Application of Analytical Hierarchy Process in the Comparison of Internet Service Providers (PLDT, Globe, and Converge) in the Philippines

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Abstract

The Internet Service Provider (ISP) is responsible for providing internet connection and services to individual and company/organizations. Nowadays, Internet service providers are growing rapidly with different advantages and disadvantages. Therefore, there are several standards that can be used to determine which internet service providers are the most appropriate for use. In this study, several internet providers were listed by the author such as PLDT, Globe and Converge. The Method that was used is AHP (Analytical Hierarchy Process) method. This method was used to determine which internet providers satisfied the respondents. With this method, Respondents are guided to make their decision in answering the survey with 8 criteria: Quality, Speed, Monthly Charges, Consistency, Latency (Ping), Contents, Customer Service and Overall user satisfaction. While for Alternatives; PLDT, Globe and Converge.

Keywords:

Internet Service Providers (ISP), Analytical Hierarchy Process (AHP), PLDT, Globe, and Converge

1. Introduction

The Internet made its way in the Philippines on March 29, 1994 with the Philippines Network Foundation (PHNet). According to Data Reportal, the average daily time Filipinos spent in using the internet was approximately 10.6 hours. And as of January 2021, there were 73.91 million internet users in the country, penetrating 67% in the population of the Philippines.

The Internet Service Provider (ISP) is responsible for providing internet connection and services to individual and company/organizations. The internet has been considered as a fast-growing technology hence, from 400 million users in 2000, it increases to over 3.4 billion users in 2016 globally (Roser, et.al., 2015). Internet is a technology used to communicate in distance worldwide by means of interactive tools such as emails, SMS, and other websites made to communicate. It also provides advantages in unlimited search of information freely accessible by anyone. The internet has become the mainstream and has been an essential to many households especially in the rise of innovation and technology. It became an access to knowledge and data for students, employees, and other workers particularly those who work in an office field.

Internet providers in the country now offer more options to be more convenient and can easily be accessible in providing internet. They offer plans such as Wi-Fi, 4G and as of now 5G is accessible via these internet providers. There are different types of ISPs namely:

- High internet speed or Cable internet - This type of connection interconnects with cables. This is often offered by cable companies
- Satellite internet - A type of connection which does not rely on wires or cables. Satellites receive and send back data to its destination. This is mostly available in rural areas.

- Digital Subscriber Line - Offered by telephone companies as it is similar to phone lines. However, since the internet became in demand telephone lines have substantially fluctuated, they have offered a new technology,
- Fiber internet or Fiber optical - Instead of using phone lines, it uses coaxial cables or copper wires. This type of connection supposed to be faster than any type of internet connection as it can carry large amounts of data in a single line, often reaching multiple terabits of data transfer fairly and easily.

With the internet being in demand, internet providers such as PLDT, Globe and Converge are listed as the most installed or service providers now in the Philippines. However, improvement on technology means improving in services such as the system of these providers.

This research aims to determine the analytical hierarchy in comparison of internet service providers in the Philippines such as PLDT, Globe and Converge. Determining in terms of quality, speed, price, consistency, latency, contents, customer service and overall user satisfaction. The questions of this research that we want to investigate are as follow:

1. Which of the three most used providers is the best?
2. What aspect or criteria considered it as the best?
3. In terms of customer satisfaction, what did they consider?
4. How do other factors affect the basis criteria of service providers?

1.1 Objectives

The researchers aim to determine the internet service provider that gives the foremost satisfaction to the users and evaluate the most efficient service provider in the Philippines.

-To determine the aspect or criteria considered to be the basis of the most efficient internet service provider.

-To specify the factors affecting the basis criteria of internet service provider

This research aims to apply the application of analytical hierarchy in comparison of internet providers in the Philippines. The study will focus on the three internet providers namely PLDT, Globe and Converge. These were selected as it is the most commonly used internet in the market today.

The study will also evaluate the given criteria to which includes quality, speed, price, consistency, latency, contents, customer service and overall user satisfaction determining the rate in each category. These criteria or factors have been determined to have common aspects with the given service providers. The researcher also conducted a survey to users of any of the given service providers. A minimum of 70 respondents per each service provider.

As the study aims at which service provider is the most efficient, the user's satisfaction will also be analyzed as it will determine whether the service provider proves its efficiency.

The research would be a baseline study for future research. It will contribute to further understanding and identify which of the three commonly used internet providers would be the best with the help of its criteria. Considering our country is one of the most active users of the internet, this will be an insight to improve the system by the internet service provider.

2. Literature Review

The country's first internet network was established in March 1994 operated by the Philippine Network Foundation (PHNet). It was connected via 64 kpbs link to Sprint link in the United States. Prior to this, the Philippines did not have a public available data network hence private companies and organizations have their own data network. Mosaic Communication was the first internet service provider (ISP) established in August 1994 (Paraz, 206). A year after the first launch of the internet in the country, the Public Telecommunications Act of the Philippines was made into law enabling organizations and companies to launch and create web sites to have their own internet service. Growth of the internet in the Philippines was interfered with by situations such as unequal distribution of internet infrastructure which led to corruption in the government. Thus, more connections have been made available in the

country, increasing the number of internet providers and users. According to AGB Nielsen Philippines, a statistic shows as of 2011, one out of three Filipinos have access to the internet. With a percentage of 43.5%, it is 5 percent higher than the Southeast Asian regional average 38%.

