Selection of Cellphone Service Provider

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TEAM 2

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Table of Contents

LIST OF FIGURES:

LIST OF TABLES:

ABSTRACT

This research study explains about the decision making process for selection of best mobile service provider. The different types of mobile server provider that are selected are AT&T, Verizon, Sprint, T-Mobile and Cricket. Hierarchy decision model was used to construct the decision model. The paper explains the four different criteria as the base criteria for structuring the decision model. We first selected the criteria that are important for the selection of best mobile service provider. Sub criteria were selected under each of the four major criteria such that they contribute as some part of each major criterion weight or relative importance. Once all the selection of four criteria was done, we validated the model on Portland's top 5 mobile service providers. Data gathered was entered into the model and used to calculate comparison among different mobile service provider. Based on this analysis, recommendation was made for the top most popular mobile service provider in Portland.

INTRODUCTION

"Moore's law" is the observation that, over the history of computing hardware, the number of transistors in a dense integrated circuit doubles approximately every two years. The observation is named after Gordon E. Moore, co-founder of the Intel Corporation, who first described the trend in a 1965 paper and formulated its current statement in 1975 [1].

So in the past 2 decades Moore's law has driven innovation in consumer electronics devices to new heights. This has been primarily possible due to the advent of immense computational power on handheld devices. Mobile phones have been used as means of wireless communication long before the introduction of phones.

The advent of smartphones has converted the mobile phone device beyond a portal for just voice and text communication. The increased use of multimedia on such devices has increased the data bandwidth used by telecommunication mobile users. The major mobile service providers have responded to this new market need by providing various kinds of data/voice, package, and customer choose package best suited to their needs and affordability.

This report tries to capture facets like speed, connectivity, cost etc. and how much importance customers give to each of these features.

PROBLEM STATEMENT

The objective of this project is to determine the best cellphone service provider in Portland. Our team has collected data on various aspects that customers considered while purchasing or signing up for a mobile service provider. Based on the analysis, best services provider is recommended.

METHODOLOGY

The figure below shows the research approach that leads to the development of decision model for selection of Cellphone service provider.

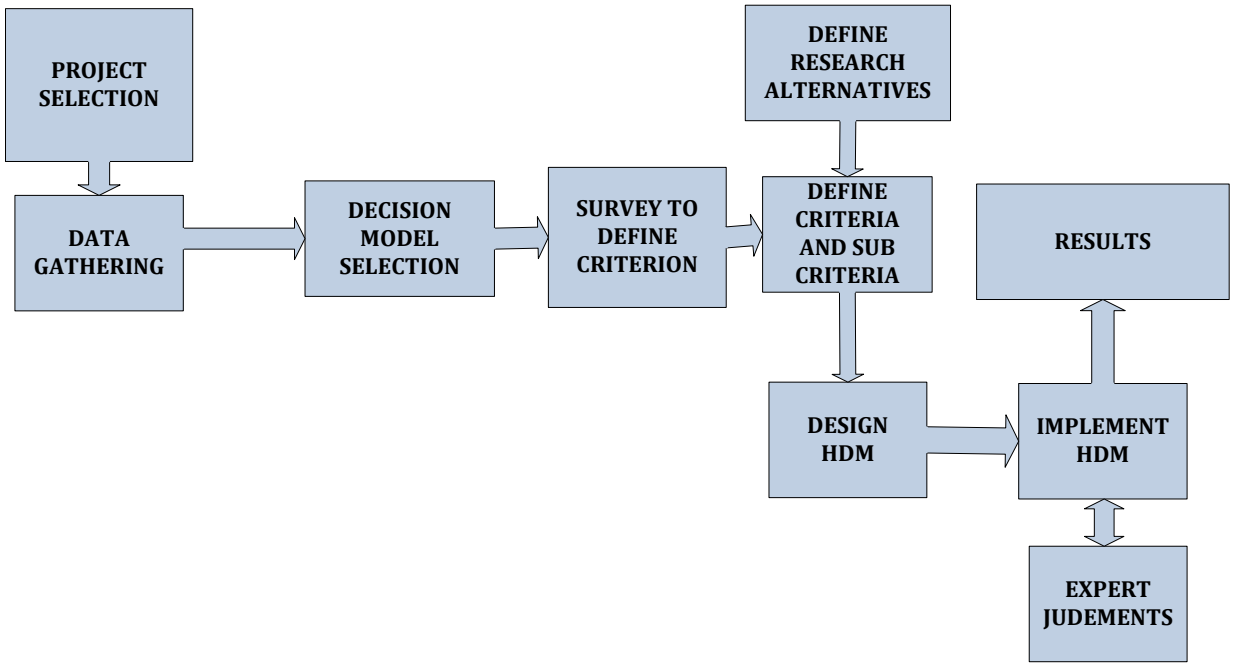

Figure 1: Research Methodology

DECISION MODEL

Deciding the best service plan depends on number of parameters that are subjective in nature based on the preferences of individual users. We did an initial customer survey to identify those preferences (Appendix 3). Further, Hierarchical Decision Model (HDM) is used to evaluate selection process, to analyze the contribution of each criterion to the decision maker's final decision. Pair wise comparison is used to further evaluate the relative importance of each alternative in terms of each criterion [2].

