called as an incomplete hierarchy [1].

Any complex decision problem can be expressed as an analytical hierarchical decision. Following figure explains a typical decision modelling process.

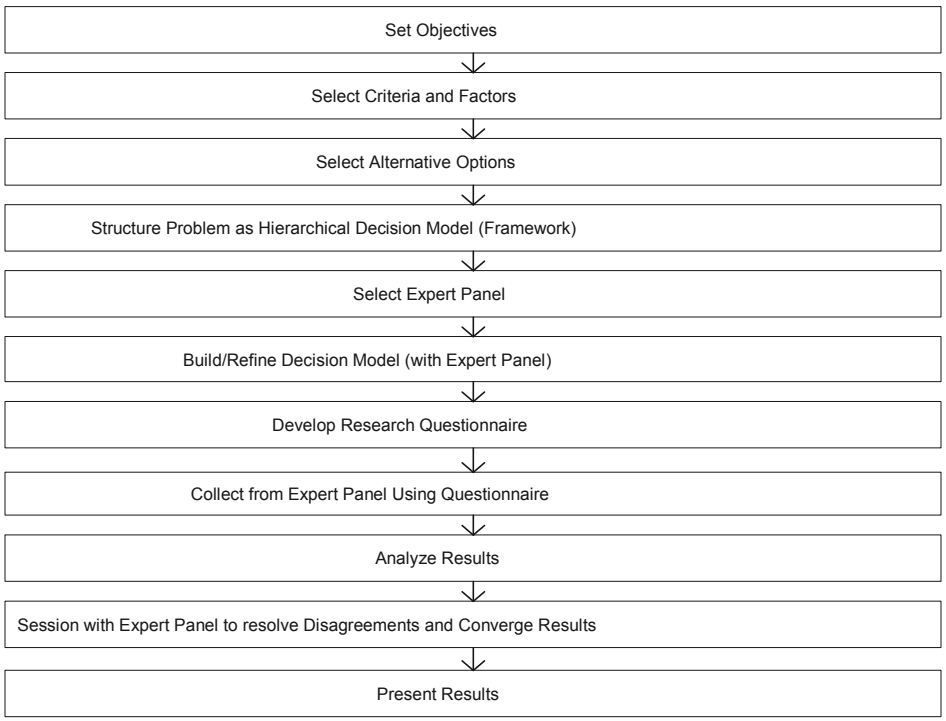


Figure: Decision Modelling Process (Source: Sheikh, Nasir J., Kiyoon Kim, and Dundar F. Kocaoglu. "Use of hierarchical decision modeling to select target markets for a new personal healthcare device." *Health Policy and Technology* 5.2 (2016): 99-112.)

4.1. Pairwise Comparison:

Decision elements at every level are compared with each other. The expert panel assigns weights to each element which contributes to the decision element to the next level. A total of 100 points is allocated between two decision elements.

The formula for the pairwise comparison is given by:

$$\text{“}N = n(n-1)/2\text{”}\ [5]$$

Where N = Number of pairwise comparisons

n = decision elements at every level.

4.2. Inconsistency:

Inconsistency occurs when there is an intentional or unintentional error while performing a pairwise comparison by an expert.

There are two types of inconsistency, ordinal and cardinal [6]. In ordinal inconsistency, the ranking order of elements should be upheld. For example, if someone likes apples more than oranges, and oranges more than grapes, then that person should like apples more than grapes.

If that person prefers grapes over apples, then that is accounted for ordinal inconsistency.

Cardinal inconsistency occurs when the element's proportion is not upheld. For example, if someone prefers Apples two times more valuable than oranges and oranges three times more valuable than grapes then that person should prefer apples six times more valuable than grapes, or else cardinal inconsistency could be observed.

It is observed that an inconsistency of 10% or 0.10 is considered as an acceptable inconsistency [5].

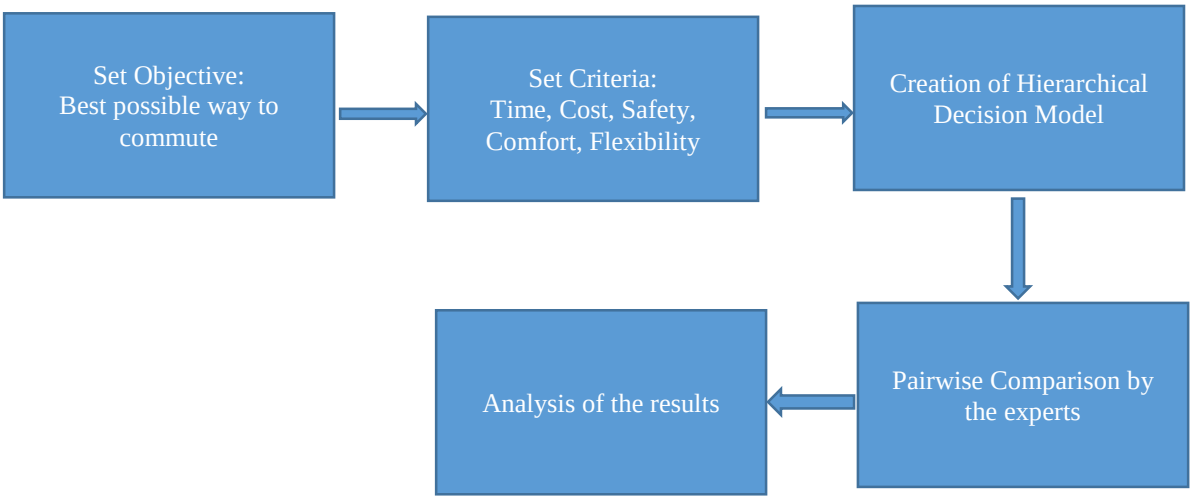
4.3. Disagreement:

Unlike inconsistency, disagreement is calculated based on the differences between the opinions or evaluations of the expert panel. If the disagreement among the expert panel is beyond a certain range (which is considered to be 10%), then a brief session should be conducted with the experts and try to convince that particular expert whose judgment does not goes with rest of the panel.

There are additional tests such as F-test that can be performed to determine whether the disagreement among expert panel is statistically significant or not [6]. “Understanding and resolving the disagreement is an important aspect of the research and for building the decision model” [6].

5. Decision Model:

The objective of the model in this paper is to decide how best to travel from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University. The figure below illustrates the process of decision making for this paper using a Hierarchical Decision Model.



5.1. Expert Panel:

An expert panel consists of Graduate students how commute from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University. All the experts are significantly related to the model's objective and decision elements. The experts are from different background, age and sex.