2.1 Quality

The quality of an internet service provider is one of the most important aspects. Since the rise of plans the ISPs now offer, customers can be more aware and observe the service they get from the service provider, which led to companies and organizations to give attention on the quality they can give to their customers. Due to exceptional rivalry, service quality became the foundation advertising for organization, featuring their enhancement in the service quality they offer.
Customers and/or users then observed criteria such as speed, price, consistency, contents, customer service and overall satisfaction on selecting an internet service provider.

2.2 Speed

The internet speed determines not only how fast you can perform a task using the internet but also determines the amount of those tasks that can handle your network. Internet speed refers to the volume of data and information that can be transferred over the web on a single connection at a given time. It is important as all tasks needed to be done through the internet will depend on the speed which is the key to transferring packets of data. The faster the connection the more packets can be transferred.

2.3 Consistency

This measures how much internet speed the respondents are receiving compared to their internet service provider. This also measures if the internet speed is reliable and remains its allocated speed.

2.4 Latency (Ping)

It measures the delay of transfer, figuring how fast a data transfer from its source to its destination. Latency can also vary depending on the type of internet connections.

2.5 Content

This measures the importance of other additional Contents within the respondent's internet service provider (eg. Streaming Services, Download Limit, 24 hrs. Technical Support, Speed of Connection), whether they provide greater benefits and are very useful on the internet usage.

2.6 Price

Prices then vary depending what type of internet connection companies have offered. According to Brett Sappington, ISPs want to keep pace with others in the market. Lowering cost can make every company offer a low-cost service provider hence it would be at risk for them to race for lowest price as it can either be a loss or win for companies depending still on the quality, they offer their customers.

However, in our country, ISPs offer expensive internet with low quality service. In 2016, it was reported that the country's average download speed at is 3.64 Mbps showing that it is eight times slower than the global average broadband download speed that has 23.3 Mbps.

2.7 Customer service

Service Providers adapted modernization and expanded on industry enhances their customer service satisfaction by improving quality and efficiency of service (Buhalijoti, 2019). A study by Anderson and Sullivan in 1993, shows that higher levels of customer service satisfaction led to a greater chance of gaining loyal customers.

2.8 Overall User Experience Satisfaction

A customer satisfaction not only comes from what the server provider gives but also the expectation of users to their provider. Customers then can criticize providers when their services are under their expectations. In addition, internet connection quality can be a way to satisfy a customer's need.

3. Methods

In the 1970s, Thomas L. Saaty, an Iraq-born University of Pittsburgh mathematics professor, developed the AHP (Analytical Hierarchy Process) method as a decision support in making a research study. In AHP, a respondent is given the option of deciding based on the comparison of the Internet Service Providers in the Philippines. The first step in making decisions is to establish a decision-making hierarchy.

In this study, the decision-making hierarchy consists of two parts, the first part is the comparison of criteria, and the second part is the comparison of alternatives based on the criteria. A respondent is asked to rate the most relevant factors in deciding. When comparing these factors, all the criteria that were used are usually compared in pairs. Number 4 denotes the highest degree of significance. Meanwhile, 1 represents the least degree of significance.

After comparing each criterion. The following move is to compare alternative decisions based on each criterion. It is the same process as the requirements comparison phase at this point. It is compared in pairs between each alternative. The comparison can be repeated as many times as there are conditions to compare. As a result, compared to comparative requirements, making alternative comparisons necessitates further comparison methods.

The final step is to summarize and evaluate the comparison so that a calculated result can be obtained. These calculations generate decisions on which criteria are more relevant than others, which alternatives are based solely on each requirement, and which alternatives are best based on all factors.

A consistency calculation must be performed in addition to the key calculation when selecting the best alternative to the AHP process. This consistency test is necessary so when a respondent compares several parameters at the same time, the values will be arranged in an inconsistent manner from most important to least important.

4. Data Collection

The researchers used a Survey Questionnaire as a data collection tool for this study. The Survey Questionnaire was created through Google Forms and distributed via online. The Questionnaire is consisted of two parts, the first part is the profiling and general classification, wherein the respondent will provide his/her age, sex, how many are there in the household, how many hours a day he/she uses the internet, what device/s he/she is/are using to connect to the internet, what Internet Service Provider (ISP) does the respondent uses, and what type of internet connection does the respondent has. The second part of it is the rating of the criteria from 4 to 1 (4 the highest and 1 the lowest) in terms of the following: Quality, Speed, Price, Consistency, Latency, Contents, Customer Service, and Overall User Satisfaction. The selected respondents are students who have online classes, so that the researchers are able to determine which ISP is the best one to use and with the help of the students who are active online are the ones who are suitable to participate for the survey. The data collected 234 responses and achieved at least 70 respondents of each of alternatives or the ISP to start organizing the data collected. After the conducting and collecting the survey, the researchers organize the data on a Excel File to compute the percentage of the results.