HIERARCHICAL DECISION MODEL (HDM)

In HDM, elements at each level are considered to be preferentially independent. Based on the gathered information about each element at all levels, the impact on decision making between elements at each level and higher level is determined. Hierarchical Decision Model (HDM) developed by Cleland and Kocaoglu; also known as the MOGSA decision hierarchy consists of Mission, Objectives, Goals, Strategies, and Actions. The MOGSA model is defined as follows [3] [4]:

Mission – What business are we in? What business do we want to be in?

Objectives – What achievements do we have to in order to satisfy the mission?

Goals – What are our targets in order to reach our goal?

Strategies – What is the path we need to choose in order to meet our goals?

Actions – What projects do we have or should we have in order to develop or accomplish our strategies?

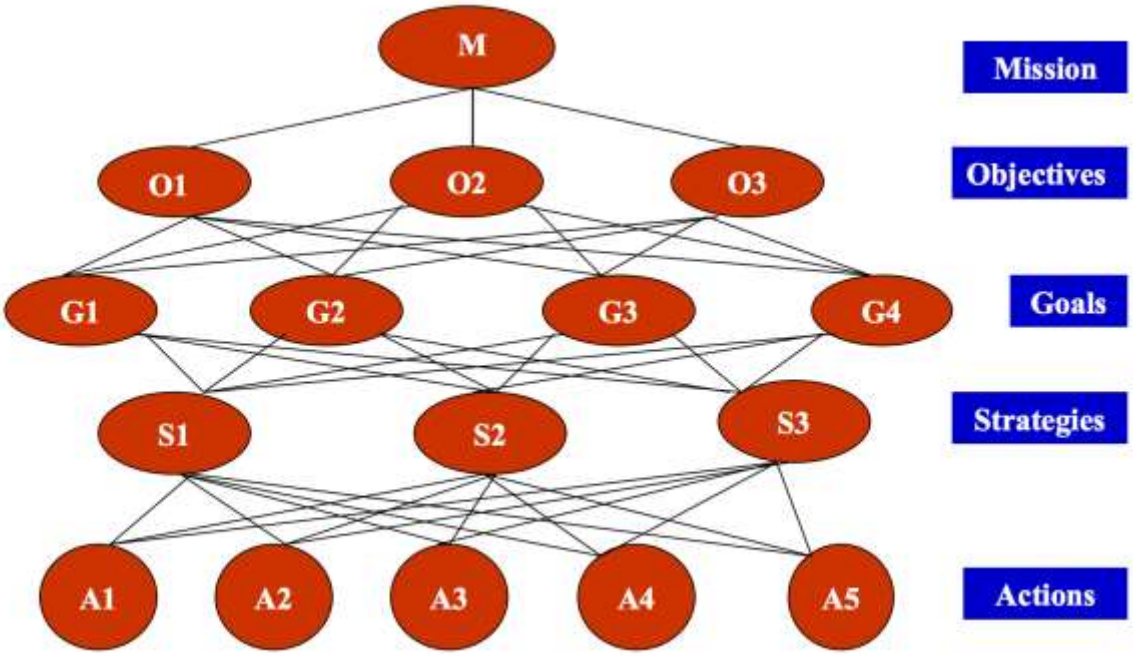

Figure 2: MOGSA Decision Hierarchy [3][4]

In MOGSA hierarchy, mission is a single node on the top and all the other levels of hierarchy have at least two or more elements. The number of levels in the model is minimum two and can be more than five. The lines in the model indicate the relationship between the lower hierarchy and the upper hierarchy. All the criteria will contribute to the mission at different weights. HDM model can be used for complex decision process [3].

PAIRWISE COMPARISON

Pairwise comparison, an approach proposed by Saaty (1980), is used to determine the relative importance of each alternative in terms of each criterion. The decision maker has to express their opinion about the value of one single pairwise comparison at a time [2].Pairwise comparisons are quantified using a scale (1 to 100) and each candidate or alternative is matched one-on-one with each of the other alternatives. This is done for all levels of HDM model i.e. for all nodes, and nodes that are compared are always in the same level of hierarchy and are compared with respect to their parent node [5]. Experts are the decision makers who determine the relative importance of each criterion. They are required to distribute points on a scale of 1-100 between each pair of comparison to signify their judgment on the importance of those criteria to another element in the preceding level.

CRITERIA AND SUB CRITERIA

To determine the various criteria used, initial web research was done to list down majority of parameters that can influence any user's decision to select best suitable service plan and provider. Amongst them, the most important criteria and respective sub criteria were identified that were considered important by any decision maker to evaluate and decide the best suitable alternative. The decision model consists of 4-levels:

Mission: The mission of decision model is selection of best cell phone service provider by selecting the most suitable plan that meets all criteria depending on buyer's personal choice.

Criteria and Sub criteria: The four criteria are Cost, Technical specifications, Customer Service and support, Availability and their respective sub criteria are specified as follows:

COST

It is nothing but the price of different plans of the five mobile service providers. These service providers are AT&T, Verizon, Sprint, T-Mobile and Cricket.

TECHNICAL SPECIFICATION

For a potential customer the factors that differentiate between a 'good' service and 'bad' service are dropped calls, call quality, limited or no coverage, crosstalk, data speeds, etc. There are many more key factors that one can consider when planning to narrow down on a service provider, but we decided on the two most important technical factors that really distinguish between the alternatives. Based on user preferences, they are network coverage and speed.

