

# **An Application of Analytical Hierarchy Process in the Comparison of Zoom, Google meet, and MS teams**

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## **Abstract**

The COVID-19 pandemic had generated issues to individuals worldwide and education was one of the factors that experienced a major downfall. People started to use web conferencing applications during this pandemic since face-to-face meetings and large gatherings are prohibited. Web conferencing software serves a huge factor in business, family, and especially education. The aim of the study is to determine which web conferencing or video telephony applications perform better based on data usage, size, user-friendliness, compatibility, security and safety, features and functionality, reliability, service, and overall satisfaction. After generating the criteria, a total of 210 respondents participated in the online survey to determine the average rating per category based on their experience of using the application Google Meet, Microsoft Teams, and Zoom. The tallied averages were used in the AHP on the Expert Choice software to determine the weight per criteria. The study result shows that the Google Meet performs better than other two web conferencing applications within the given criteria.

## **Keywords**

Pandemic, Videotelephony, Google Meet, Zoom, Microsoft Teams

## **1. Introduction**

There are a lot of people using different web conferencing applications especially during this pandemic where having big meetings, gatherings is not allowed. Now that most people are just staying in our homes, web conferencing applications have been a huge factor for businesses, family, and especially education. With people learning through online classes, there are a lot of web conferencing applications that are being used by different schools. This paper focuses on comparing the three most used web conferencing applications which are Zoom, MS Teams, and Google Meet. Majority of the people who use web conferencing applications are workers and students. According to Charlotte Verbrugghe, since the coronavirus started to spread around the world, people are forced to stay in their houses and since a lot of things can be done digitally, people started using different web conferencing applications. It is important to look for the right video conferencing tool to fulfill the meeting's needs (Verbrugghe, 2020).

There have been a lot of changes in the different video conferencing applications in the past years. Video conferencing has been made easier by the creators of zoom, ms teams, and google meet. The study aims to help people be aware of the different factors when it comes to choosing the right web conferencing application for different meetings, especially since online classes and work from home has been the new normal. This study will serve as reference for future use in determining which is the better web conferencing application when it comes to different factors such as features, security, availability, etc.

### **1.1 Objectives**

The main objective of the study is to determine which communication software or application performs better in terms of the criteria utilized in the decision analysis. The specific objectives of the study are described as: (1) to determine factors that affects the performance of communication software or application used by students for online learning,

(2) To identify modern application utilized by students synchronous sessions, (3) to apply the Analytical Hierarchy Process (AHP) method in evaluating which alternative performs better based on the criteria used by the researchers.

## **2. Literature Review COVID - 19 Pandemic**

During the first few months of 2020, an unfortunate turn of event had occurred, a major virus called the “Coronavirus disease 2019 or COVID-19. The pandemic led thousands of lives to face unprecedented circumstances that affected their mental health. Mental health, defined by World Health Organization (WHO), is a “a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community” (World Health Organization, 2018). Maintaining a stable mental health is very crucial during the pandemic. COVID-19 has definitely changed the lives of multiple people, the rapidly increase of COVID-19 cases has forced everyone to stay on their own homes for safety measurements. Many schools, institutions, shops, and restaurants were forced to be closed temporarily to lessen the cases. But, despite the dangerous outbreak amid by this disease, some workers have no choice but to be exposed to the outside world for them to mitigate the risks.

Kumar and Modalavalasa (2020) wrote an article that talks about the five major changes that happened during the pandemic. The pandemic helped humanity to identify the unearthed weaknesses that were neglected before the tragedy; thus, the article listed the (5) five fundamental changes; they are, (1) Employment: More automation, (2) Health care: Increased telemedicine, (3) Travel: Stricter precautions, (4) Job Staffing: Increasing work-from-home options, and lastly, (5) Education: Virtual curriculum will grow. As for the companies, companies like LinkedIn and Shaw Academy are offering skill-based virtual training to help prospective employees find appropriate alternative positions (Kumar and Modalavalasa, 2020). As for the health care workers, based on the Google search trends, people began searching for online therapy sessions because some experience mental health issues during the pandemic while they were being placed for isolation. As for travels, people were prohibited to travel for the time being to stop it from spreading globally, which resulted the airline industries from suffering financially. As for people who work from their homes, they were forced to shift to working online using online web conferencing tools, such as Zoom, Microsoft Teams, and G-suite applications. Similarly, students were also able to fully utilize these conferencing tools. Many academic institutions that were earlier reluctant to change their traditional pedagogical approach had no option but to shift entirely to online teaching–learning (Dhawan, 2020).