5. Results and Discussion

The initial step to this process is by making a hierarchical presentation of the process. The method of compiling this hierarchy would include a review of the literature to determine which standards have a significant impact on the decision-making process. The computer software package *Expert Choice* is used to validate respondent consistency for a particular level of the hierarchy. Gathering data from related literature during this process allows the researchers to conclude this hierarchical system that illustrates the following.

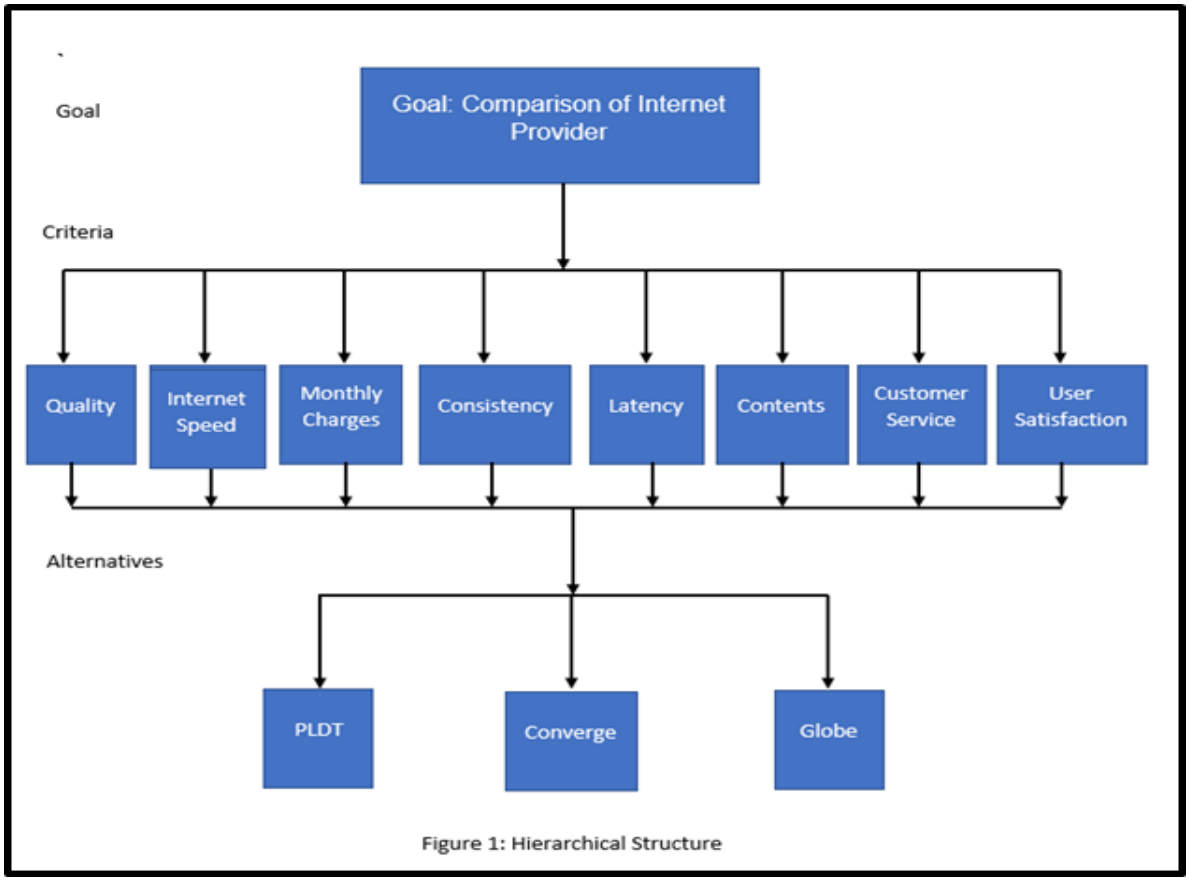


Figure 1: Hierarchical Structure

Figure 1 represents the Hierarchical Structure in this research. The criteria in the selection are Quality, Internet Speed, Monthly Charges, Consistency, Latency, Contents, Customer Service and Overall User Experience Satisfaction. Then the next step is to create a pairwise comparison for each criterion as seen in the following Figure.