- **Network Coverage:**

  Most service providers compete to provide excellent service around the coastline and major cities whereas their coverage is spotty in some areas. If a service provider has great coverage across other places and poor coverage at a customer's residence or work, the customer is most likely not going to continue with the same provider. Therefore, it makes sense for a customer to check how well his/her most frequently visited areas are covered.

- **Speed:**

  As of today, 4G LTE is the fastest and most reliable form of mobile broadband coverage. For a feature phone user, it may not relate much but for smartphone users, it is the second most important factor after call quality. If multimedia streaming is a preference, then the user should ensure that there are enough 4G LTE towers around his/her most-frequently visited areas.

CUSTOMER SERVICE AND SUPPORT

Customer service is important to an organization because it is often the only contact a customer has with a company. Customers are vital to an organization. Some customers spend hundreds and even thousands of dollars per year with a company. Consequently, when they have a question or product issue, they expect a company's customer service department to resolve their issues. The various ways of providing customer service by cell phone providers are listed below.

- **Online –Support**:

  Customers may have enquiries about products or services. It is ideal to provide a self-support service on your site, such as a 'How To' page; FAQs. Online-Support also helps in determining ROI (return of Investment) to measure the success of the marketing campaigns. The majority of e-businesses is always worried about the % of bounce rates as people visit sites and leave immediately. There are a few reasons for this, they don't find what they are looking for or they find the site navigation too complicated. By offering online support such as Live Chat and e-mail replies businesses can capture this valuable market research data and hopefully 'save the sale' plus make changes to their site to make it more user friendly.

- **Call-Support:**

  Call supports provide quick and rapid solutions to any technical or non-technical problems. Individuals simply call the available hotline to begin getting their issues resolved.

- **Walk-ins:**

  Walk-ins represent a potential boost to business, provided they are converted to potential customers. For existing customers' walk-ins to the stores is a way to check on the new devices, plans, discounts or seek a quick solution to any issues. Even if the satisfactory solutions are not provided pointers in the correct directions are quick to get.

AVAILABILITY OF FEATURES

- **Plans:**

  A plan is a package of services offered by wireless service providers that includes the activation, monthly charges, per-minute airtime charges, roaming terms, local service area as well as additional services (such as voicemail, data, or international roaming) [6]. Selection of right cell phone plan is a difficult task and very baffling. With so many options available in terms of pricing, data, talk minutes confusions are usual. It's important to address what elements of a phone plan are important to decide which cell phone plan is right for anyone. Various factors that could be considered for cellphone plan selection are:

  i. **Individual or Family plan:**
  This choice is relatively simple. It depends on the person. If a single line is required then individual plan can be chosen or if the multiple phone lines are combined then family plans give the best bang for the buck.

  An individual plan offers minutes and data for monthly use by one individual.

  A family plan offers a 'bucket' of minutes and data for use between members of a family, with each line added to the bucket costing around $10 per month. Family plans can often offer impressive savings, rather than signing up for several individual plans for multiple lines in a family [7].

  ii. **Monthly Minutes:**
  Minutes are calls that a person makes and receives. Hence it is better to determine the plenty number of minutes required per month. A look at a couple of previous bills helps in the decision.

  iii. **Data:**
  Both email access, and web surfing (including an individual's use of apps on his phone like Facebook, maps etc.) will count towards monthly usage.

  iv. **Messages:**
  How many messages a person sends each month determine the plan for texting. Nowadays, most of the cellular providers offer bundles for unlimited texting and web surfing.

v. **Device availability:**
Sometimes people get confused choosing over service provider or a good device. More and more people chase the phone they want before they even start looking at carriers and contracts. It is important to figure out what devices are available with each service provider if device is a priority.

- **Discounts**:

Cell phone service providers thrive by peddling a plethora of extra features and services on top of basic service plans. Thousands of companies, organizations, and educational institutions have partnerships in place with wireless carriers to offer discounts to employees, members, and students. AT&T, Sprint, T-Mobile and Verizon all have discount pages. Discounts that range from 10% off to as much as 25% off provide great opportunity to people who can avail them.

- **International Roaming**

International mobile roaming is a service that allows mobile users to continue to use their mobile phone or other mobile device to make and receive voice calls and text messages, browse the Internet, and send and receive emails, while visiting another country.

Roaming extends the coverage of the home operator's retail voice and SMS services, allowing the mobile user to continue using their home operator phone number and data services within another country. The seamless extension of coverage is enabled by a wholesale roaming agreement between a mobile user's home operator and the visited mobile operator network [8].

ALTERNATIVES

We have chosen the 5 alternatives to compare between. All the characteristics with respect to our criteria and sub-criteria are listed in **Appendix1.**

Where, A stands for alternative

A1: Verizon

A2: AT&T

A3: T-Mobile

A4: Sprint

A5: Cricket

ASSUMPTIONS

- All survey participants are considered as experts who have sufficient knowledge about all the alternatives under study.
- Our decision model is not focused to a particular group of people.
- Our research is limited to only five leading service providers in Portland.

