# Weighting the Position & Skillset of Players in League of Legends Using Analytic Hierarchy Process

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**Abstract -** *Today, esports such as League of Legends are a popular form of competition using video games. Many researchers have conducted studies in the esports field such as player psychology, training, and physical exercise; however, those that apply quantitative techniques are still scarce. In this paper, Analytic Hierarchy Process is proposed for weighting position and skillsets of players in League of Legends. It is hypothesized by the developer that pairwise comparison can be used to derive priority scale through the judgment of experts. A questionnaire is designed to obtain pairwise comparison from players which are then used to develop the priority scale. The empirical results obtained show the weightage of position and skillset of each player. This weightage shows the priorities of certain position compared to other positions, and the priorities of skillsets needed to perform well in each position, based on their judgment. The results can be used to determine the most suitable players for each position with the right skillset quantitatively and systematically.*

**Keywords:** AHP, esports, League of Legends, team formation.



## 1 Introduction

League of Legends is a competitive multiplayer online battle arena (MOBA) game where a team of five fights against another team of five in order to destroy the opponent's base (called the Nexus) as the winning condition in a map called Summoner's Rift (Riot, 2020). Communicative ability and teamworking skill among teammates are important in achieving success (Costa, 2019). Deciding who plays in a team can determine whether the team wins or loses, therefore this study will use Analytic Hierarchy Process in weighting player roles and skillset to highlight the level of importance and significance of finding a suitable player for a certain position.

## 1.1 Problem Statement

In a team-based esports tournament such as League of Legends, the main problem faced by teams is the formation of a team of five that can compete against other teams. This is a problem faced by an esports organization that wants to enter the competitive scene. When picking a member of a team, an esports organization would look into what position the player can fill and their skillset that works well in a team.

Firstly, team formation has always been done with qualitative judgments by key experts such as managers or coaches, where the players are selected based on their observed performances and the experts' opinions (Dwivedi *et al.*, 2020). This cause certain difficulties (Yusubova *et al.*, 2020), like (i) a player may have good overall performances, but the player's abilities are not the best fit for the position needed in the team, or (ii) different experts might have different interpretation on the best player for their team.

The second issue is finding the importance of positions and the skillsets required to play at a certain position in the team. According to Costa *et al.* (2019), the success and competitiveness of a team depends on the player's experience and knowledge. The experience comes from knowing how to play the position they are good at. Knowledge comes from knowing a Champion strength and weaknesses while having the skillset required to perform well.

Finally, research papers that apply quantitative techniques are still scarce when it comes to esports (Tobias, 2020) which includes research that applies quantitative techniques in esports. The judgment obtained from a select group to be researched are a qualitative judgment. Qualitative judgment needs to be quantified because qualitative judgment by itself can't be measured. By using a mathematical model, the judgment can be understood with measurable data and an objective conclusion can be drawn.

To the best of our knowledge, there has been no study on AHP on weighting the position and skillset of players in League of Legends. Based on these, the three research questions are as established:

1. How to determine the weight of position and skillset of players when playing League of Legends?
2. What needs to be quantified for each position and skillsets to increase the chances of winning a game?
3. What are the weights of position and skillsets needed when playing League of Legends?

## 1.2 Objectives

The objectives of this project to answer the research questions above are as follows, that is to:

1. Propose the mathematical concept of Analytic Hierarchy Process in determining the weight of position and skillset of players when playing League of Legends.
2. Determine quantifiable qualifications for each position and skillsets to increase the chances of winning a game.
3. Identify the weight of position and skillsets needed when playing League of Legends, where the problems are decomposed into a hierarchy of small problems which can be analysed independently.

The objective of this project is to obtain the weightage of position and skillset of players in League of Legends. To achieve this, we will use Analytical Hierarchy Process (Saaty, 2008) to obtain the weightage of each position and skillset. This would be useful for team coaches to decide which players are best filled into each of the five positions available in a team. The decision will be based entirely on the judgment of individuals such as team coaches on the players' position and skillsets. This would create a better team that is able to perform well as a team. This of course would lead to higher chances of winning a competitions, trophies and cash prizes (Ozceylan, 2016, p. 190), promote healthy competitive spirit among players and increase interest from outside spectators such as sponsors and investors (Budak *et al.*, 2017). The methodologies to solve the research objective would entirely be adapted from what Professor Thomas L. Saaty (2008) has written in his paper on Analytic Hierarchy Process, with some help from other similar examples that will be discussed soon.