Table 1. Numerical Pairwise Comparison

Model Name: AHP Research

Numerical Assessment

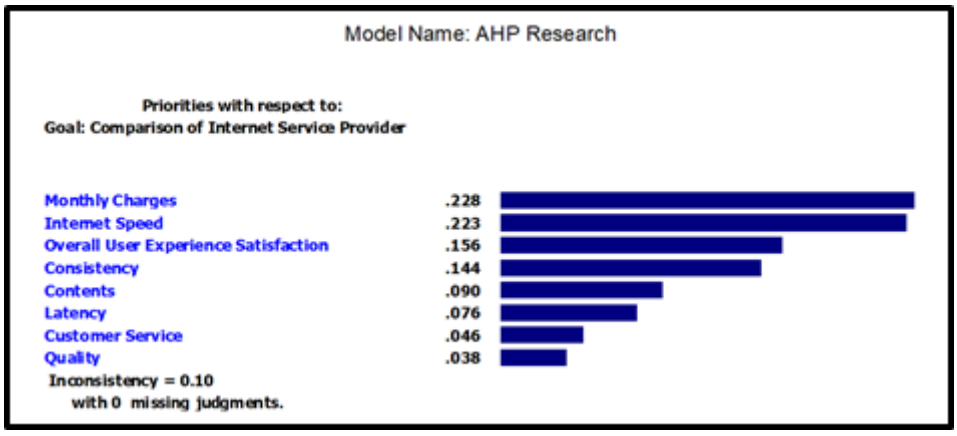
Quality | 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 | Internet Speed

Compare the relative importance with respect to: Goal: Comparison of Internet Service Provi

	Quality	Internet Sp	Monthly Ch	Consistenc	Latency	Contents	Customer S	Overall Use
C		(3.0)	(4.0)	(2.0)	(4.0)	(4.0)	(2.0)	(5.0)
Ir			1.0	3.0	2.0	4.0	4.0	2.0
M				3.0	3.0	2.0	3.0	3.0
C					3.0	4.0	4.0	1.0
L						(3.0)	3.0	(3.0)
C							2.0	(4.0)
C								(3.0)
C	Incon: 0.10							

5.1 Numerical Results

After assigning weight for each criterion with the basis gathered from related Literature, the next step is to calculate the Priorities of each criteria. Each priority value is shown at the figure below.



It is therefore important to compare each option in addition to each criterion. Since there are eight criteria to consider, all alternatives are weighed against each other using comparative matrix tables, one for each parameter.

Table 2. Synthesized Values

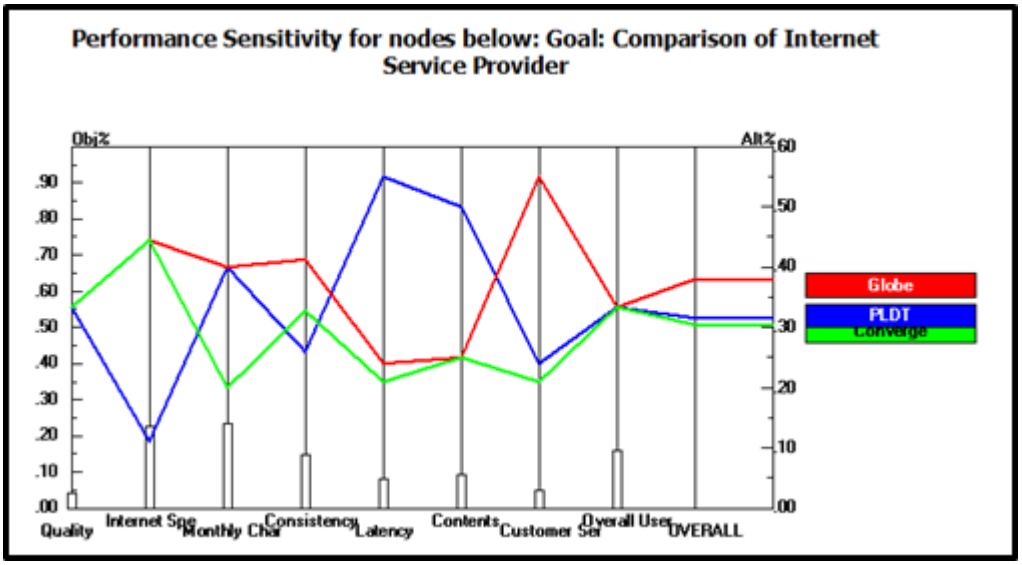
Synthesis: Details

Level 1	Alts	Prty
Percent Quality (L: .038)		**3.9**
Quality (L: .038)	PLDT	.013
	Globe	.013
	Converge	.013
Percent Internet Speed (L: .223)		**22.3**
Internet Speed (L: .223)	PLDT	.025
	Globe	.099
	Converge	.099
Percent Monthly Charges (L: .228)		**22.8**
Monthly Charges (L: .228)	PLDT	.091
	Globe	.091
	Converge	.046
Percent Consistency (L: .144)		**14.5**
Consistency (L: .144)	PLDT	.038
	Globe	.060
	Converge	.047
Percent Latency (L: .076)		**7.6**
Latency (L: .076)	PLDT	.042
	Globe	.018
	Converge	.016
Percent Contents (L: .090)		**8.9**
Contents (L: .090)	PLDT	.045
	Globe	.022
	Converge	.022
Percent Customer Service (L: .046)		**4.6**
Customer Service (L: .046)	PLDT	.011
	Globe	.025
	Converge	.010
Percent Overall User Experience Satisfaction (L: .156)		**15.6**
Overall User Experience Satisfaction (L: .156)	PLDT	.052
	Globe	.052
	Converge	.052