DECISION MODEL FOR CELLPHONE SERVICE PROVIDER

Our HDM decision model consists of 4 levels of hierarchy as demonstrated in figure below:

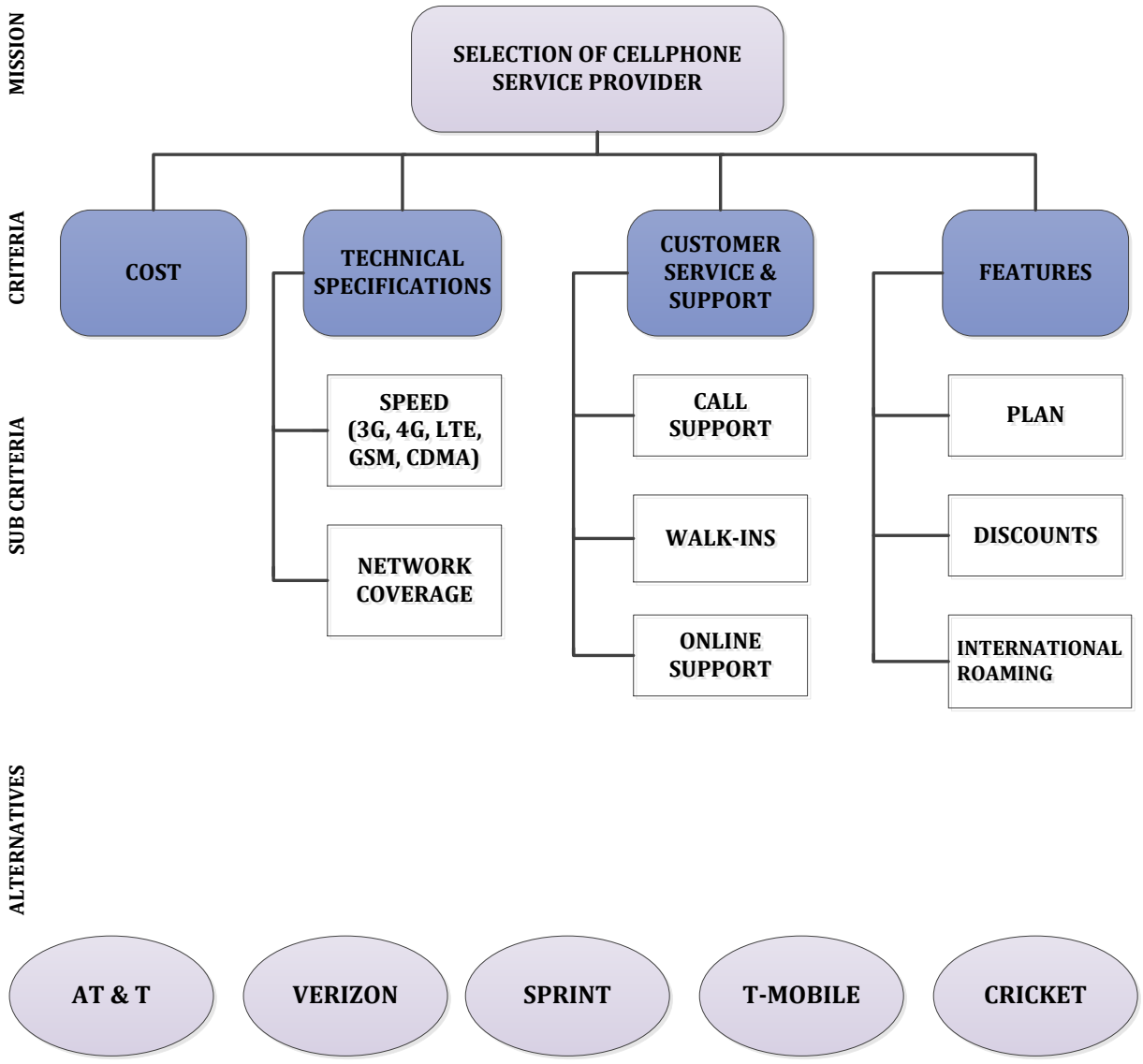

Figure 3: Cellphone Service Provider Decision Model

IMPLEMENTING THE MODEL

After deciding on the methodology and criteria /sub-criteria we created a model in HDM and sent the survey to different experts who have at least used or have knowledge about our alternatives.

The result below shows the average of each criterion specifying what feature is considered important by the experts as shown in table below.

We collected the data of all the users and calculated the average of their scores in all the primary criteria. According to our expert panel the importance for each criterion in terms of average is shown in table below.

Level - 1

Criteria	Cost	Technical Specification	Customer Service	Features
Average	**0.286**	**0.227**	**0.1815**	**0.306**

Table 1: Level 1 (Average)

The below graph summarizes the above table graphically. As represented the availability of **'features'** is preferred more when choosing the service provider followed by cost, technical specifications and then customer service.