### *Online Learning*

The modern way of teaching started on the 2<sup>nd</sup> day of March where face-to-face classes were suspended in universities and schools globally. The use of online software arises to keep up with the missed classes in mid-summer. Along with the emergence of online classes, teaching through G suite, Gmail, Classroom were proposed (Basilaia et al., 2020). In the aspect of online learning, the pandemic had generated difficulties to individuals worldwide and education was one of the factors that experienced a major downfall. On behalf of academic institutions, it was a challenging time since the demand for alternative teaching has emerged that led to the introduction of e-learning through online classes to continue the learning process for the students. The study focused on evaluating the effectiveness and satisfaction of online classes compared to the traditional learning system to medical students. The results indicated that the online learning was effective in other factors, but the students would still prefer the classroom teaching. The study concluded that the students are somehow dissatisfied with the alternative and the online classes are supplementary on the current situation but being substitute for the traditional teaching was unlikely (Kaur et al., 2020).

### *Online Software/Application for Communication*

With the continued growth of communication technologies, this can give opportunity to people when conducting a qualitative research. One of the examples of the communication technologies is the Zoom, this web conferencing application has many kinds of features to conduct a qualitative research. There are few who have studied the perspective of the researchers and participants when it comes to using the web conferencing applications. With this study, it explores the feasibility and acceptability of using Zoom to gather qualitative interview data to have knowledge about its suitability for its qualitative method. Archibald (2019) asked 16 practice nurses who have experienced answering an online qualitative interview about their experience in using Zoom. In this study, the findings suggest the possibility of the Zoom as a tool in gathering the qualitative data because of its ease of use, cost-effectiveness, data features, and its security option.

With COVID-19 transmitting the virus from all over the world, lockdown and social distancing has been implemented everywhere as a part of preventive measures against the virus. This where the online learning shifts in, the reason is the shutdown of the education system from all over the world. During this crisis we have been dependent on information technology. In this study, the researchers offer the insight of the impact of Microsoft Teams application in enhancing teaching-learning English during COVID-19. Bsharat and Behak (2020). Moreover, this study recommended in using the Microsoft Team's application, also gives the English teachers, students, and workshops to have the knowledge on using the application.

#### *Analytical Hierarchy Process (AHP) method*

There have been a lot of advancements in technology, and various things can be done digitally especially in terms of communication which are utilized by students and professors during this time of pandemic. AHP can be used in this research in comparing three different web application software and determine the which is the better software to use. The use of AHP is effective to deal with qualitative decisioning of operation management (Partovi et al., 1990)

#### *Criteria for Decision Analysis*

#### *Security and Safety.*

Online web conferencing tools such as Zoom, Google Meet and MS Teams have become central to our professional, educational, and personal lives (Ling et al., 2020). When it comes to education and personal lives, securing personal information is very essential, especially if it is associated to huge platforms. There are multiple ways on how to secure personal data. Large web conferencing platforms are being operated by a vast number of users to which every single one of them serves their own purposes (i.e., Online Classes, Meetings, Group Discussions, etc.). However, considering the amount of users and how huge the platform is, it is quite reasonable to say that not all users has the same purpose. During the first seven months of 2020, a phenomenon known as “zoombombing” has emerged, in which aggressors join online meetings with the goal of disrupting them and harassing their participants (Ling et al., 2020). Zoom is plagued with a huge number of security and privacy issues which they are trying to fix with regular updates, this app which was once touted for its easy interface is now used along with terms like “hack” and “security issues” (Singh, 2020). No person would be pleased if they found out that their personal accounts or information was revealed. Securing personal information should be one of the most essential things that should be prioritized.