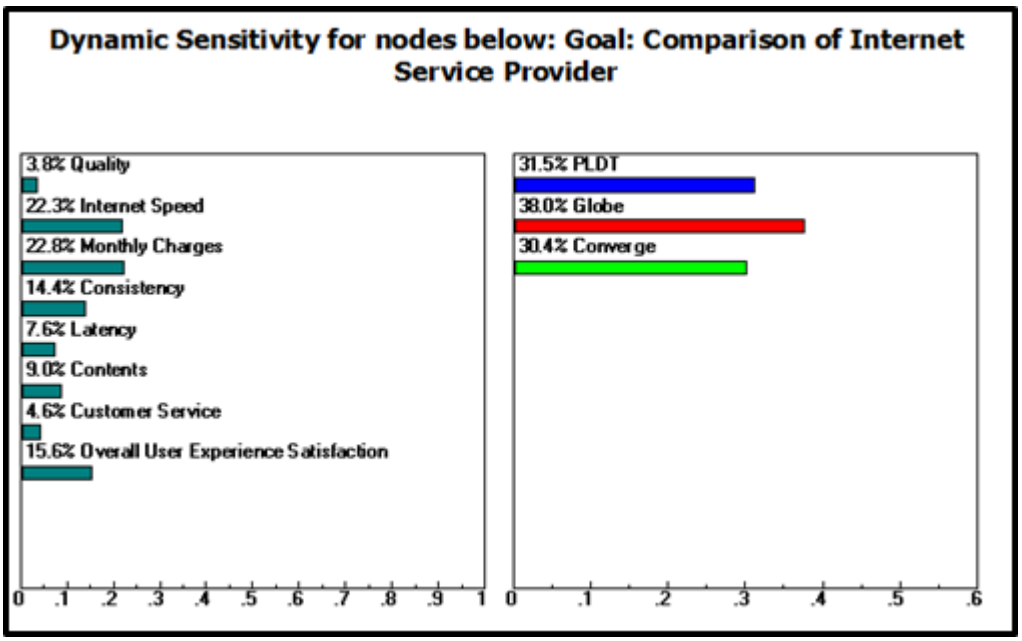
5.2 Graphical Results

The final step is to choose the best alternative based on the parameters, priority vectors, and priority vectors for each alternative. Table 2 shows the outcomes of these equations.

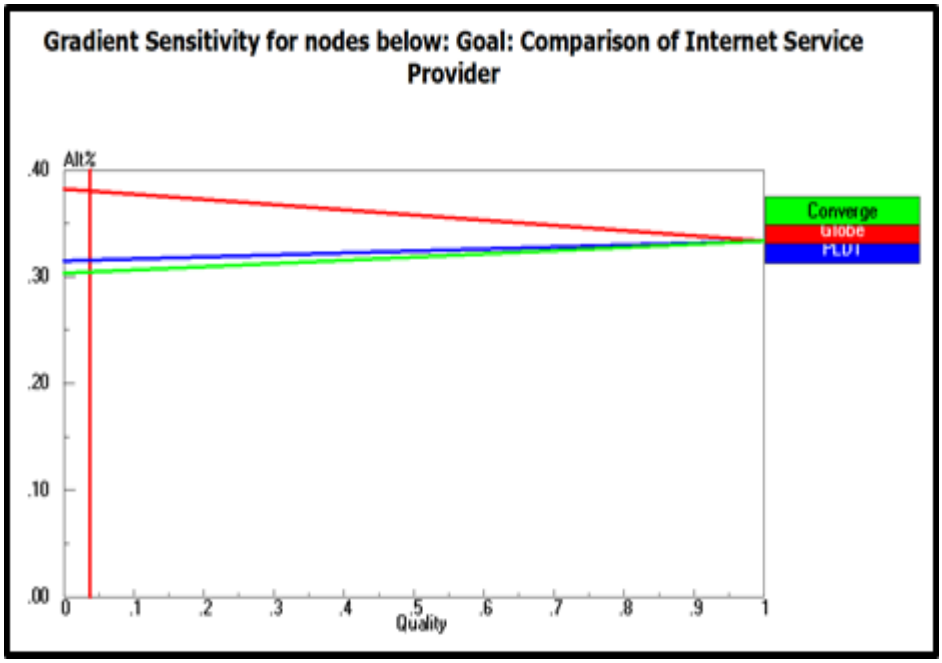
1) Graphical Illustration: Performance Sensitivity