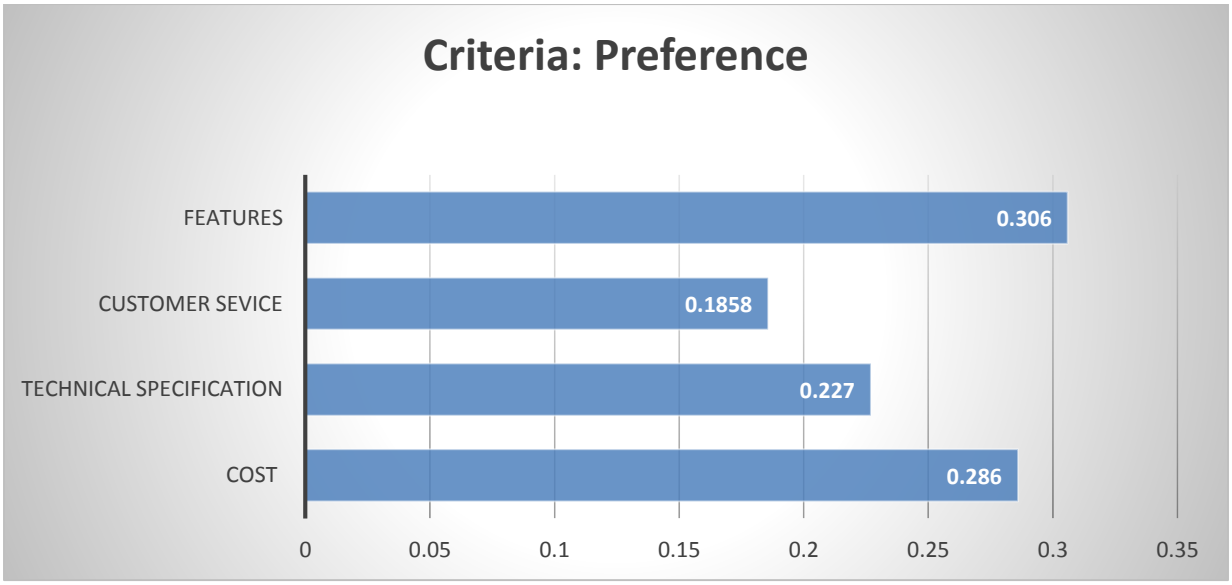

Figure 4: User Preference

Similarly we arranged the data for the sub-criteria level and calculated an average for each sub-criterion. The table below shows the data.

Level - 2

Sub Criteria	Cost	Speed	Network Coverage	Online Support	Call Support	Walk-ins Support	Plan	Discounts	International Roaming
Average	**1**	**0.43**	**0.57**	**0.3015**	**0.373**	**0.349**	**0.415**	**0.389**	**0.198**

Table 2: Level 2 (Average)

After analyzing the data categorically, we came up with the below charts under sub-criteria.

The following chart exhibits the preferences of experts under criteria -'Technical Specification'. Our analysis shows that experts prefer 'network coverage' more than 'Speed'.

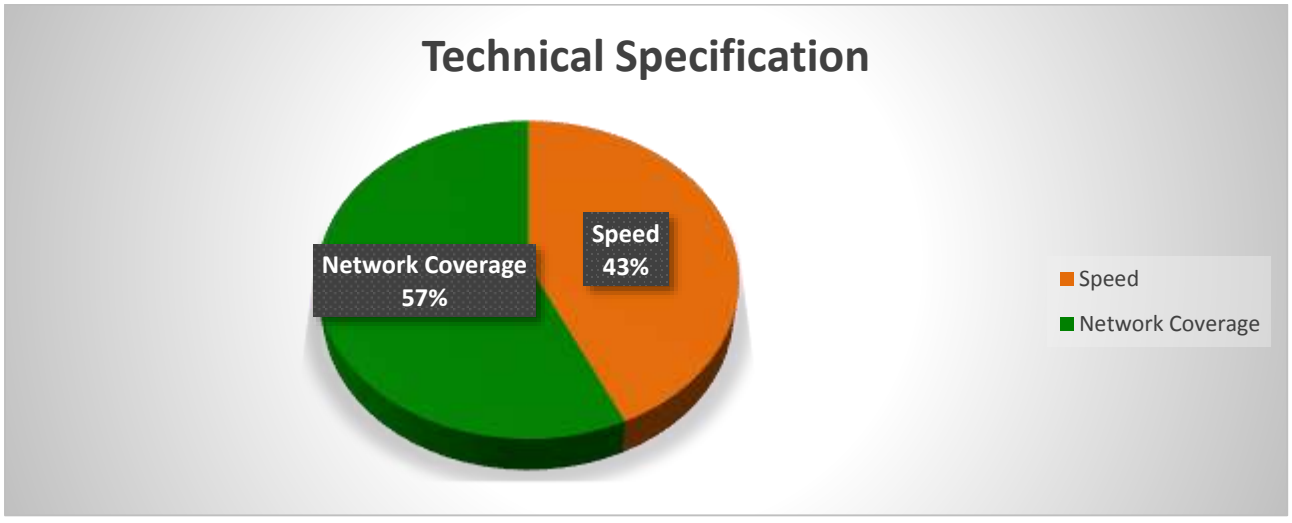

Figure 5: User Preference - Technical Specifications

The following chart shows the preferences of experts under criteria- Customer service and support'. We found out that experts prefer call support more than 'walk-ins' and 'online support'.

Figure 6: User Preference - Customer Service and Support

The following chart exhibits the preferences of experts under sub criteria - 'Features'. Our analysis shows that experts prefer suitable plans more followed by 'Discounts' then 'International Roaming'.