Research paper that applies quantitative techniques into esports are scarce, but there have been studies on esports such as psychology of esport player and spectator where the motivation of being a player or spectator is examined and compared to poker players (Banyai *et al.,*2019). Kari *et al.* (2019) did research on professional esports players on how their training, with a focus on physical exercise, contributed to their esports performance.

Based on our findings, there has yet to be any study on using AHP to achieve the specific objectives in this paper. However, AHP has been used in other sports such as volleyball (Budak *et al.*, 2017) and soccer (Ozceylan, 2016) to evaluate the weightage of position and skillset of their players. As we are dealing with intangibles, we can quantify qualitative human judgment in calculating the weightages or priorities for multi-level criterion decision making using AHP (Saaty, 2008). The positions and skillsets are transformed into a structured hierarchy that allows us to only focus on those elements. Overall, we have made use of human judgment to help humans be able to make a better choice.

### 1.3 Project Scope

This project involves using Analytic Hierarchy Process (AHP) to obtain the weight of position and skillset of players when playing League of Legends. The weight can be determined by finding skillsets that can be measured to determine whether a player is good or not in a certain skillset. This allows the user of the collected data to determine which player with a certain skillset is the most suitable to fill into which role. The data of these skillsets will be obtained by using. It is best to include at most five skillsets to avoid having too large pairwise comparisons needed from the respondents to tabulate the data, and to allow higher consistency of the weightage. AHP is not used to obtain a correct decision; instead, it is used as an indicator of what is the best choice depending on the situation and goal.

### 1.4 Project Significance

Team formation plays a vital role for a team-based sport especially when different positions are weighted, and each position requires certain skillsets for the player in the role to perform well for the team. This also applies to esports, for instance, if the player of the team at a position has a better performance than the player of the equivalent position in the opposing team, then the team would have a better chance to win the match. Assessments are done by the team management to pick suitable players in each role to work together as a team and produce the best results to achieve victory and win tournaments. The weightage of positions and skillsets provided through this study will be useful for team managers to decide the best players in each game.

### 1.5 Outcome

This project will produce computed and tabulated datasets of weights for different positions in a team. This will show the importance level of all positions, and weights for skillsets needed for each position and in the team to show the importance levels of skillsets. The weights obtained can be used by team coaches, players, and others to determine which player will bring out the best results in a team and who to prioritize in a team.

## 2 Literature Review

This study begins with a literature review on Analytic Hierarchy Process (AHP), a powerful tool developed in 1980 by Thomas L. Saaty that manages qualitative and quantitative multi-criteria elements for decision-making process. AHP is often used in many fields such as resource planning and allocation, purchasing and supplying management, warehouse and data collecting system, as well as team formation in a team-based sport. The literature review will also include understanding the game mechanics in League of Legends such as character roles, player positions, skillsets, winning condition, map awareness, map control and many more.

In this section, we will introduce the concept of Multi-Criteria Decision Making (MCDM) method in achieving our research objective. The purpose is to determine the advantages and disadvantages of one method over another and explain why Analytic Hierarchy Process (AHP) is being used for our paper. After that, we will review other papers that make use of AHP in their research paper and find out what is the advantages and disadvantages of

AHP in this research while finding out how using AHP can allow us to achieve our research objectives. According to Velasquez and Hester (2013), Multi-Criteria Decision Making (MCDM) methods have been used for various applications. Here, we will review some of the common MCDM methods and then analyze the advantages and disadvantages of each method.

## 2.1 Analytic Hierarchy Process

According to Saaty (2008), Analytic Hierarchy Process is "a theory of measurement through pair-wise comparisons and relies on the judgments of experts to derive priority scales". Loken (2007) said that one of the major characteristics of Analytic Hierarchy Process is the use of pairwise comparison where the preferences between two choices or alternatives are compared to each other in order to estimate the weightage of criteria.