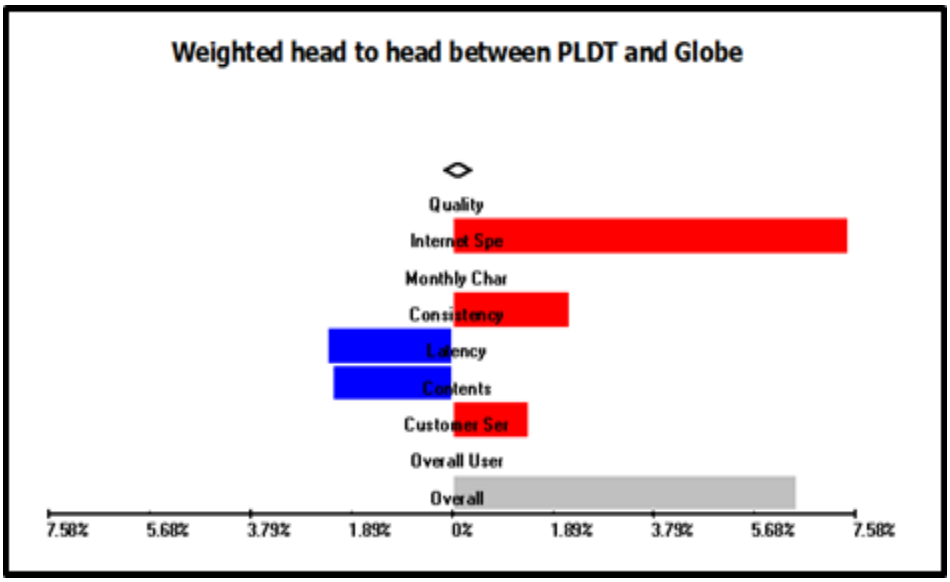
2) Graphical Illustration: Dynamic Sensitivity



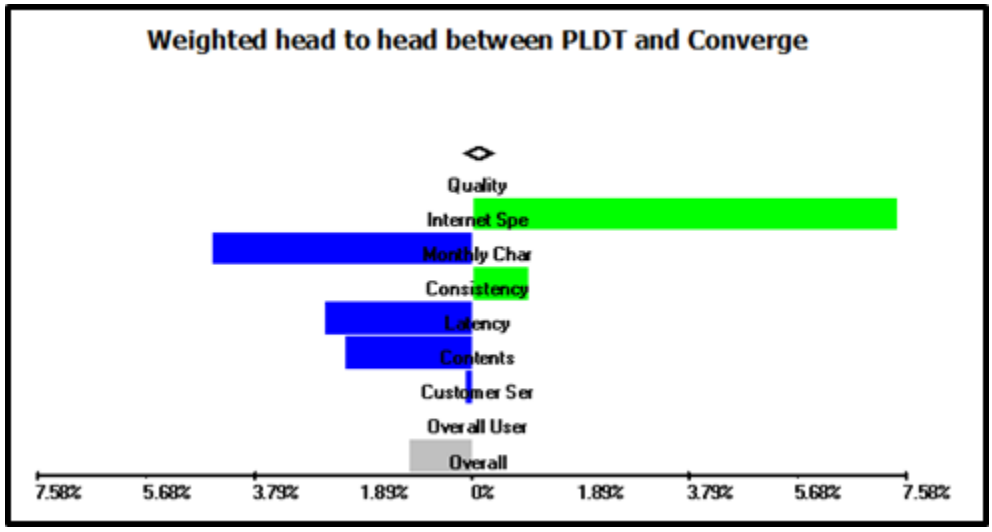
3) Graphical Illustration: Gradient Sensitivity



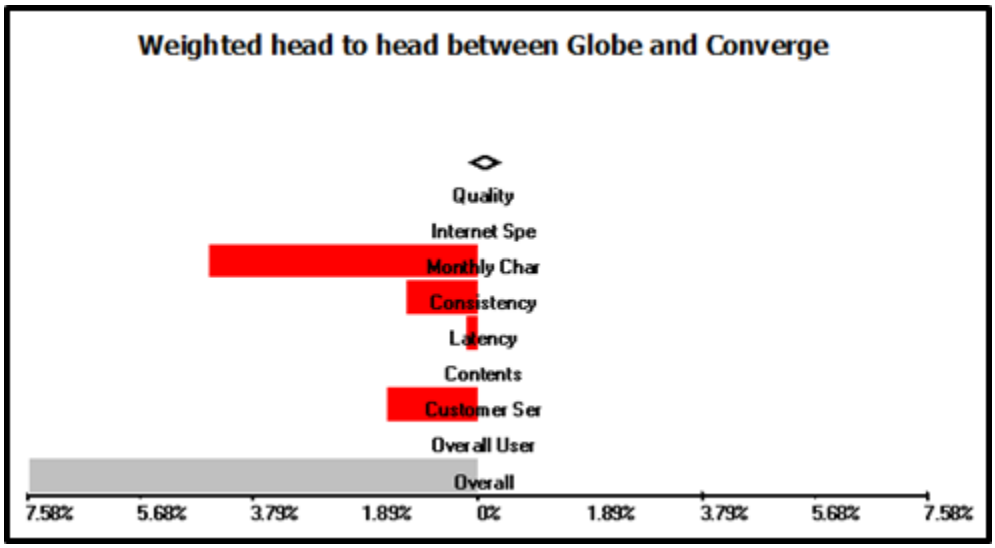
4) Head-to-Head Comparison: PLDT – Globe