#### *Features and Functionality.*

In the past years, a lot has changed on web conferencing applications especially since it is being used by most students and professors during this pandemic. Different features and functions have been made for the convenience of the users. Communication is a very important thing but communicating through long distances introduces some problems (Hurst, 2020). Through advancements in technology, different features and functionality are added to web conferencing applications that are mostly used today such as zoom, ms teams, and google meet. While these remote sessions have many advantages, they may result in challenges and frustration for both host and attendees when there are technological issues, poor or distracting audio, or ineffective presentation styles (Lewis et al., 2020). That is why different features and tools are made for the convenience of the user.

#### *Reliability*

The study indicates video conferencing applications allow individuals to interact through video calls that require a camera and a microphone. A type of a video conferencing application that allows users to send video and audio to other users is WebRTC or Web Real-Time Communication). The application's reliability and performance were tested through various factors such as the quality of image, number of frames, errors, internet connection, and delay. The study indicated that connections in different conditions whether mobile or web browser and maintaining the connection when errors, crashes, and other difficulties that occurs plays a major role (Choros & Hitterski, 2020)

#### *User-friendliness*

The evaluation of the usability of web conferencing applications of Metso were proposed to assist the early phase of designing and the development of user interface. The study used a System Usability Scale (SUS) since it was quick and easy. The results indicated that the usability of Metso was below average while other provided statements regarding the video conferencing service in general. However, the study concluded that the SUS was not very informative on determining the solutions for improvement of Metso but more of a feedback of overall experience (Suominen, 2013).

### 3. Methods

The paper consists of 210 respondents with 70 respondents for each web conferencing application (Zoom, MS teams, Google Meet). The chosen respondents are people who use web conferencing applications, which mostly consists of students. The researchers handed out their survey to different people that uses these three conferencing applications may it be for online classes, work meetings, etc. The survey consists of 13 questions that involves the different factors such as features, security, compatibility, etc. The researchers used the AHP (Analytical Hierarchy Process) method in order to compare the three different web conferencing applications and to determine which among this application is better in different situations.

### 4. Data Collection

For the data collection, the researchers gathered necessary information through an online survey. The sampling technique used in this study is purposive sampling since the researchers would only assess respondents who are currently taking online education which utilizes communication software. The respondents, composed of 70 participants for each software, are asked to rate the level of importance and their satisfaction based on the given criteria. The purpose of the questionnaire is to evaluate the respondent’s satisfaction and preference on the given online communication software. Through this, essential data was gathered and will undergo Analytical Hierarchy Process (AHP) method to determine which software performs better based on the criteria used for the decision analysis.

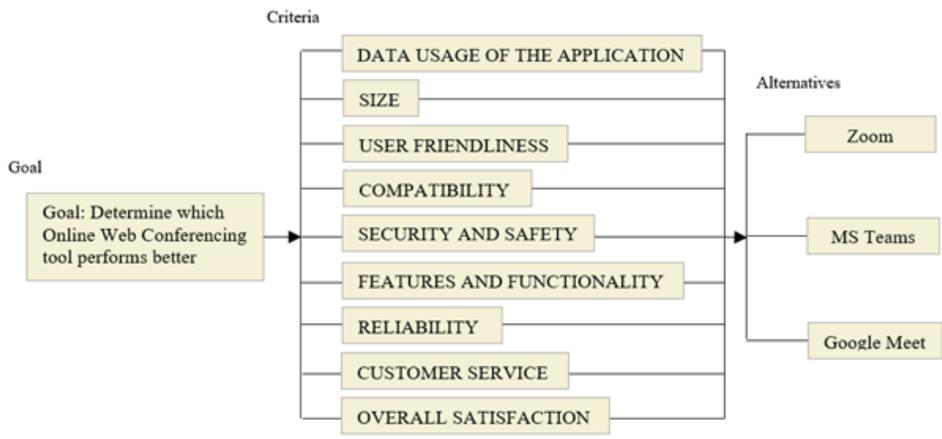


Figure 1. Hierarchical Structure

	COMPATIB	CUSTOMER	DATA USA	FEATURES	OVERALL	RELIABIL	SECURITY	SIZE	USER FRIE
COMPATIBILITY		4.0	3.0	4.0	5.0	2.0	7.0	1.0	2.0
CUSTOMER SERVICE			3.0	1.0	2.0	1.0	6.0	2.0	2.0
DATA USAGE OF THE APPLICATION				3.0	3.0	2.0	7.0	1.0	2.0
FEATURES AND FUNCTIONALITY					1.0	2.0	2.0	2.0	1.0
OVERALL SATISFACTION						2.0	5.0	2.0	1.0
RELIABILITY							2.0	1.0	2.0
SECURITY AND SAFETY								7.0	2.0
SIZE									2.0
USER FRIENDLINESS									