AHP has seen several uses such as Lee *et al.* (2012) that evaluated the factors and alternatives of Technology Transfer Adoption to increase revenue using AHP to weight seven factors and rank three alternatives. Bentes *et al*. (2012) examined a telecommunication company to assess its organizational performance using AHP to prioritize performance perspectives and indicators. The method was used in combination with the Balanced Scorecard (BSC), a framework for performance assessment, in order to rank the alternatives properly. This framework shows the associated necessary criteria and alternatives while the AHP is responsible for comparisons, weighting, and rankings. With four criteria and three alternatives, AHP was able to handle the multiple measures and perspectives.

Velasquez and Hester (2013) mentioned that one of the advantages of AHP is that it is easy for decision makers to use. It is also scalable and can change depending on the number of criteria and alternatives. Also, it is mentioned that AHP "has experienced problems of interdependence between criteria and alternatives". Since AHP uses the approach of pairwise comparisons, it can be susceptible to inconsistencies in the judgment and ranking criteria.

## 2.2 Advantages and Disadvantages of AHP with other methods

There are many methods which has been applied in various decision-making situations. Other than AHP, these methods include fuzzy theory, multi-attribute utility theory and simple multi-attribute ranking technique. Table I shows the advantage and disadvantages of each of the multi-criteria decision-making listed.

TABLE I. ADVANTAGE AND DISADVANTAGE OF EACH MCDM METHOD

| Method | Advantages | Disadvantages |
|---|---|---|
| **Analytic Hierarchy Process (AHP)** | 1. Easy to use<br>2. Scalable<br>3. Hierarchy structure can be adjusted | 1. Criteria and alternatives are interdependent<br>2. Can be inconsistent |
| **Fuzzy Theory** | 1. Allows imprecise input<br>2. Takes into account insufficient information | 1. Difficult to develop<br>2. May require multiple simulations before use |
| **Multi-Attribute Utility Theory (MAUT)** | 1. Takes uncertainty into account<br>2. Can use preferences | 1. Require lots of inputs<br>2. Preferences has to be precise |
| **Simple Multi-Attribute Ranking Technique (SMART)** | 1. Allows for any type of weight assignment technique<br>2. Require less effort by decision makers | 1. Inconvenient procedure |

In our study, AHP's advantages suit our purposes in evaluating and quantifying human judgment for concrete quantitative analysis.

## 2.3 Analytic Hierarchy Process applications

One of the applications of AHP studied is in volleyball. Team formation in volleyball is important. It is said by Budak, Kara and Iç (2017) that sponsors invest more into the sport industry in recent years and the sponsored teams are a big factor in increasing the revenue obtained. As the investments increase, so is the need to ensure that the team is performing well in the sport. This can be achieved by the team coach ability to attract talented players. Each player needs a certain skillset that reaches a certain level to be able to perform in a team (Sullivan *et al.*, 2014). Deciding which players to fill a position within the team can improve the quality of the team and increase their chance of winning. The decision maker will have to consider multiple elements from a large number of players available, and the qualifications they have as a member within a team (Budak *et al.*, 2017).

Budak *et al.* (2017) proposes a real-life application of AHP as a procedure to weight the position and skills of player for sport clubs. The weights obtained are then used for a team formation problem (p. 24). In the paper, Budak *et al.* (2017) mentioned that there are different approaches for a team formation problem. One of the researches comes from Boon and Sierksma (2003) that gives a suggestion of using linear programming model. They focus on data obtained through questionnaires that are filled by team coaches. Tavana *et al.* (2013) uses a two-phase fuzzy inference system. Another approach is from Ahmed, Deb and Jundal (2013) that uses success-to-trials ratio in selecting players in a cricket sport team. It also mentions that Ozceylan (2016) has a case study on selecting players in a football team using AHP and linear mathematical model. That case study will also be discussed in the next literature review.