5.2. Decision Elements and Model Levels:

Each of the eleven experts accessed the HDM Software and gave their professional judgments and quantification with regards to each of the following criteria using their experience as their guide:

1. Cost: The total monetary expense of the proposed commute.
2. Time: How long it takes for the entire commute to transpire
3. Flexibility: The flexibility to arrive or leave campus.
4. Comfort: The physical comfort that can be had while on the commute
5. Safety: The safety with regards to persons and property while on the commute

Level 1:

Mission (Travelling from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University).

Level 2:

Five criteria were evaluated using a pairwise comparison method. A total of one hundred points was divided between the two criteria in proportion to their relative importance to the problem objective.

Level 3:

Four transportation alternatives were evaluated using a pairwise comparison method. A total of one hundred points was divided between the two alternatives in proportion to their relative importance to the problem objective.

5.3. Cost:

As Graduate students, cost plays an important role. It is very important to consider what are the costs related to each alternative.

For Trimet Max and Trimet Bus alternative a student can get a Flexpass under a Student transit program available at the Portland State University Transportation and Parking Services (TAPS). The Student FlexPass is a reduced-rate, quarterly transit pass that can be used throughout the region. The Flexpass is offered in each academic term, the FlexPass is valid on all Trimet buses, Trimet Max, Portland Streetcars, C-Tran local service buses (non-Express), WES Commuter train, and the OHSU aerial tram. The Flexpass is valid for unlimited use during the 3-month service period, which correspondences with the PSU academic calendar. The cost of the FlexPass is 40% less than the Trimet standard monthly rate -- $180 per 3-month FlexPass compared to

$100/month for Trimet public rate [8]. By getting a Flexpass a student can save up to $120 per term.

If a student is driving a personal car to Portland State University campus, then he needs to pay for a parking permit or has to pay hourly. A Full Time general permit costs $390 for one academic term. The Full Time general permit is valid in three of the ten Portland State University Parking lots. While driving a personal car, cost of fuel should also be considered. On an average it costs around $350 for fuel. So the total cost for personal car including parking permit and fuel could go up to $740. Cost of hourly parking is not calculated as the time for parking may vary from student to student.

If a student decides to take a Taxi/Cab, it would cost a student up to $3000 for one academic term. On an average it costs $50 for a round trip to travel back and forth from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University. If a student commutes for five days, it will cost around $250 per week, $1000 per month and $3000 per term.

Considering the above costs to travel from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University, it is observed the Trimet Max and Trimet Buses are the most cost efficient means to commute.

5.4. Time:

Time is limited to twenty four hours a day. A graduate student needs to plan his commute time in a very functional way. If a student decides to take Trimet Max as a means of transport, then he should plan his commute according to time of arrival and departure of Trimet Max from his place to Portland State University.

Following table shows the average time taken by Trimet Max traveling from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University.

Place	To Portland State	From Portland State	Total Time of Transit
Hillsboro	1hr 05 mins	1hr	2hrs 05mins
Gresham	1hr	1hr 10 mins	2hrs 10 mins
Milwaukie	35 mins	30 mins	1hr 05 mins
Tigard	40 mins	35 mins	1hr 15 mins

Average Time taken by Trimet Max to Travel

Google maps was observed for one week to get the above average time taken to travel by Trimet Max at 7:00 am (from mentioned places to Portland State University) and at 5:30 pm (from Portland State University to the mentioned places). Reason, these timings were chosen is because most of the classes from different departments at Portland State University are conducted between 8:00 am to 5:00 pm (except for Engineering and Technology Management Department).

Unlike Trimet Max, Personal car takes less time to commute. For commute time by personal car, Google maps was observed for one week to get the average time taken to travel by Personal Car at 7:00 am (from mentioned places to Portland State University) and at 5:30 pm (from Portland State University to the mentioned places). Reason, these timings were chosen is because most of the classes from different departments at Portland State University are conducted between 8:00 am to 5:00 pm (except for Engineering and Technology Management Department).

Following table shows the average time taken by Personal Car traveling from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University.

Place	To Portland State	From Portland State	Total Time of Transit
Hillsboro	28 mins	35 mins	1hr 03 mins
Gresham	27 mins	30 mins	57 mins
Milwaukie	16 mins	20 mins	36 mins
Tigard	20 mins	25 mins	45 mins

Average time taken by Personal Car to travel

For a student travelling by Trimet Bus is a little exasperating commute. There are times when a student might change couple of busses and also take a Trimet Max during his commute to reach his destination. Trimet bus is not as flexible as Trimet Max. There would be times when a student will not be able to take a direct Trimet Bus which commutes between point A and point B as there are limited options for direct transit.

Following table shows the average time taken by Trimet Bus traveling from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University.

Place	To Portland State	From Portland State	Total Time of Transit
Hillsboro	1hr 25 mins	1hr 22 mins	2hr 47 mins
Gresham	35 mins	40 mins	1 hr15 mins
Milwaukie	30 mins	28 mins	58 mins
Tigard	25 mins	30 mins	55 mins

Average time taken by Trimet Bus to travel

Google maps was observed for one week to get the above average time taken to travel by Trimet Bus at 7:00 am (from mentioned places to Portland State University) and at 5:30 pm (from Portland State University to the mentioned places). Reason, these timings were chosen is because most of the classes from different departments at Portland State

University are conducted between 8:00 am to 5:00 pm (except for Engineering and Technology Management Department).

While commuting by Taxi/Cab, the time taken is almost same as Personal Car. The only difference is that, it takes on an average up to 10 minutes for the Taxi/Cab to pick up the passenger. The time required to pick up the passenger was calculated by observing the smartphone apps for Uber and Lyft.

Following table shows the average time taken by Trimet Bus traveling from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University.

Place	To Portland State	From Portland State	Total Time of Transit
Hillsboro	38 mins	45 mins	1hr 18 mins
Gresham	37 mins	40 mins	1hr 17mins
Milwaukie	26 mins	30 mins	56 mins
Tigard	30 mins	35 mins	1hr 05 mins

Average time taken by Taxi/Cab to travel

Following table shows a combined analysis of total time taken by each means of transport.

Place	Total Time taken by Trimet Max	Total Time taken by Personal Car	Total Time taken by Trimet Bus	Total Time taken by Taxi/Cab
Hillsboro	2hrs 05mins	1hr 03 mins	2hr 47 mins	1hr 18 mins
Gresham	2hrs 10 mins	57 mins	1 hr15 mins	1hr 17mins
Milwaukie	1hr 05 mins	36 mins	58 mins	56 mins
Tigard	1hr 15 mins	45 mins	55 mins	1hr 05 mins

Total time taken by each means of transport to travel

Considering the above table, total transit time taken by each means of transport to travel from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University, it is observed the Personal Car and Taxi/Cab are the most time efficient means to commute.