Incon: 0.05

Figure 2. Numerical Pairwise Comparison

### 5. Results and Discussion

The table shown in Figure 1 depicts the Hierarchical structure of this research. The goal which is to determine which

online web conferencing application performs better has different criterias being the Data usage, Size, User friendliness, Compatibility, Security and safety, Features and functionality, Reliability, Customer service, and Overall satisfaction. After this, the researchers will create a pairwise comparison of the different criterions which can be seen in Figure 2.

### 5.1 Numerical Results

After determining the weight for each criterion, the priorities of each criterion will be computed as shown in Figure 3. The next step is to consider each criterion, and weigh the criteria with each other by using the comparative matrix for each parameter. Synthesized values are shown in Figure 4.

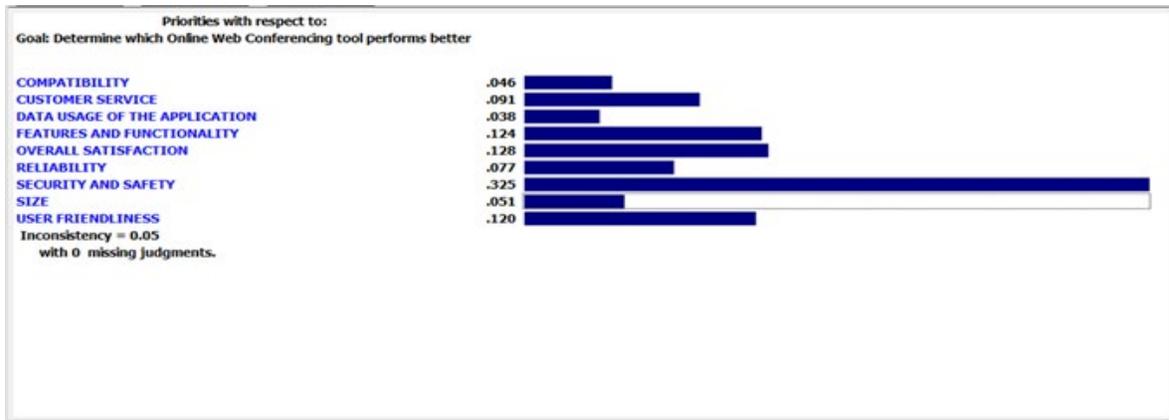


Figure 3. Priorities Derived from Pairwise Comparison

Level 1	Alts	Pnty
<b>Percent COMPATIBILITY (L: .046)</b>		<b>4.5</b>
COMPATIBILITY (L: .046)	Zoom Me...	.008
	MS Teams	.005
	Google M...	.032
<b>Percent CUSTOMER SERVICE (L: .091)</b>		<b>9.1</b>
CUSTOMER SERVICE (L: .091)	Zoom Me...	.024
	MS Teams	.011
	Google M...	.056
<b>Percent DATA USAGE OF THE APPLICATION (L: .038)</b>		<b>3.9</b>
DATA USAGE OF THE APPLICATION (L: .038)	Zoom Me...	.023
	MS Teams	.010
	Google M...	.006
<b>Percent FEATURES AND FUNCTIONALITY (L: .124)</b>		<b>12.4</b>
FEATURES AND FUNCTIONALITY (L: .124)	Zoom Me...	.089
	MS Teams	.011
	Google M...	.024
<b>Percent OVERALL SATISFACTION (L: .128)</b>		<b>12.8</b>
OVERALL SATISFACTION (L: .128)	Zoom Me...	.043
	MS Teams	.018
	Google M...	.067
<b>Percent RELIABILITY (L: .077)</b>		<b>7.7</b>
RELIABILITY (L: .077)	Zoom Me...	.018
	MS Teams	.006
	Google M...	.053
<b>Percent SECURITY AND SAFETY (L: .325)</b>		<b>32.5</b>
SECURITY AND SAFETY (L: .325)	Zoom Me...	.038
	MS Teams	.065
	Google M...	.222
<b>Percent SIZE (L: .051)</b>		<b>5.2</b>
SIZE (L: .051)	Zoom Me...	.034
	MS Teams	.009
	Google M...	.009
<b>Percent USER FRIENDLINESS (L: .120)</b>		<b>12.0</b>
USER FRIENDLINESS (L: .120)	Zoom Me...	.028
	MS Teams	.007
	Google M...	.085