First, it is determined that there are seven positions and five skills needed to create a volleyball team. After that, a questionnaire is created for a team coach to fill which uses pairwise comparisons of position and skills. This is then given to twenty volleyball team coaches. Then, the consistency index of each coach is calculated. With the consistency index, the weight of position and skillset can be calculated and obtained (Budak *et al.*, 2017). The procedure used to obtain the weight of each position and skill in Budak *et al.* (2017) paper is shown in the flow chart below.

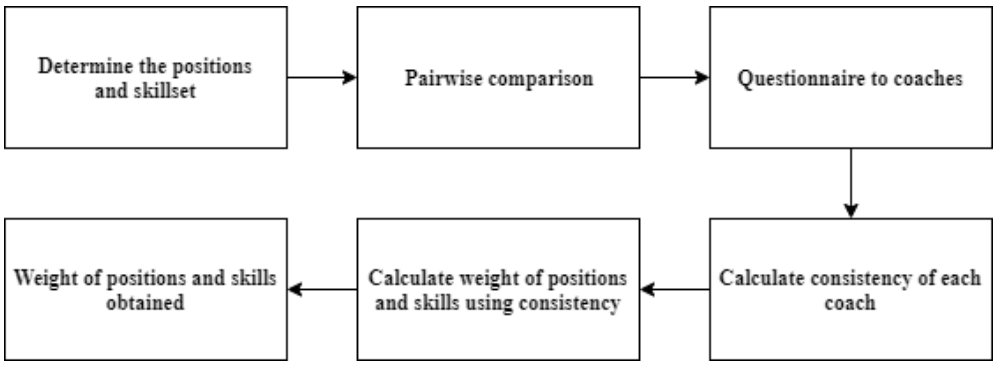


Figure 1. Flow chart of Analytical Hierarchy Process for Volleyball sport

Another application of AHP is in team selection of a soccer team. Ozceylan (2016) mentioned that player selection in a soccer team is usually based on the coaches' judgment. A poor team selection will lead to failure which costs trophies, titles, money and player loyalty. This is a challenging task because many attributes must be considered. The paper proposes a two-phase approach to select the best soccer player from a particular team. For the 1st phase, the criteria of each player are based on their position. As for the 2nd phase, a 0 to 1 integer linear programming model is produced, with the top performers being determined using weights of player criteria. The author believes that it is the first study to combine AHP and mathematical modeling approach to evaluate and select soccer players (Ozceylan, 2016).

There are three phases of the AHP modeling process, which are structuring the decision problem, pairwise comparisons, and calculating the priorities of each criterion. First, it is determined by Ozceylan (2016) that there are six positions and 44 criteria overall based on a computer game called 'Football Manager 2015', with only 20

of the most suitable criteria given to each position. After that, a pairwise comparison of the relative importance of each criterion is made. This is done using hierarchical structure of criteria which helps the user to focus on specific criteria when allocating weight. Then, the calculation for the priority of each criterion is made. Software is used to find the priority weights and the consistency ratio of each position is calculated. Ozceylan (2016) notes that AHP is not used to find the best player, only to find the priority or weightage of each criterion.

# 3 Methodology

Analytic Hierarchy Process (AHP) is one of Multi-Criteria Decision-Making method that was originally developed by Prof. Thomas L. Saaty. In simple terms, it is a method to derive ratio scales from paired comparisons. The input can be obtained from actual measurements such as price, weight etc., or from subjective opinion such as satisfaction and preference. AHP allows some small inconsistency in judgment because human is not always consistent. The ratio scales are derived from the principal Eigen vectors and the consistency index is derived from the principal Eigen value.

Next, the hierarchical problem involving player position and skillsets needed for position is established. Questionnaires will be designed and distributed to respondents that include experienced players, team managers, coaches, game casters and streamers to obtain their judgement. The data is then sorted into a pairwise matrix for a pairwise matrix comparison.

In the final phase, the consistency ratio is calculated to validate the results obtained from the questionnaire. Using the consistency data, a geometric mean is obtained and normalized which will produce the weights of position and skillset for each position.