5.5. Flexibility:

Flexibility of timings to commute helps a student to reach or leave his/her destination early or late depending on the situation. Sometimes a student has to stay for longer time on campus to finish a particular project or he/she might have doubts about some topic which needs to address by the Professor. Sometimes a student is running late, in that case he/she might miss his/her Trimet Max or Bus.

Trimet Max and Bus timings are very flexible. The timings for Trimet Max starts at as early as 3:21am and the last Max can be board at as late as 1:35am. There is a Max at every station once every 15 minutes and a Bus at every start once every 20 minutes. But a car is much more flexible than a Trimet Max and Bus as a student can leave by a personal car whenever he/she wants. Even for a Taxi/Cab it take at least 10 minutes to pick up the passenger.

Means of Transport	Very Flexible	Flexible	Not at all Flexible
Trimet Max	-	Yes	-
Personal Car	Yes	-	-
Bus	-	Yes	-
Taxi/Cab	-	Yes	-

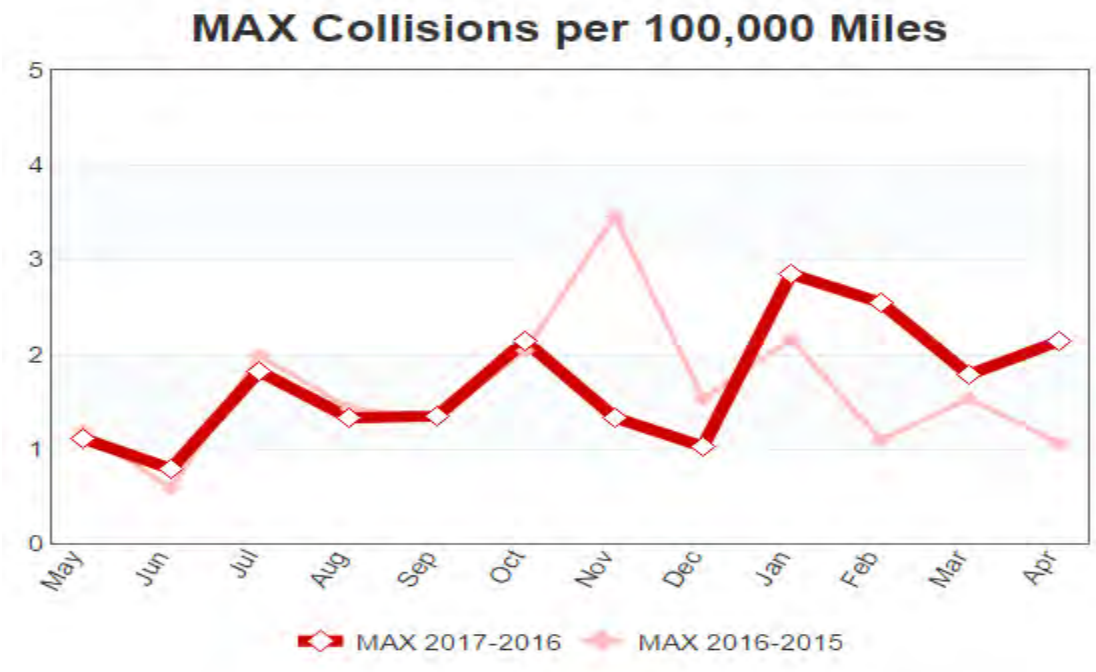
5.6. Comfort:

What is more blissful than a comfortable commute after an exhaustive day? If a student travels by Trimet Max, it is not at all necessary that he/she will find a place to sit. It has been observed that, maximum number of people travelling by Trimet Max and Trimet Bus between 8:00 am to 9:30am and then at 5:00 pm to 6:00 pm. If a student travels between these timings then it would be one heck of a commute. It would not be as comfortable as a personal car or Taxi/Cab. But the downside of travelling by personal car is that a student has to drive by himself. Sometimes it is very annoying for a student to drive in conditions where traffic is bumper to bumper. A personal car would be more comfortable to drive in the mornings, but it is very irksome to drive through heavy traffic after a long tiring day.

5.7. Safety:

A serious injury or death changes lives forever – for families, friends and communities too. Human loss and suffering are immeasurable. Occupational injuries and illnesses can provoke major crises for the families in which they occur. Road Accidents in and around the Portland area are rising day by day.

Following graph gives an idea about Collisions reported in last two years for Trimet Max.



Source: https://trimet.org/about/dashboard/index.htm#safety

This graph shows the MAX Light Rail monthly collision rate per 100,000 miles. The rate includes all collisions involving MAX. Preventability/liability is not distinguished in these figures. On a typical weekday, MAX trains travel approximately 11,600 miles [9].

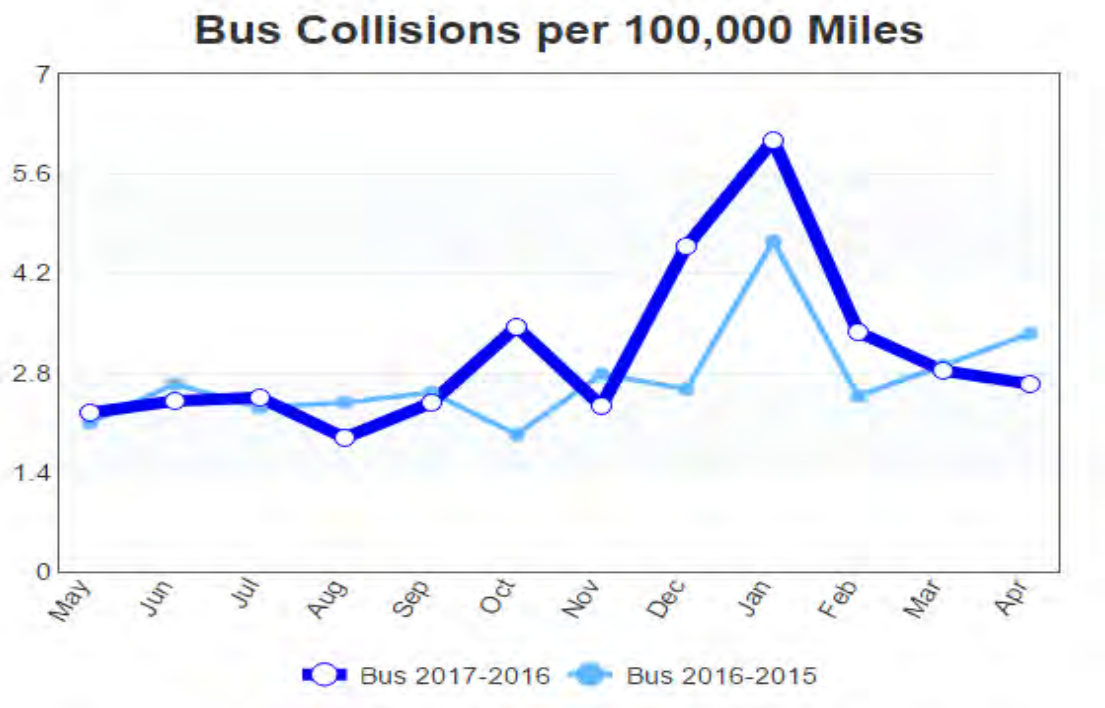
Similarly all the Accidents/Crashes involving Cars and Taxi/Cab from year 2011 to 2015 cab been seen in the below graph.