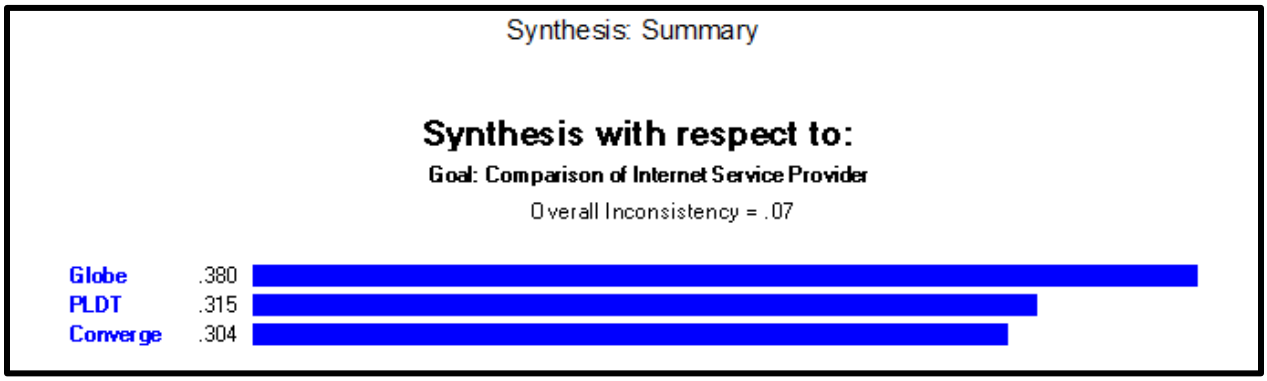
5) Head-to-Head Comparison: PLDT – Converge



6) Head-to-Head Comparison: Globe - Converge



Based on the outcome, the best alternative is the Internet Service Provider: Globe. The calculated results show significant differences per alternative within each criterion. For Quality, all the given alternatives were equal (0.333) with little to no difference. For Internet Speed, Globe (0.444) and Converge (0.444) are tied in the lead while PLDT (0.111) had the least rating. In terms of Monthly Charges, PLDT (0.400) and Globe (0.400) shared the same rating leaving converge (0.200) with lesser score. For Consistency, Globe (0.413) had higher rating consistency among the three with Converge (0.327) in second and PLDT (0.260) at third. With regards to Latency, PLDT (0.550) had the highest rating making Globe (0.240) second and Converge (0.210) third. For Contents, PLDT (0.500) had the higher rating with Globe (0.250) and Converge (0.250) tie results. Customer Service shows that Globe (0.550) had more score than the other two, making PLDT (0.240) second and Converge (0.210) third. Lastly, all three alternatives were at tie (0.333) for the Overall User Experience Satisfaction. Overall, Globe had the most rating among the other alternatives with PLDT in second and Converge at third.



5.3 Proposed Improvements

A The use of other approaches for making a decision is essential for the advancement of future research. Furthermore, an analysis of the criteria applicable to the decision-making process may be conducted in advance.

According to the results and discussion, there are different ranking of Internet Service Provider in terms of the 8 factors: Quality, Speed, Price, Consistency, Latency, Contents, Customer Service, and Overall User Experience Satisfaction. The researchers recommend in each factor the following:

- Quality- all the Internet Service Providers denoted an equal result in the quality factors. But still, the researchers would like to recommend a consistent provision of high-quality internet connection to the customers.
- Speed- Globe and Converge denoted an equal result in Internet Speed, while PLDT had the least rating. Therefore, the researchers recommend a good internet speed provision to the customers wherein they can get a good amount of Mbps of download speed and upload speed. This is highly recommended for PLDT ISP.
- Price- PLDT and Globe denoted an equal result in the monthly charges. Therefore, the researchers recommend a fair pricing of monthly charges of the ISP and can provide the best internet service to the customers. This is highly recommended for Converge ISP.
- Consistency- Globe denoted the highest rating in consistency among the three ISP. Therefore, the researchers recommend a fair consistency that is reliable and remains its allocated speed. This is highly recommended for PLDT and Converge ISP.
- Latency- PLDT denoted the highest rating in Latency among the three ISP. Therefore, the researchers recommend an excellent latency that is ideal for online gaming and online classes or work, and for the customers to receive a reliable internet connection through their streaming and browsing. This is highly recommended for Globe and Converge ISP.
- Contents- PLDT denoted the highest rating in Contents among the three ISP. Therefore, the researchers recommend providing greater benefits that is very useful to the internet usage of the customers. This is highly recommended for Globe and Converge ISP.
- Customer Service- Globe denoted the highest rating in Customer Service among the three ISP. Therefore, the researchers recommend a more accommodating and cooperative Customer care representative and a service that provides help immediately and respond in time. This is highly recommended for PLDT and Converge ISP.
- Overall User Experience Satisfaction- all the Internet Service Providers denoted an equal result in this factor, therefore are no more additional recommendation for this.