Team coaches in League of Legends, especially new ones have struggled to find a way to decide how to choose and fill players into a team as there are many variables to consider when deciding who will be in a team. AHP opens up a method to do so in an easy way as it can be easily calculated and the weightage obtained can be used to assist them in making the decision (Saaty, 2008). People who use it will also be able to gain insights on the important aspects of a decision-making process.

AHP calculation is based on qualitative judgment which is susceptible to inconsistency or inaccuracy. Therefore, obtaining the consistency ratio is important in finding out whether the human judgment is consistent. Another problem would be that it would be hard to do the calculations when there are many criteria such as the skillsets to consider. A big list of criteria would increase the size of calculation necessary to find out the weightage of positions and skillsets. With a big number of criteria to consider, the consistency of the judgment would also decrease which means that it is best to minimize the criteria available to avoid those pitfalls. Therefore, when deciding the number of skillsets, we would limit it to 4 to 8 skillsets while the number of positions remains as 5 because there are only 5 players in a team when playing League of Legends.

## 3.1 Formulation of team formation in League of Legends

League of Legends is a multiplayer online battle arena (MOBA) where 5 players fight together as a team against another 5 players. Every player controls a single Champion (Zhang *et al.*, 2017) and fights in a map called Summoner's Rift. There are 145 playable Champions to choose from in the game as of this writing which is based on Patch 9.23 of the game. Each Champion has unique abilities and playstyle. Before a match begins, each team takes turn in banning Champion that the enemy team might use and choosing their Champions. With multiple combinations of Champions from each team, each match can go differently because each match may have a different combination of Champions in each team. The way each player utilizes each Champion in different games will decide whether they win or lose. To achieve victory in a game of League of Legends, the enemy Nexus must be destroyed while protecting the team's Nexus.


Figure 2. The Summoner's Rift map (Ratanak, 2021)

Each team is assigned to either the blue team on the bottom left corner of the map or the red team at the top right corner of the map. There are 3 lanes that connect from one Nexus to the other Nexus called top lane (also known as baron lane), mid lane, and bot lane (also known as dragon lane). Protecting the Nexus are 2 towers and there are 3 inhibitors for each lane. The inhibitor is also protected by a tower which is also protected by 2 more towers each ahead of it in each lane. Overall, a team has 1 Nexus, 3 inhibitors and 11 towers. One of the 3 inhibitors needs to be destroyed before having access to the two towers protecting the Nexus, and both these towers must be destroyed before having access to the Nexus to win the game. With 5 players on each team, each player is responsible in a position for each lane and one player is responsible in the areas between the lanes called the jungle. During a match, each inhibitor spawns minions to each of the 3 lanes. These minions are the main source of income for Champions in lane since, killing them gives gold. For a jungler, monsters that spawn in the jungle are their main source of income.

Every player starts the game on Level 1, Champions gets stronger by obtaining experience points to level up and obtain gold to buy items that strengthen their Champion. The main goal every player should have is obtaining faster income, get stronger from buying items, survive throughout the game, and destroy towers to push toward the enemy Nexus. Some of the additional objectives are having vision on the map to know where the enemy Champions might possibly be and killing epic monsters which are additional objectives on the map. These include Dragon, Rift Herald and Baron Nashor, where each gives unique buffs. They can even change the map or even introduce a new method to destroy towers and most importantly the Nexus.

Every player in a team of 5 will fill into one of the 5 positions in the game. Together, they do what they can through the different skills required to facilitate a winning game. These 5 positions are called Top, Jungle, Mid, Bottom and Support (See Table II). Bottom can also be called ADC or Attack Damage Carry.

TABLE II. DESCRIPTION OF 5 POSITIONS IN LEAGUE OF LEGENDS

| **Position** | **Description** |
|---|---|
| Top | Player is responsible for the top lane and fights a 1v1 matchup. Usually fills the role of a tank by choosing character with high survivability or a bruiser by choosing character with a balance of survivability and combat. Allows the team to have a character that can engage in teamfight or making sure their teammates don't die. |
| Jungle | Player is responsible for the jungle quadrants and helps their teammates through ganking a lane to get kills or damage turrets. The player should also obtain objectives such as Dragon, Rift Herald and Baron Nashor whereby getting any of these 3 gives unique advantages each by either strengthening the characters of the team or giving an option to damage lane objective |