Note: The data was available till year 2015. No official data was available for year 2016 and 2017. Also, there was no way to verify the accidents reports involving personal car and Taxi/Cab separately. This is the combined data for Personal Cars and Taxi/Cab.

	CRASHES				
MONTH	2011	2012	2013	2014	2015
January	404	421	412	392	425
February	395	419	328	357	465
March	436	423	396	407	511
April	484	433	409	417	538
May	489	480	474	432	452
June	453	435	454	405	554
July	477	489	461	435	515
August	497	521	443	423	568
September	485	454	526	491	495
October	481	534	416	553	582
November	478	495	406	468	491
December	487	486	347	504	586
TOTAL	5,566	5,590	5,072	5,284	6,182

Source: https://www.oregon.gov/ODOT/TD/TDATA/pages/car/car_publications.aspx

Following graph gives an idea about Accidents/Collisions reported in last two years for Trimet Bus.



Source: https://trimet.org/about/dashboard/index.htm#safety

This graph shows the fixed-route bus monthly collision rate per 100,000 miles. The rate includes all collisions involving Trimet buses, excluding minor mirror strike incidents. Preventability/liability is not distinguished in these figures. On a typical weekday, buses travel approximately 73,300 miles [9].

From the above analysis, Trimet Max is to be considered as the safest way to commute for students.

6. Analysis and Key Findings:

The model of the project has two levels. While the first one shows the criteria, the second one shows the alternatives for the project. Therefore, it has been decided to quantify the

model by sending the model to eleven experts and get responses that can be helpful to choose one of the alternatives. The responses that came from the eleven experts agree that cost is the most important criteria that should be considered where the mean for a cost that has been calculated, which can be seen in Appendix B (Table 3), by all the experts was 0.29. The responses from the expert panel also shows that safety is the second most important criteria that should be considered where the mean for the safety that has been calculated and displayed in Appendix B table 3, by all the experts was 0.219. While the third important criteria was Comfort with a mean of 0.17.

After the final results have been collected from the eleven experts, it is indicated by the final calculation results shown in Appendix A Table (1), using the given criteria, The students should choose Trimet Max as the means of transportation to get to Portland State University from Hillsboro, Gresham, Milwaukie and Tigard because it gets the highest mean value of 0.32 which can be seen in Appendix A Table 1. However, Trimet MAX also has a biggest Stand Deviation of 0.04 compared to other alternatives. It is noteworthy that the data obtained from our panel of experts did not show a high disagreement value. The disagreement value shown, just 0.024, gives us a good indication that the experts opinions about the decision were very close. The advantage suggested by this low disagreement value is that there is little value in investing any further efforts to decrease the disagreement value more.

If the results are observed carefully, it can be concluded that the second best option to commute was in Personal Car. Important factors that contributed to Personal Car were Time and Flexibility. For Personal Car, Time has the highest mean of 0.308 and Flexibility has the highest mean of 0.316.

Trimet Max is the clear winner because of the cost with the highest mean of 0.369, safety with the highest mean of 0.347 and comfort with the highest mean of 0.308. Also the reason Trimet Max is the best alternative is because, the responses from the eleven experts at the criterion level indicates that, the three important criteria a student should look for while travelling from Hillsboro, Gresham, Milwaukie and Tigard to Portland State University are Cost, Safety and Comfort.

Trimet Bus was rated as the second poorest compared to other alternative because it is considered to be the most inflexible and time consuming commute with a lower mean of 0.189 and 0.196 respectively.

Taxi/Cab was rated as the poorest compared to other alternative because it is considered to be the most expensive and unsafe alternative with a lower mean of 0.166 and 0.167 respectively.

7. Future Research and Limitations:

This model tries to cover the important factors related to students who travels from different places to Portland State University. However, certain assumptions were made while building this model. There are many students how come to Portland State University from different places apart from Hillsboro, Gresham, Milwaukie and Tigard. But the research for this model is limited to only four places. Also, it was assumed that a student lives within a five to ten minutes of walk from Trimet Max station and Trimet Bus stop.

In future research, those places should also be considered where the student has to combine two or more than two alternatives to reach Portland State University.

There are a number of parking permits available for Portland State University students which are not as costly as Full Time General Permit. Permits are available for students who have their classes on alternate days. For example, if a student has a class on Monday and Wednesday only, a Mon/Wed permit is available in the Portland State University Transportation and Parking Services which cost around $238. There is a significant difference in a Full Time General Permit and a Mon/Wed or Tue/Thur General Permit.

In future, more alternatives such as Motorcycles, Street Car, C-Tran local service buses (non-Express) and WES Commuter train should be included. A motorcycle permit costs as inexpensive as $98. A pairwise comparison between a Trimet Max and a motorcycle would be worth to do, as motorcycle could be much more cost efficient than a Trimet Max. It would be great to see the responses from the same experts if these alternatives are considered.

8. Conclusion and Recommendations:

In conclusion, the proposition that traveling with Trimet Max would be the best mode of travel was proven correct using pairwise comparisons and HDM. It is interesting to note that the individual values did not all rate Trimet Max as the highest, but once all the calculations were done it came out the clear front-runner. HDM is a useful tool when trying to make a decision or a classification among alternatives that have a lot of different criteria to consider. In this model, multiple criteria were used in a decision regarding the best alternative to travel. Even though each of the experts already had an idea which mode of travel they would choose, once all the comparisons were done in a couple cases their

answer was different. The HDM had taken the biases out of the decision and was left with an alternative that fit what felt was most important. Use of Hierarchical Decision Model should be made as a means of decision making to any group of individuals with a multifaceted decision to make.