5.4 Validation

Based on the Analytical Hierarchy Process (AHP), it is given in the table that the best alternative for Internet Service Provider is Globe. As stated in the table, the first criteria showed that the three alternatives have the same result of value. This information was obtained from the expert choice and it resulted in the internet service provider rankings. In the second criteria, it is shown that PLDT is the smallest value while Globe and Converge had the same result. Whereas in the third criterion, Monthly charges, it is indicated that converge has the less monthly charges

among the three alternatives. To add, Globe has the highest ranking among the three alternatives such that it is consistent when it comes to its consistency when it comes to stability of the internet. All the three alternatives gave all the customers' needs but Globe's Customer service has the highest ranking among the three and it simply showed that Globe can give all the service that they can to satisfy their customers. Lastly, all the Internet service providers satisfy all their customer's needs.

6. Conclusion

Based on the Analytical Hierarchy Process (AHP) method's definition and arrangement of criteria and alternatives, it formed 8 criteria and 3 alternatives. Through this method, respondents were asked through a Survey Questionnaire to rate the criteria and to determine which alternative or Internet Service Provider they use so that the researchers will be able to calculate which one has the priority value. To determine which is the best Internet Service Provider that can be used is derived from using the AHP process and calculations using the computer software package *Expert Choice* is used to validate respondent consistency for a particular level of the hierarchy.

Based on the outcome, the best alternative is the Internet Service Provider: Globe. The calculated results show significant differences per alternative within each criterion. For Quality, all the given alternatives were equal with little to no difference. For Internet Speed, Globe and Converge are tied in the lead while PLDT had the least rating. In terms of Monthly Charges, PLDT and Globe shared the same rating leaving converge with lesser score. For Consistency, Globe had higher rating consistency among the three with Converge in second and PLDT at third. With regards to Latency, PLDT had the highest rating making Globe second and Converge third. For Contents, PLDT had the higher rating with Globe and Converge tie results. Customer Service shows that Globe had more score than the other two, making PLDT second and Converge third. Lastly, all three alternatives were at tie for the Overall User Experience Satisfaction. Overall, Globe had the most rating among the other alternatives with PLDT in second and Converge at third.

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Biographies

Daniel John B. Sacramento was born on September 6, 2000 in Paranaque City. He is also the eldest son of Margie Briones Sacramento and Billy Jay Sacramento. He took his primary and secondary education at St. Andrew's School Paranaque, where he received a lot of achievements in sport and sometimes received an academic excellence award. In the 4 years he spent in high school, he became an organization secretary of Science club, Treasurer of STEM club, etc. Daniel is currently studying college at Mapúa University. He is currently taking the course Bachelor of Science Major in Industrial Engineering. He is also a member of PIIE, and this is his first organization when he entered college.

Christlyn Mae C. Valeriano, born on June 1, 2000 in Manila City. Youngest daughter of Lino Valeriano and Angela Valeriano. In her Junior High School, she graduated at Sta. Lucia High School with Honors, a Leadership Awardee as the Student Council President and School's Quezon City Student Representative, and Handog sa Bayan-Center for Excellence (CENTREX) scholar. While in her Senior High School, she took the academic Strand of STEM and graduated at Our Lady of Fatima University with academic awards. She is now studying in college at Mapúa University as a 2nd year student taking up Bachelor of Science Major in Industrial Engineering. A member of PIIE, CCC, and PROMAP.

Charles Kristian Ilo, is a second year Mapua University student, A member of PIIE and PROMAP currently enrolled and pursuing the course of Industrial Engineering. Born on January 1, 2001, at Bocaue, Bulacan now living at Balagtas, Bulacan, Charles went to Children's Mindware School at Elementary and St. Paul College of Bocaue completed his Primary and Secondary Education, respectively. He received awards with honors awarded to him in Elementary and Nestle Scholarship through High School. In senior High School, he took the academic Strand of STEM. Currently, Charles studies at Mapúa University pursuing the course of Industrial engineering. Industrial Engineering is a great fit choice as the flexibility and wideness of this course is applicable to various fields in the real world.

Maria Kathryne A. Illescas, born in Manila on March 31, 2000 as the Youngest of Rosalie A. Illescas and Danilo I. Illescas. She took primary and secondary education in Colegio San Agustin in Biñan City, Laguna. Was an active member and officer of *Himanyon* under the school organization, Center for Performing Arts and Culture (CPACS). She graduated Senior High School with honors in Mapúa University --Manila under Science, Technology, Engineering and Mathematics (STEM). Then continue to pursue college in the same university taking up Bachelor of Science Major in Industrial Engineering. Currently, a member of school organization Productions and Operations Management Association of the Philippines (PROMAP) and Philippine Institute of Industrial Engineers (PIIE).

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