| | |
|---|---|
| | faster. The jungler can also provide vision around the map since they move around the jungle quadrants. |
| Mid | Player is responsible for the mid lane and fights a 1 vs 1 matchup. Usually fills the role of a mage by choosing character with high combat stats and is able to move either top or bot lane quickly to gank lanes or obtain objectives. |
| Bottom | Player is responsible for the bottom lane and fights a 2 vs 2 matchup. Usually fills the role of a carry that focuses on farming well and being able to have high combat stats by the mid or late game to help win the game by providing high damage output. In lane, they mostly focus on farming before transitioning into combat once they have the items necessary to perform well. |
| Support | Player is responsible for the bottom lane and fights a 2 vs 2 matchup. Usually fills the role of a support that can keep the bottom alive thus needing to have high survivability. Support also provides vision around the lane. |

When it comes to the skillsets, we decided to refer to an article which has more skillsets and the details on it. An article from a website called Mobalytics (Macabasco, 2019) provides 8 skillsets which they use in their calculation of player performance. It includes Aggression, Consistency, Farming, Fighting, Objective Control, Survivability, Versatility and Vision. Since there will always be 5 positions in the game, there will be no changes to the number of positions. However, with 8 skillsets to consider, this will be a burden for decision makers as they will have to consider a lot of comparisons amongst the 8 skillsets. To show the number of comparisons to be made using 8 skillsets, a combination formula or *nCr*, will be used. The formula and calculation are (C(8,2) = 28)

It is shown that 8 skillsets give a total of 28 comparisons to be made. When this is multiplied with the 5 positions, there will be a total of 140 comparisons to be made. The number of comparisons is too large respondents when filling up the questionnaire. Therefore, the number of skillsets must be reduced. By analyzing each skillset, it is decided that consistency and versatility can be removed. It is seen through the Volleyball (Budak, 2017) and Soccer (Ozceylan, 2016) papers that consistency and versatility is not used as part of the criteria. Therefore, both skillsets will not be used for this research. Aggression and Fighting will be combined together as Combat skillset. This will be defined as the ability to enter combat situation and win trades, skirmishes and teamfights. The final 5 skillset used will be named Combat, Farming, Objective Control, Survivalbility and Vision. Table III below shows the definition of all eight skillsets.

TABLE III. DESCRIPTION OF 8 SKILLSET IN LEAGUE OF LEGENDS

| **Skillset** | **Description** |
|---|---|
| Aggression | Skill where the player enters or initiates a fight, whether in a 1v1 situation or a teamfight of more than 2 players. Being aggressive forces the enemy to respond, creating opportunities. |
| Consistency | Ability to do certain repetitive tasks regularly for the purposes of achieving your goals. |
| Farming | Farming is the ability to obtain gold income. In lane, gold is obtained through killing enemy minions that spawn in each lane. For jungler, they obtain income by killing monsters in the jungle. Farming can also be done by taking objectives or killing enemy champions. |

| | |
|---|---|
| Fighting | Ability to handle fights well and win in trades against the opposing team. |
| Objective Control | Ability to obtain objectives and defend the objective from being taken by the enemy team. |
| Survivability | Capability to survive pokes or trades from the enemy team. Dying in this game will lock you out of the game for a time limit, and that can affect which team can safely secure objectives and win the game. |
| Versatility | Capability to change how one plays to adapt to the circumstances or changes in the game. |
| Vision | Ability to scout the map and obtaining vision for the team using wards or clearing any enemy vision. Vision allows your team to process what is going on around the map and react accordingly. |

## 3.2 Pairwise Comparison

Using the 5 positions in League of Legends and the 5 skillsets, a pairwise comparison among them can be made. Both position and skillset have 5 criteria. Using the combination formula, we can find out that we have a total of 10 comparisons for both the 5 positions and 5 skillsets. The comparison is done using a scale of 1 to 9. Players who prefer the left option will tick a value between 1 to 9 on the left side of the scale which represents their level of preference toward the left side option, and the right side of the scale if they prefer the right-side option. The value of 1 is marked only when the player has an equal preference on either position or skillsets being compared.