9. References:

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8. https://www.pdx.edu/transportation/student-commuter-permits
9. https://trimet.org/about/dashboard/index.htm#safety
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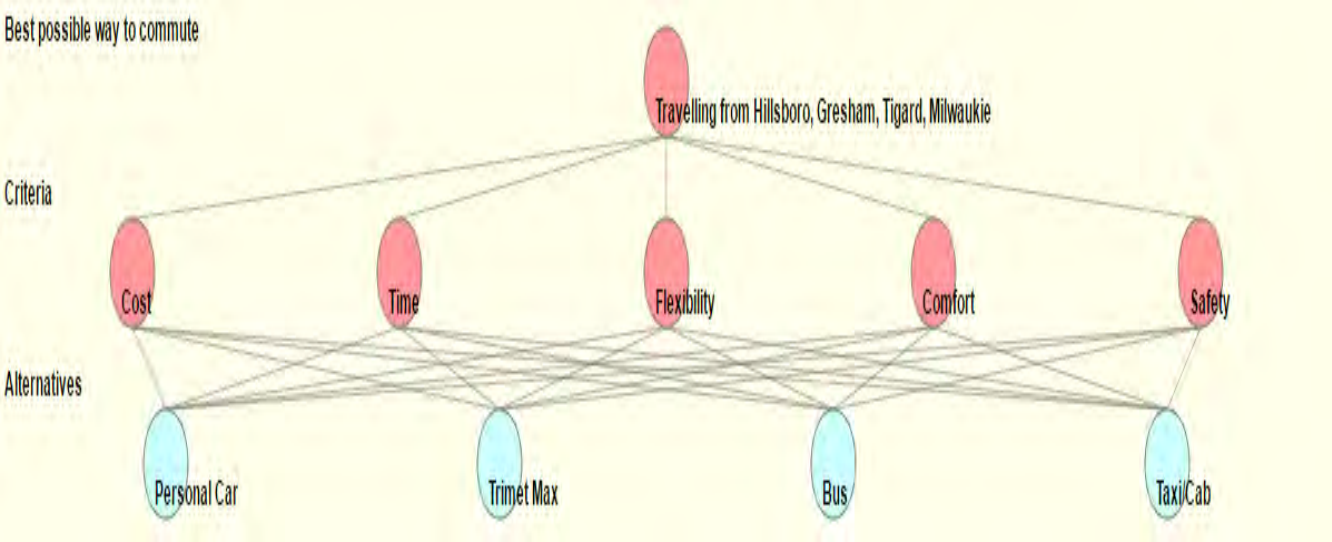
10. Appendix A:



Hierarchical Decision Model

Travelling from Hillsboro, Gresham, Tigard, Milwaukie	Personal Car	Trimet Max	Bus	Taxi/Cab	Inconsistency
Arjun Sridhar	0.28	0.29	0.23	0.2	0.01
Cynthia Jain	0.25	0.36	0.22	0.17	0.01
Daksh Dharod	0.24	0.38	0.22	0.17	0.02
Harsh Momaya	0.3	0.29	0.21	0.2	0.03
Hiral Barot	0.23	0.37	0.23	0.17	0.01
Kajal Zatale	0.31	0.27	0.21	0.22	0.02
Laasya Raja	0.28	0.32	0.21	0.18	0.01
Shreyas Shankaran	0.3	0.28	0.21	0.21	0.01
Sukrut Kelkar	0.28	0.33	0.19	0.19	0.03
Suraj Kulkarni	0.25	0.36	0.21	0.18	0.01
Yash Shah	0.3	0.28	0.21	0.22	0.02
Mean	**0.27**	**0.32**	**0.21**	**0.19**	
Minimum	**0.23**	**0.27**	**0.19**	**0.17**	
Maximum	**0.31**	**0.38**	**0.23**	**0.22**	
Std. Deviation	**0.03**	**0.04**	**0.01**	**0.02**	
Disagreement					**0.024**

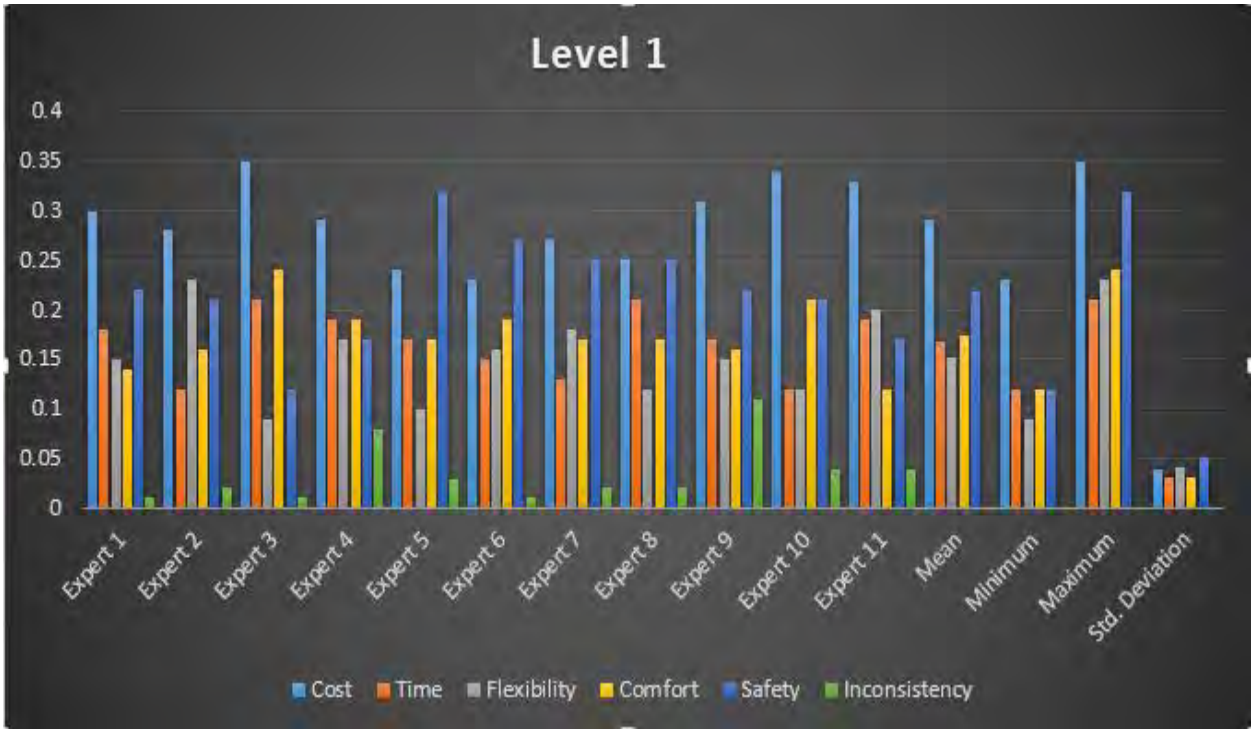
Final Results (Table 1)

The statistical F-test for evaluating the null hypothesis (Ho: ric = 0) is obtained by dividing between-subjects variability with residual variability:

Source of Variation	Sum of Square	Deg. of freedom	Mean Square	F-test value
Between Subjects:	0.11	3	.037	35.76
Between Conditions:	0.00	9	0.000	
Residual:	0.03	27	0.001	
Total:	0.14	39		
Critical F-value with degrees of freedom 3 & 27 at 0.01 level:				4.6
Critical F-value with degrees of freedom 3 & 27 at 0.025 level:				3.65
Critical F-value with degrees of freedom 3 & 27 at 0.05 level:				2.96
Critical F-value with degrees of freedom 3 & 27 at 0.1 level:				2.3

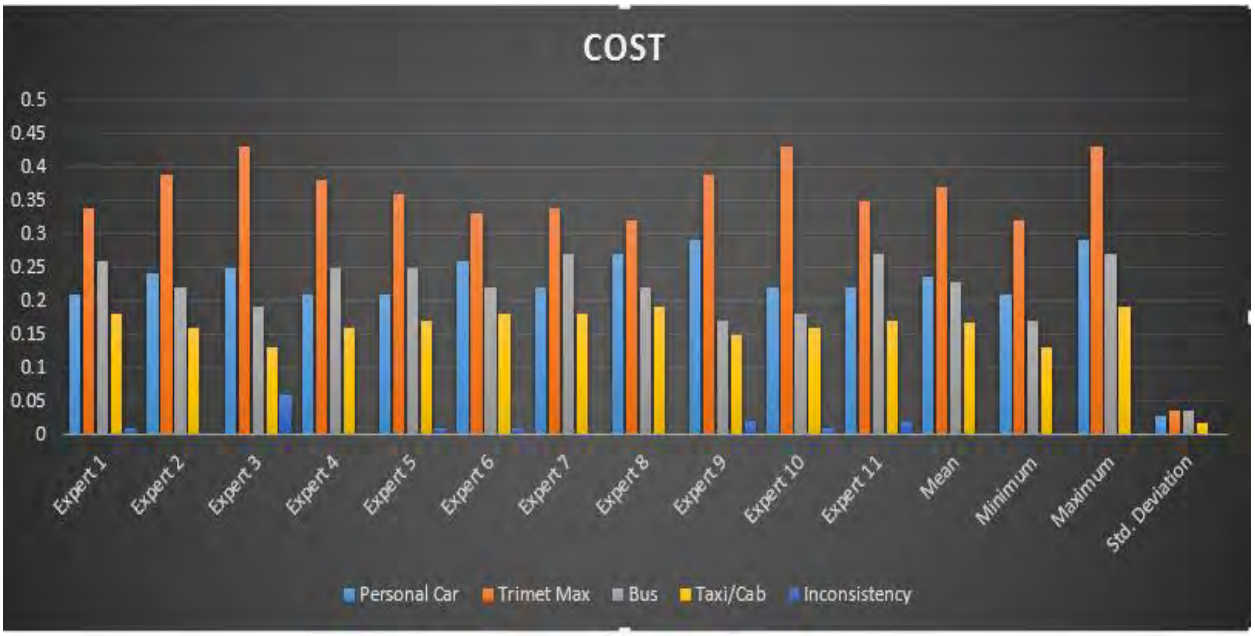
Table (2) The Statistical F-Test

11. Appendix B:



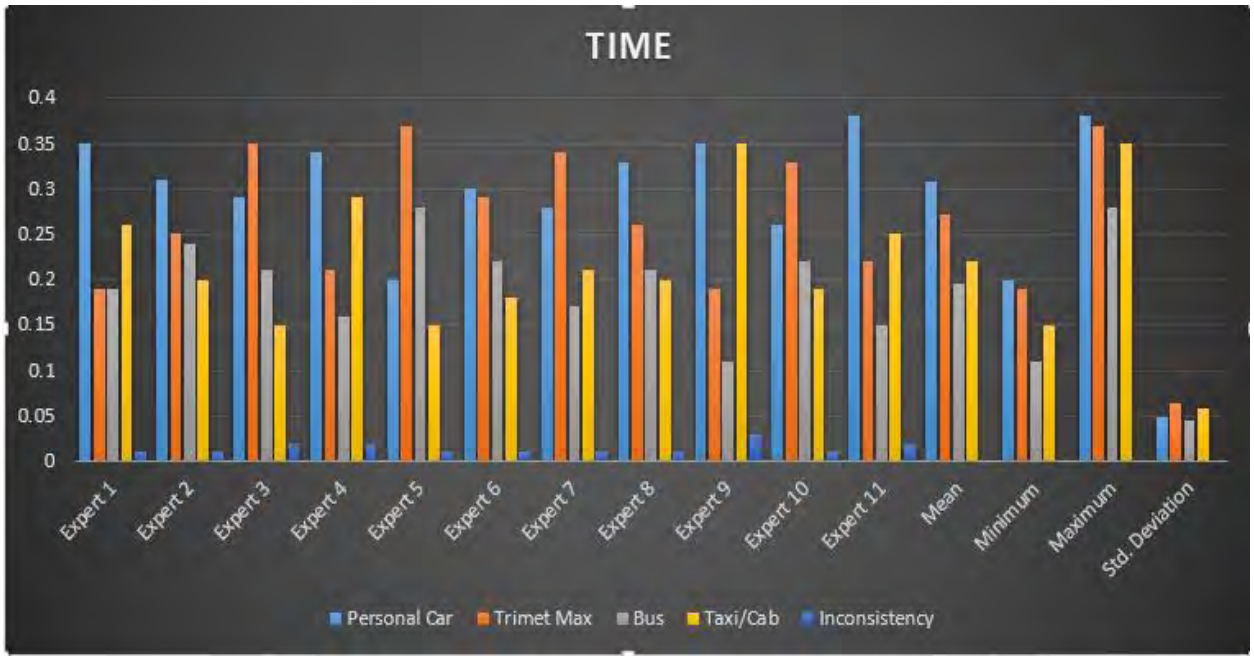
Level 1	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Expert 10	Expert 11	Mean	Minimum	Maximum	Std. Deviation
Cost	0.3	0.28	0.35	0.29	0.24	0.23	0.27	0.25	0.31	0.34	0.33	0.29	0.23	0.35	0.038612292
Time	0.18	0.12	0.21	0.19	0.17	0.15	0.13	0.21	0.17	0.12	0.19	0.167273	0.12	0.21	0.0316489
Flexibility	0.15	0.23	0.09	0.17	0.1	0.16	0.18	0.12	0.15	0.12	0.2	0.151818	0.09	0.23	0.040635448
Comfort	0.14	0.16	0.24	0.19	0.17	0.19	0.17	0.17	0.16	0.21	0.12	0.174545	0.12	0.24	0.031148803
Safety	0.22	0.21	0.12	0.17	0.32	0.27	0.25	0.25	0.22	0.21	0.17	0.219091	0.12	0.32	0.051778294
Inconsistency	0.01	0.02	0.01	0.08	0.03	0.01	0.02	0.02	0.11	0.04	0.04				