Figure 4. Synthesized Values

## 5.2 Graphical Results

Figures 5-10 are shown various graphical results

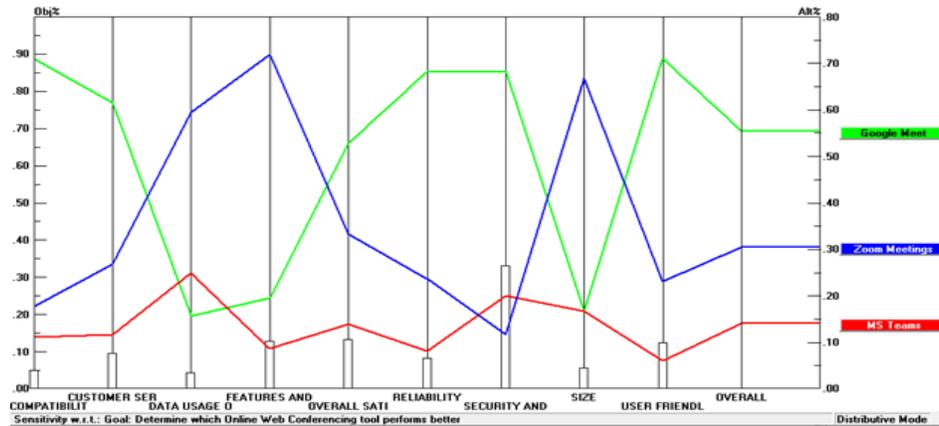


Figure 5. Graphical Illustration: Performance Sensitivity

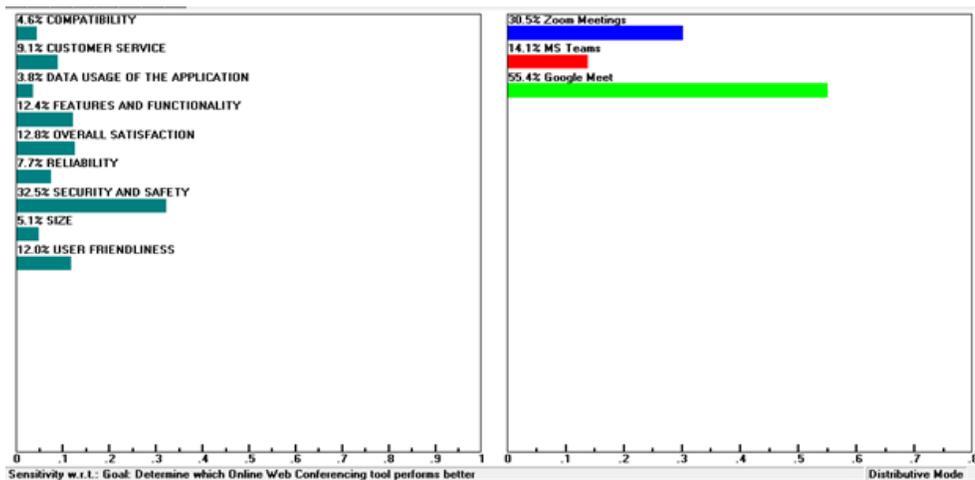


Figure 6. Graphical Illustration: Dynamic Sensitivity

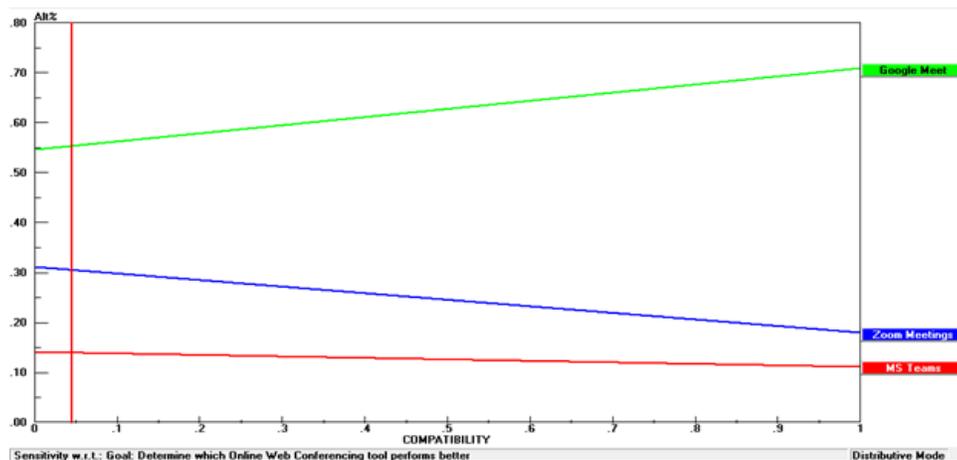


Figure 7. Graphical Illustration: Gradient Sensitivity

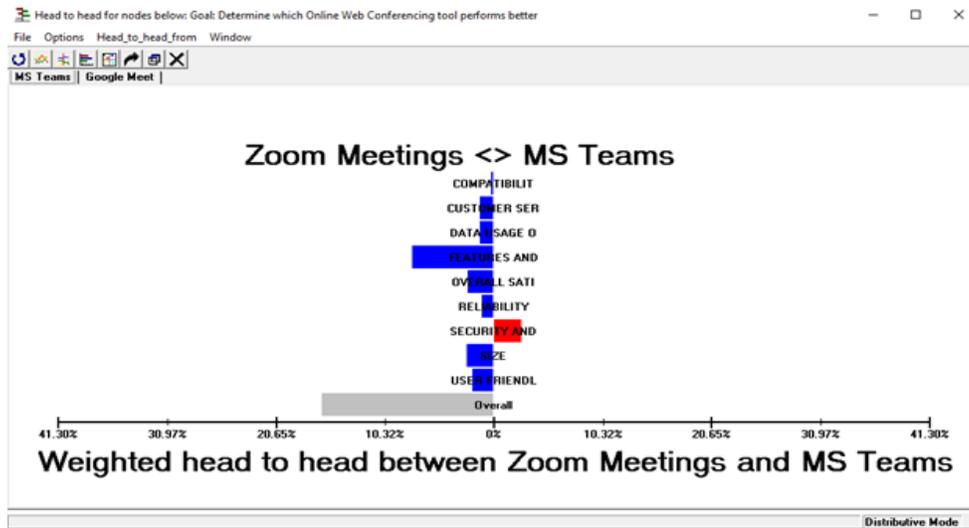


Figure 8. Head-to-Head Comparison: Zoom vs. MS teams

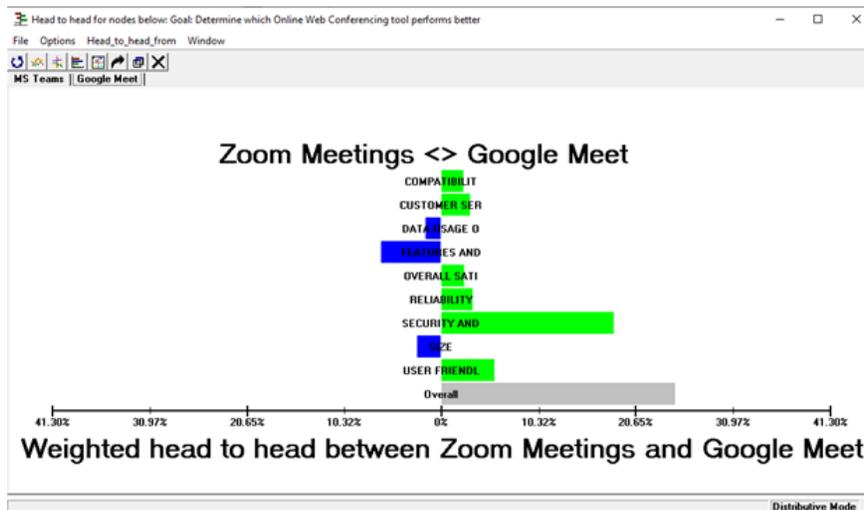


Figure 9. Head-to-Head Comparison: Zoom vs. Google meet

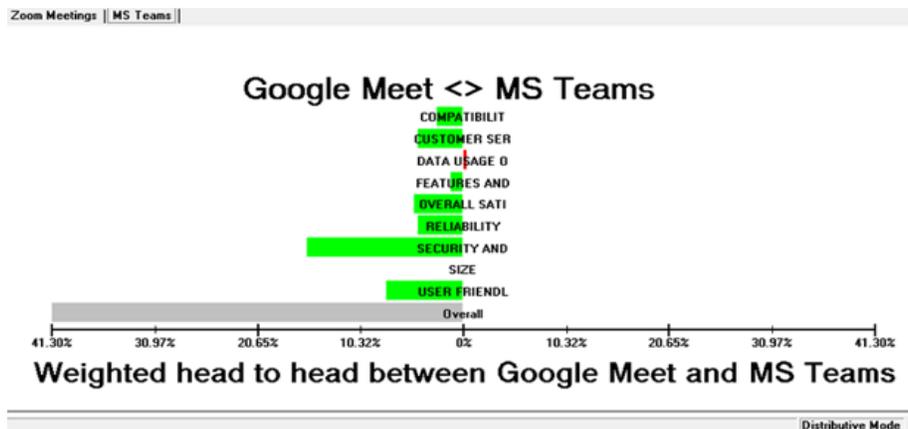


Figure 10. Head-to-Head Comparison: Google meet vs. MS teams

Based on the results of the given data, the web conferencing application that performs best is Google meet. The results given shows the significant difference between each alternative for each criterion. When it comes to Data usage, Zoom meetings got a rating of 0.594, while MS teams got 0.249, and Google meet got 0.157. In size, Zoom gets another high rating of 0.667, next is MS teams tied with Google meet with a rating of 0.167. User friendliness, Google meet with the highest rating of 0.709, Zoom with a rating of 0.231, and MS