After deciding the preference of each comparison, a matrix can be made from the comparisons. With 5 skillsets to compare between each other, we have a 5 by 5 matrix. The diagonal element of a matrix is always valued as 1 and we can choose to fill either the upper or lower triangular matrix, and in this case, we use the upper triangular matrix.

The pairwise comparisons will be obtained from the questionnaires. Saaty (2008) suggested in his paper to use a geometric mean approach to combine multiple individual judgment to obtain the general view of all chosen samples. The geometric mean is then rounded up as an integer.

The priority vector will be calculated next. It is the normalized eigen vector of the matrix. With a 5 by 5 matrix, each column is summed and then each element of the matrix is divided with the sum of each column. Now the normalized relative weight is obtained. Here, the priority vector is obtained by averaging across the rows, giving us a value for each row. These five values obtained will be the relative weights for everything we have compared.

## 3.3 Consistency Index

With the relative weight of each position obtained, relative ratio scales can be obtained. The consistency index is then obtained to check the consistency of these weights. The principal Eigen value is calculated by the sum of product for each element of Eigen vector with the sum of column for the reciprocal matrix. With the principal Eigen value and five skillsets to compare which means the *n*-value is 5, the consistency index value is obtained.

The CI is then compared with Random Consistency Index (RI). Saaty (2008) has randomly generated a reciprocal matrix called the Random Consistency Index then compared it with CI to check whether it is at 10% or less. The value of the RI can be obtained from Table IV below.

TABLE IV. SAATY'S RANDOM CONSISTENCY INDEX (SAATY, 2008)

| **n** | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|
| **RI** | 0.58 | 0.9 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 |

### 3.4 Consistency Ratio

The Consistency Ratio (CR) is obtained by comparing Consistency Index and Random Consistency Index. If the CR value is 10% or less, according to Saaty (2008) inconsistency can be ignored. However, if it is above 10%, the judgment needs to be revised. When obtaining the judgment from the participants, the consistency will be checked for every judgment from each sample participant using an Excel table to make sure that each judgment is consistent and can be combined in a geometric mean.

### 3.5 Priority Vector

Table V below shows the priority vector of each skillset.

TABLE V. PRIORITY VECTOR OF EACH SKILLSET

| **Skillset** | **Top** | **Jungle** | **Mid** | **Bottom** | **Support** | **Priority Vector** |
|---|---|---|---|---|---|---|
| **Top** | 1 | a | b | c | d | PV1 |
| **Jungle** | k | 1 | e | f | g | PV2 |
| **Mid** | l | l | 1 | h | i | PV3 |
| **Bottom** | m | n | o | 1 | j | PV4 |
| **Support** | p | q | r | s | 1 | PV5 |
| **Sum** | SA | SJ | SM | SB | SS | 100% |

There will be 5 comparison matrices for each skillset, with respect to each position. The priority vector of each of comparison matrices is calculated and the Consistency Ratio is also checked. When there is a very low priority vector below 10%, it is ignored and set to 0%. For the rest of the unaffected priority vectors, an average is obtained between the values so a total of 100% is obtained. For the purposes of the table below, the position of Bottom and Support is assumed to have a priority vector below 10%, thus ignored.

Now we compute the overall composite weight of each skillset based on the priority vector or weight of level 1 and level 2. Table VI shows how the composite weight is obtained. The overall consistency of the hierarchy can also be checked by summing all levels with the weighted consistency index (CI) and weighted random consistency index (RI).

TABLE VI. COMPOSITE WEIGHT OF SKILLSETS

| | **Top** | **Jungle** | **Mid** | **Composite Weight** |
|---|---|---|---|---|
| **Adjusted Weight** | AWT | AWJ | AWM | |

| | | | | |
|---|---|---|---|---|
| **Combat** | CT | CJ | CM | CWC |
| **Farming** | FT | FJ | FM | CWF |
| **Objective Control** | OT | OJ | OM | CWO |
| **Survivability** | ST | SJ | SM | CWS |
| **Vision** | VT | VJ | VM | CWV |

### 3.6 Hierarchy Tree

With the position and skillsets determined, a hierarchy tree can be made. In League of Legends, there are 5 positions that will work together to accomplish the goal of winning the game. Every player has the same basic shared skillsets that each player must have in one way or another to allow the team to win. Within the hierarchy tree, there are 3 levels. The 1st level is the goal, the 2nd level are the positions, and the 3rd level are the skillsets.