Table (3) Relative Importance of the Criteria



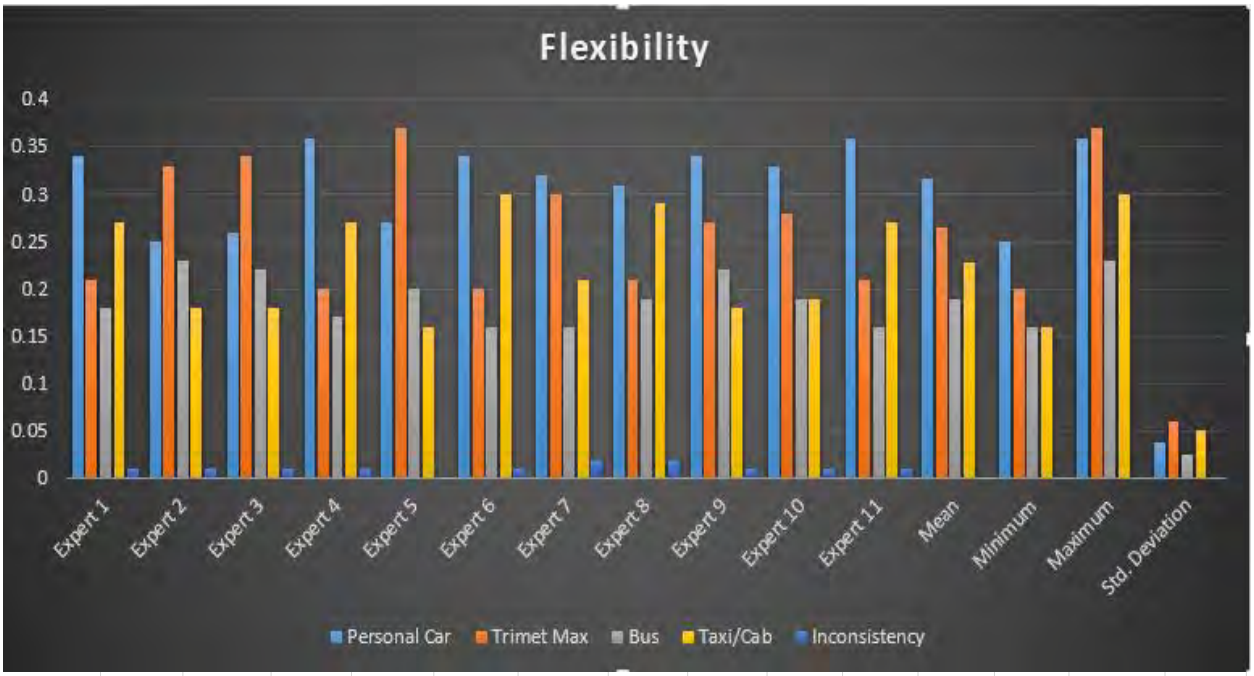
Cost															
Level 2	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Expert 10	Expert 11	Mean	Minimum	Maximum	Std. Deviation
Personal Car	0.21	0.24	0.25	0.21	0.21	0.26	0.22	0.27	0.29	0.22	0.22	0.236364	0.21	0.29	0.026379306
Trimet Max	0.34	0.39	0.43	0.38	0.36	0.33	0.34	0.32	0.39	0.43	0.35	0.369091	0.32	0.43	0.036295391
Bus	0.26	0.22	0.19	0.25	0.25	0.22	0.27	0.22	0.17	0.18	0.27	0.227273	0.17	0.27	0.034136333
Taxi/Cab	0.18	0.16	0.13	0.16	0.17	0.18	0.18	0.19	0.15	0.16	0.17	0.166364	0.13	0.19	0.016109132
Inconsistency	0.01	0	0.06	0	0.01	0.01	0	0	0.02	0.01	0.02				

Table (4) Evaluation of Alternatives with Cost



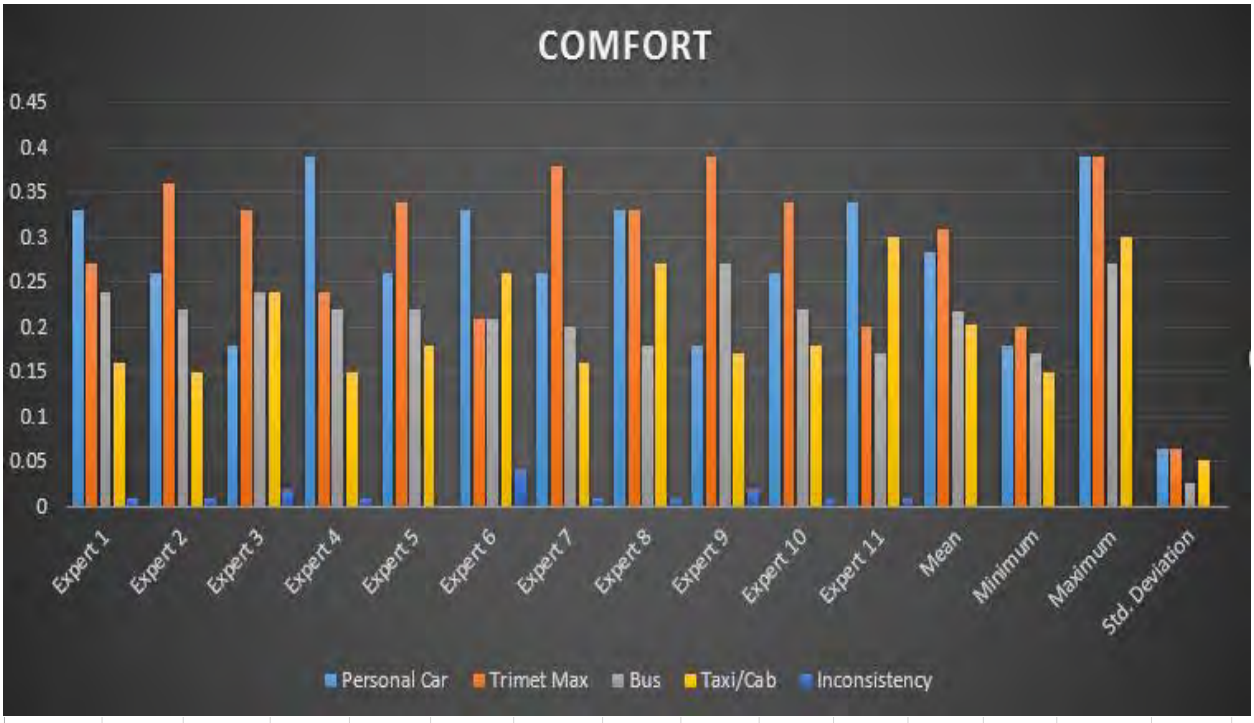
Time															
Level 2	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Expert 10	Expert 11	Mean	Minimum	Maximum	Std. Deviation
Personal Car	0.35	0.31	0.29	0.34	0.2	0.3	0.28	0.33	0.35	0.26	0.38	0.308182	0.2	0.38	0.048018591
Trimet Max	0.19	0.25	0.35	0.21	0.37	0.29	0.34	0.26	0.19	0.33	0.22	0.272727	0.19	0.37	0.063688291
Bus	0.19	0.24	0.21	0.16	0.28	0.22	0.17	0.21	0.11	0.22	0.15	0.196364	0.11	0.28	0.044776765
Taxi/Cab	0.26	0.2	0.15	0.29	0.15	0.18	0.21	0.2	0.35	0.19	0.25	0.220909	0.15	0.35	0.058380343
Inconsistency	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.03	0.01	0.02				