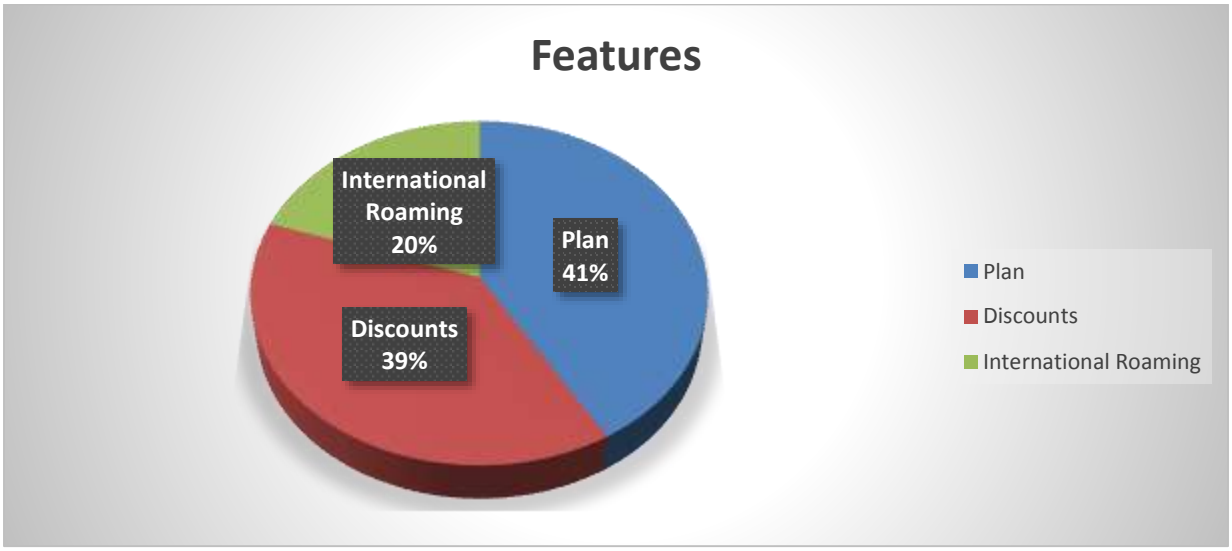

Figure 7: User Preference - Availability

The above analysis gave the importance of each criteria and sub criteria as per the expert panel. The comparison determined the relative importance for each criterion with respect to the main objective, and then we determined the relative weight that each sub-criterion has from the main criterion. Multiplying these weights as shown in below, gives us how much each of the sub-criterion defined compensate in the decision making for the ultimate goal.

Criteria	Weight	Relative	Final
Cost	0.286		0.28
Technical Specification	0.23		
Speed		0.43	0.0989
Network Coverage		0.57	0.1311
Customer Service & Support	0.1815		
Online Support		0.3	0.05445
Call Support		0.37	0.067155
Walk Ins		0.35	0.063525
Features	0.306		
Plan		0.41	0.12546
Discounts		0.39	0.11934
International Roaming		0.19	0.05814
			0.99807

Table 3: Final Output Data

The Pairwise comparison of experts' opinion was used to determine the relative importance of each criterion. The outputs of the comparison are as shown in table below. All the pairs have been listed in Appendix 2.

Cellphone Service Provider	Verizon	AT & T	T- Mobile	Sprint	Cricket	Inconsistency
EXPERT 1	0.22	0.21	0.2	0.18	0.19	0.02
EXPERT 2	0.85	0.05	0.05	0.03	0.02	0.04
EXPERT 3	0.29	0.26	0.17	0.15	0.12	0.05
EXPERT 4	0.24	0.28	0.18	0.17	0.13	0.01
EXPERT 5	0.21	0.18	0.14	0.11	0.35	0.03
EXPERT 6	0.25	0.19	0.19	0.18	0.18	0
EXPERT 7	0.21	0.21	0.21	0.21	0.16	0
EXPERT 8	0.03	0.07	0.61	0.24	0.05	0.17
EXPERT 9	0.19	0.19	0.18	0.14	0.3	0.02
EXPERT 10	0.11	0.13	0.13	0.51	0.12	0.02
EXPERT 11	0.16	0.45	0.18	0.1	0.1	0.06
EXPERT 12	0.14	0.12	0.14	0.1	0.1	0.16
EXPERT 13	0.18	0.21	0.17	0.23	0.2	0.01
EXPERT 14	0.34	0.27	0.18	0.12	0.1	0.08
EXPERT 15	0.29	0.4	0.1	0.11	0.11	0.05
EXPERT 16	0.16	0.18	0.22	0.22	0.22	0.03
EXPERT 17	0.11	0.23	0.21	0.27	0.19	0.19
EXPERT 18	0.12	0.21	0.55	0.08	0.04	0.1
EXPERT 19	0.18	0.23	0.23	0.18	0.18	0.01
EXPERT 20	0.22	0.2	0.2	0.19	0.18	0
Mean	**0.23**	**0.21**	**0.21**	**0.18**	**0.15**	
Minimum	**0.03**	**0.05**	**0.05**	**0.03**	**0.02**	
Maximum	**0.85**	**0.45**	**0.61**	**0.51**	**0.35**	
Std. Deviation	**0.16**	**0.09**	**0.13**	**0.1**	**0.08**	
Disagreement						**0.11**

Table 4: Pairwise Comparison of Experts' Opinion

The above result table shows that with 20 expert users the disagreement value comes to 0.11. We analyzed the results and found out that three expert users were more inconsistent with respect to other users. Those experts are - expert 8, expert 12 and expert 17.