teams with a rating of 0.060. Compatibility, Google meet placed first with a rating of 0.709, while Zoom placed second with a rating of 0.179, Last is MS teams with 0.113. When it comes to Security and safety, Google meet has 0.683, while MS teams has 0.200, lastly Zoom's rating is 0.117. In Reliability, Google meet has a rating of 0.682, while Zoom has 0.236, and MS teams has 0.082. In Customer service, Google meet has 0.614 rating, while Zoom has 0.268, and MS teams has 0.117. Lastly, in Overall satisfaction, Google meet placed first with a rating of 0.528, second is Zoom with a rating of 0.333, and MS teams in last place with a rating of 0.140.

### 5.3 Proposed Improvements

The researchers think that the companies holding these applications should focus more on improving the different factors that can make video conferencing more convenient to the users. Companies should add more features, and add more security for the user's needs. They should also take care of their customers and address their concerns as fast as possible, since video conferencing applications are a trend during this pandemic. Conducting surveys about the user's experience in order for them to determine which factors the web application is lacking.

### 5.4 Validation

In this study, based on the Analytical Hierarchy Process (AHP), it shows the result of what is the best alternative for the web conferencing application. As shown from the data, the first head to head comparison between Zoom Meetings and MS Teams shows that from the 9 criteria, Zoom Meetings is the best alternative based on the criteria and MS Teams only stands out from its security and safety. As for the second head to head comparison between Zoom Meetings and Google Meet. Zoom Meetings is only the best alternative when it comes to Data Usage, Features and Functionality, and its size, so based from the second head to head comparison, Google Meet is the best alternative. Lastly, the third head to head comparison between Google Meet and MS Teams. It is clearly shown from the results of the data that Google Meet has the best alternative when it comes to all of its criteria. In addition, Google Meet has the highest ranking among the three head to head comparison. In all of the alternatives from the data, it is shown that all of its criteria has all the customer needs, but when it comes to satisfying the customer needs it is clearly shown that Google Meet can give all of its satisfaction for the customer needs.