Table (5) Evaluation of Alternatives with Time



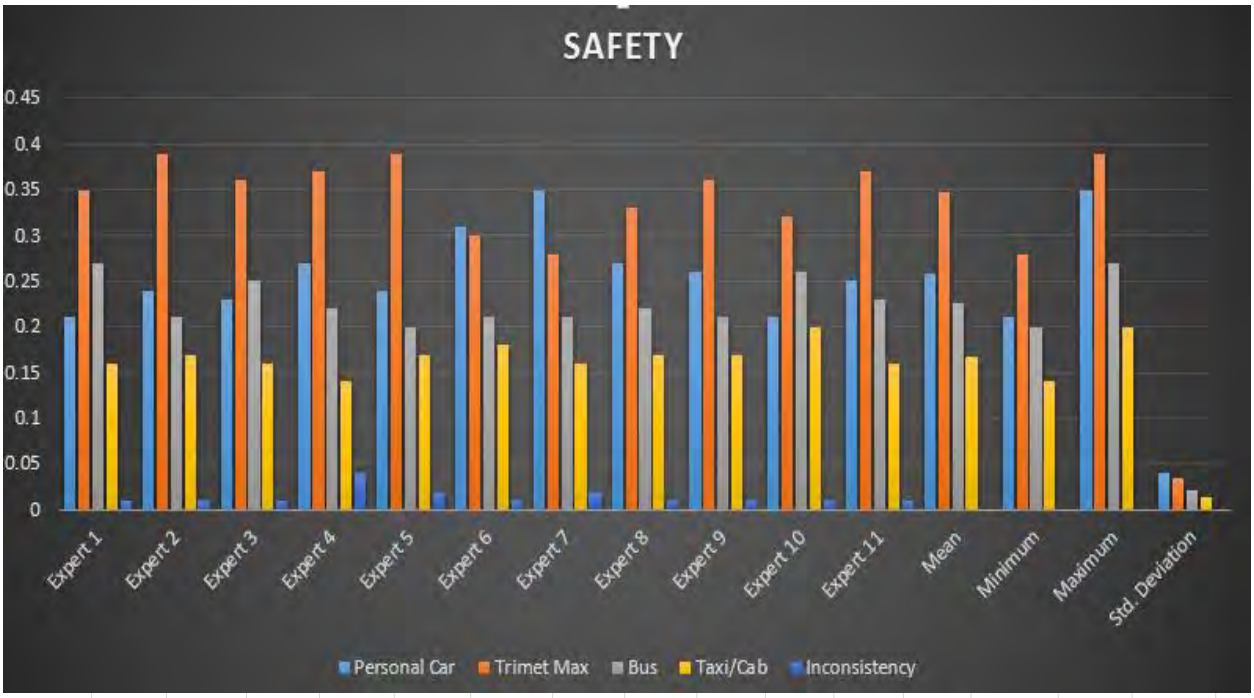
Flexibility															
Level 2	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Expert 10	Expert 11	Mean	Minimum	Maximum	Std. Deviation
Personal Car	0.34	0.25	0.26	0.36	0.27	0.34	0.32	0.31	0.34	0.33	0.36	0.316364	0.25	0.36	0.037482778
Trimet Max	0.21	0.33	0.34	0.2	0.37	0.2	0.3	0.21	0.27	0.28	0.21	0.265455	0.2	0.37	0.060206257
Bus	0.18	0.23	0.22	0.17	0.2	0.16	0.16	0.19	0.22	0.19	0.16	0.189091	0.16	0.23	0.024663018
Taxi/Cab	0.27	0.18	0.18	0.27	0.16	0.3	0.21	0.29	0.18	0.19	0.27	0.227273	0.16	0.3	0.050107323
Inconsistency	0.01	0.01	0.01	0.01	0	0.01	0.02	0.02	0.01	0.01	0.01				

Table (6) Evaluation of Alternatives with Flexibility



Comfort															
Level 2	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Expert 10	Expert 11	Mean	Minimum	Maximum	Std. Deviation
Personal Car	0.33	0.26	0.18	0.39	0.26	0.33	0.26	0.33	0.18	0.26	0.34	0.283636	0.18	0.39	0.063714238
Trimet Max	0.27	0.36	0.33	0.24	0.34	0.21	0.38	0.33	0.39	0.34	0.2	0.308182	0.2	0.39	0.063934367
Bus	0.24	0.22	0.24	0.22	0.22	0.21	0.2	0.18	0.27	0.22	0.17	0.217273	0.17	0.27	0.026659779
Taxi/Cab	0.16	0.15	0.24	0.15	0.18	0.26	0.16	0.27	0.17	0.18	0.3	0.201818	0.15	0.3	0.052191637
Inconsistency	0.01	0.01	0.02	0.01	0	0.04	0.01	0.01	0.02	0.01	0.01				

Table (7) Evaluation of Alternatives with Comfort



Safety															
Level 2	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	Expert 10	Expert 11	Mean	Minimum	Maximum	Std. Deviation
Personal Car	0.21	0.24	0.23	0.27	0.24	0.31	0.35	0.27	0.26	0.21	0.25	0.258182	0.21	0.35	0.039958656
Trimet Max	0.35	0.39	0.36	0.37	0.39	0.3	0.28	0.33	0.36	0.32	0.37	0.347273	0.28	0.39	0.034136333
Bus	0.27	0.21	0.25	0.22	0.2	0.21	0.21	0.22	0.21	0.26	0.23	0.226364	0.2	0.27	0.022268089
Taxi/Cab	0.16	0.17	0.16	0.14	0.17	0.18	0.16	0.17	0.17	0.2	0.16	0.167273	0.14	0.2	0.014200454
Inconsistency	0.01	0.01	0.01	0.04	0.02	0.01	0.02	0.01	0.01	0.01	0.01				

Table (8) Evaluation of Alternatives with Safety