Inconsistency can be explained as:

Imagine that the software asks you to enter 3 comparisons. You answer that:

A = 3*B

B = 2*C

Result will be totally consistent only if answer is that A = 6*C. Any other value will be inconsistent (a little, if A = 5*C but more if A = C)[2].

Hence, in an effort to reduce the disagreement we tried to analyze the results by eliminating the above mentioned 3 users. We found that disagreement value changed to

0.109 from **0.11.** Even though the change is minor, we observed that higher the difference in inconsistency higher the disagreement.

Cellphone Service Provider	Verizon	AT & T	T- Mobile	Sprint	Cricket	Inconsistency
Expert 1	0.22	0.21	0.2	0.18	0.19	0.02
Expert 2	0.85	0.05	0.05	0.03	0.02	0.04
Expert 3	0.29	0.26	0.17	0.15	0.12	0.05
Expert 4	0.24	0.28	0.18	0.17	0.13	0.01
Expert 5	0.21	0.18	0.14	0.11	0.35	0.03
Expert 6	0.25	0.19	0.19	0.18	0.18	0
Expert 7	0.21	0.21	0.21	0.21	0.16	0
Expert 9	0.19	0.19	0.18	0.14	0.3	0.02
Expert 10	0.11	0.13	0.13	0.51	0.12	0.02
Expert 11	0.16	0.45	0.18	0.1	0.1	0.06
Expert 13	0.18	0.21	0.17	0.23	0.2	0.01
Expert 14	0.34	0.27	0.18	0.12	0.1	0.08
Expert 15	0.29	0.4	0.1	0.11	0.11	0.05
Expert 16	0.16	0.18	0.22	0.22	0.22	0.03
Expert 18	0.12	0.21	0.55	0.08	0.04	0.1
Expert 19	0.18	0.23	0.23	0.18	0.18	0.01
Expert 20	0.22	0.2	0.2	0.19	0.18	0
Mean	0.24823529	0.2264706	0.19294118	0.171176471	0.15882353	
Minimum	0.11	0.05	0.05	0.03	0.02	
Maximum	0.85	0.45	0.55	0.51	0.35	
Std. Deviation	0.16629174	0.0919199	0.10233308	0.102340263	0.08320775	
Disagreement						0.109218541

Table 5: Effect on Disagreement after removing Inconsistent Experts

We removed the three users with greater inconsistencies to develop our understanding about inconsistencies and their affect on disagreement. For the actual analysis of data we did not eliminate the users and used their data as is.

RESULT

The overall score value is the product of the user preference value and the values of the criteria. Then, they are summed together to give the weighted score, and a decision is reached.

Table 5 shows the results and values of each alternative.

Alternatives\Weight	Cost	Speed	Network Coverage	Online Support	Call Support	Walk-in Support	Plan	Discounts	International Roaming	Total Value
	0.28	0.1311	0.0989	0.05445	0.0671	0.0635	0.12546	0.11934	0.05814	0.99799
Verizon	0.0647	0.0295631	0.0271975	0.0125778	0.0150975	0.0133081	0.0281	0.0253598	0.0131978	0.2288557
AT&T	0.051	0.0385434	0.0247745	0.0127114	0.0161711	0.0148908	0.02559	0.02351	0.013721	0.2208786
T-Mobile	0.0581	0.0226148	0.0181976	0.0142933	0.0133722	0.0144478	0.03111	0.0260161	0.0133722	0.2119078
Sprint	0.0545	0.0234014	0.0176042	0.00795	0.0114406	0.0112713	0.02196	0.0215409	0.0090408	0.1786641
Cricket	0.0561	0.0171086	0.0114724	0.0070779	0.0101321	0.0099695	0.01863	0.023152	0.0089826	0.1626664

Table 6: Result Table

The results can be graphically shown as below:

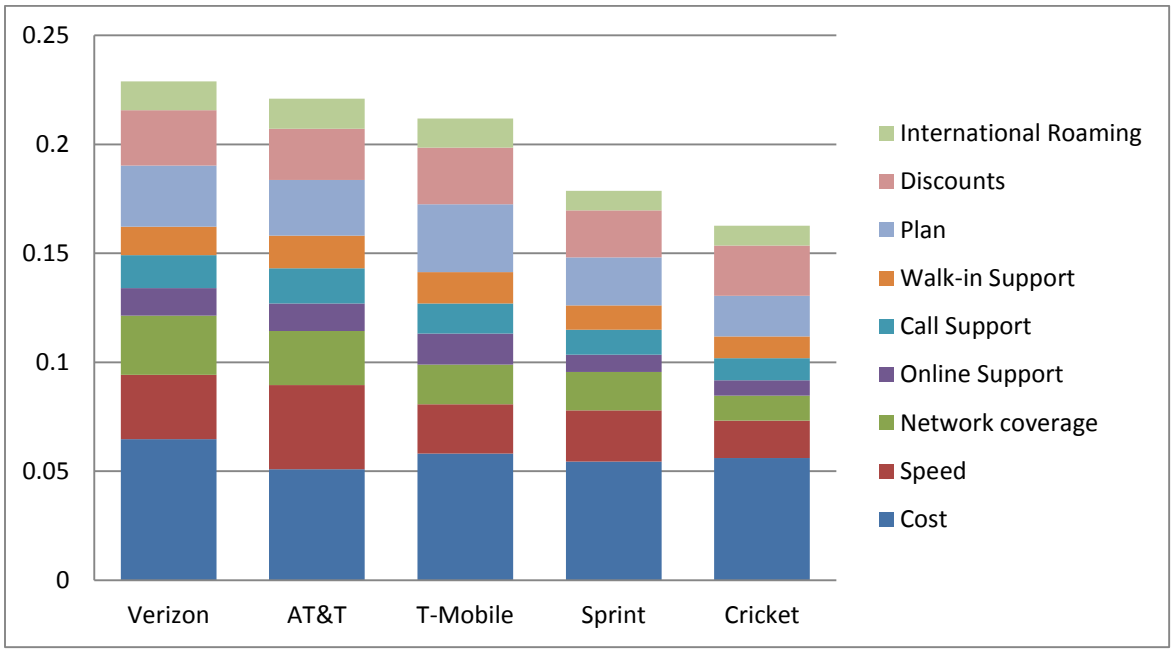

Figure 8: Graphical Analysis

The final column, which indicates total value, is the value of the alternative with respect to the perfect situation we have determined. We ranked the five alternatives to make an informed decision as shown in Table 6. The table summarizes that **Verizon** is the best alternative with a weight of 0.22885757.

Alternatives	Weight
Verizon	**0.22885757**
AT&T	**0.220878635**
T-Mobile	**0.211907825**
Sprint	**0.17866419**
Cricket	**0.16266645**

Table 7: Alternatives

CONCLUSION

In this paper, we have established a Hierarchical Decision Model for selecting the best cellphone service provider in Portland. The criteria selection of this model was cellphone plan buyer concentrated. Our hope of this research paper is to find a model that will match the desire of the service provider chooser at maximum degrees. Anyone can use this model alone as an assistant tool to select the desired service provider.

Because of the limited time and sample size we could not verify our results in a larger manner. But our model can be modified to give alterations as per the preferences of any person interested. The alterations could be selecting cellphone service provider as per-device availability, discounts availability, no. of lines with data plan, income specific and many more. We believe that the model can be fine tuned or adjusted in the future once more cases are tested.

FURTHER RESEARCH

Although we have not included utility curve in our decision model, using utility curve methodology can further enhance the usability of our model for adding any additional alternatives as desired.

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APPENDIX 1

SERVICE PROVIDER	PROS	CONS
	❖ Unlimited Talk ❖ Unlimited text ❖ Shareable data ❖ Personal hotspot ❖ International Messaging ❖ 25GB cloud storage ❖ Largest coverage	❖ CDMA network: Most of the devices will not work in many places around the world ❖ Costliest plans
	❖ Unlimited talk ❖ Unlimited text ❖ Shareable data ❖ Rollover data ❖ Unlimited international texting ❖ 50GB cloud storage ❖ GSM network: More success with international usage of devices	❖ Second most expensive ❖ Comparatively less coverage than Verizon
	❖ Unlimited talk ❖ Unlimited text ❖ Shareable data ❖ Switches from Verizon / AT&T networks provide further incentives such as cutting bill in half	❖ Limited network than Verizon and AT&T
	❖ GSM Network ❖ Prepaid Plans ❖ Cheaper Plans ❖ Unlimited data service	❖ Network suffers as compared to Verizon and AT&T ❖ Becomes most expensive for a family plan
	❖ Unlimited talk ❖ Good coverage in Portland, but limited national coverage ❖ Pay-you-go plans	❖ Roaming / long-distance plans not available ❖ Plans not available for smart phones

APPENDIX 2

CRITERIA COMPARISON

Experts: _____

Allocate

Use pair wise comparison to quantify your judgment. Allocate a total of 100 points to express your judgment about ratio of one criterion to the other one in pair.

Criterion	Weight	Weight	Criterion
Cost			Technical Specification
Cost			Customer Service and Support
Cost			Availability
Technical specification			Customer Service and Support
Technical specification			Availability
Customer Service and Support			Availability

- Technical Specification-It includes network and speed
- Customer Service and Support –It includes walk –in, online support and call support
- Availability - It includes, plan, discount and international roaming

Sub criteria comparison
(With respect to Technical Specification)

Criterion	Weight	Weight	Criterion
Speed			Network Coverage

- Speed- 3G, 4G, LTE, GSM, CDMA
- Network Coverage

Sub criteria comparison
(With respect to Customer Service and Support)

Criterion	Weight	Weight	Criterion
Online Support			Walk –in
Call Support			Online Support
Walk –in			Online Support
Walk –in			Call Support

- Online Support
- Call Support
- Walk –in

Sub criteria comparison
(With respect to Availability)

Criterion	Weight	Weight	Criterion
Plan			Discount
Plan			International Roaming
Discount			International Roaming

- Plan
- Discount
- International Roaming

APPENDIX 3

Cellphone Service Provider Survey

Please take a moment to help us gather information on your cell phone provider. Please note that this information will be kept strictly confidential.

Name

Age

Gender (Optional)

1. How important are/were each of the following attributes in your decision for plan selection? In the order of your preference rate the below on **scale of 1 to 10 (10 being highest and 1 being the lowest)**

Attributes	Scale of Importance
Network Coverage	
Plan Cost	
High Speed Data	
Talk Time	
Text	
Quality of Service	
Discounts(Corporate, Student, Senior Citizen)	
Customer Service	