## 6. Conclusion

In this study, based on the Analytical Hierarchy Process (AHP) data. It shows that it has about 9 criteria and resulted into 3 alternatives. In this method, we asked the respondents to evaluate the three web conferencing applications based on the criteria that we have shown, and determine what is the best alternative among the three. As shown from the data, we have been able to determine the best web conferencing applications from the results of the evaluation of the respondents, Google Meet is the web conferencing application that has the high ranking value among the three. In addition, Google Meet did not only have the highest ranking but its customer satisfaction has met all the criteria that is all needed by a customer.

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## Biography

**James Brylle C. Foz**, a second-year student in Mapua University. He was born on March 22, 2002 in Pasay City, and now lives in Las Pinas City. James took his primary education at Integrated Montessori Center and took his secondary education at Saint Francis of Assisi College. During his primary and secondary education, he achieved a lot of academic excellence awards and has won a lot of cooking competitions for his co-curricular activities. While in Senior High School, he took STEM for his academic strand. and now currently pursuing his course of Bachelor of Science Major in Industrial Engineering at Mapua University, he joined his first organization at PIIE and currently he is a member of it.

**Ervin Josh P. Santos**, born on August 18, 2001 and a 2nd year Industrial Engineering student of Mapua University. He currently lives at Paranaque City, and is the eldest son of Janet Santos. He took his primary education at Mother Maria Madalena Starace school he graduated grade school as top 3 in his class. He then studied highschool at St. Andrew's School Paranaque, where he also received different academic achievements. At senior highschool he transferred at Mapua University and took the STEM course. At grade 12 his group received the best research paper award. He studied at Mapua University until college, where he took Bachelor of Science in Industrial Engineering program.

**Martin James Del Rosario Olan** was born on October 28, 2000 in Malolos, Bulacan. He was raised in Manila and the youngest of their family. Martin took his primary education in Christian Academy of Manila where he graduated as Salutatorian of his class. For his secondary education, he went to Malayan High School of Science and engaged into extracurricular activities such as sports and became a member of the basketball varsity team of their school, Mapua Red Robins. In Senior High School, he took STEM strand in Mapua University Intramuros and graduated with honors last 2019. Currently, He is studying his 2<sup>nd</sup> year of Bachelor of Science in Industrial Engineering in Mapua University.

**Daniel N. Perez**, born and raised in the province of Paete, Laguna on the 20th of July, 2001. He grew up being the youngest of the family together with his two older brothers. On his educational background, he started his primary education at Little Shepherd Integrated Montessori in Lumban, Laguna. Then, on his secondary education, he migrated to Italy to continue his studies for five years. During those five years, he was able to fully understand the Italian language and to speak it fluently. After finishing his secondary education, he went back to the Philippines to continue on pursuing his studies. He went back to his primary school in Lumban for his Senior Year and took the General

Academic Strand (GAS). He is now studying at Mapua University and is currently taking the course of Bachelor's of Science Major in Industrial Engineering.

**Rianina D. Borresis** an Assistant Professor of School of Industrial Engineering and Engineering Management at Mapua University in Intramuros, Manila, Philippines. She has earned her B.S degree in Industrial Engineering (IE) and Masters of Engineering Program major in IE from Mapua University, Intramuros, Manila, Philippines. She is a Professional Industrial Engineer (PIE) with over 15 years of experience. She has taught courses in Probability and Statistics, Methods and Time Study, Systems Engineering, Operations Research and Computer Integrated Manufacturing. She is a part-time consultant that specializes in improving different systems/processes which includes re-layout, computation of manpower requirement, establish Job Description, etc. She has done research projects in operations research, production and human factors and ergonomics. She is a member of Philippine Institute of Industrial Engineers (PIIE).