## 4 Results

In this paper, three software or programs are used. First, *draw.io* (https://app.diagrams.net/) is used to create the hierarchy tree. Next, the online service called Google Form (https://docs.google.com/forms/) will be used to create a questionnaire that can be shared to participants to fill out. Finally, Microsoft Excel is used to create the matrix of data obtained from the participants. This will also be used to calculate the weightage of each position and skillset from the data obtained.

The data collected are obtained through questionnaires. The questionnaire is made using Google Form which is distributed to people who plays League of Legends within Universiti Malaysia Sarawak. In total, there are eight respondents that have filled in the form. These respondents are considered experts as League of Legends has a ranking-based system to distinguish players at different levels, and the respondents selected are not from the lower ranked (Conroy *et al*., 2020) levels.

### 4.1 Consistency Index

Table VII below shows the consistency index value for position (by itself) and for each of the 5 positions, for all 8 respondents.

TABLE VII. CONSISTENCY INDEX OF EACH RESPONDENT

| **Description** | **Respondent** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Position | 0.99 | 0.64 | 0.99 | 0.28 | 0.32 | 0.60 | 0.11 | 0.04 |
| Top | 1.54 | 0.16 | 0.33 | 0.11 | 1.08 | 0.28 | 0.22 | 0.08 |
| Jungle | 1.02 | 0.40 | 0 | 0.14 | 1.07 | 0.20 | 0.11 | 0.39 |
| Mid | 1.16 | 0.34 | 0 | 0.34 | 0.99 | 0.15 | 0.16 | 0.20 |
| Bot | 0.64 | 0.25 | 0.35 | 0.40 | 0.99 | 1.28 | 0.29 | 0.12 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Support | 0.80 | 0.28 | 0.95 | 0.65 | 0.99 | 0.36 | 0.17 | 0.58 |

## 4.2 Consistency Ratio

Table VIII below shows the consistency ratio value for position (by itself) and for each of the 5 positions, for all 8 respondents.

TABLE VIII. CONSISTENCY RATIO OF EACH RESPONDENTS

| **Description** | **Respondent** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Position | 0.8834 | 0.5677 | 0.8834 | 0.2503 | 0.2826 | 0.5400 | 0.0947 | 0.0399 |
| Top | 1.3715 | 0.1394 | 0.2980 | 0.0979 | 0.9627 | 0.2507 | 0.1933 | 0.0718 |
| Jungle | 0.9107 | 0.3605 | 0 | 0.1224 | 0.9540 | 0.1798 | 0.1007 | 0.3495 |
| Mid | 1.0395 | 0.3017 | 0 | 0.3014 | 0.8834 | 0.1351 | 0.1431 | 0.1825 |
| Bot | 0.5689 | 0.2206 | 0.3134 | 0.3584 | 0.8834 | 1.1406 | 0.2631 | 0.1047 |
| Support | 0.7113 | 0.2496 | 0.8505 | 0.5800 | 0.8834 | 0.3220 | 0.1483 | 0.5176 |

As seen from Table VIII, Respondent 3 had Jungle and Mid with perfect consistency, Respondent 7 with his Position being consistent and Respondent 8 with Position and Top being consistent. These 5 respondents are highlighted to show that they have consistency ratio less than 10%, which indicate consistency.

For respondent 3, both Jungle and Mid has consistency ratio of 0%. Respondent 4 has Top with a consistency ratio of 9.79%. Respondent 7 has Position with 9.47%. Finally, respondent 8 has Position at 3.99% and Top at 7.18% consistency ratio. In total, there are only four respondents that have one or two criteria that fulfil the consistency ratio. Due to the lack of consistency, the calculations will have to be continued even with the inconsistencies in mind due to the inability to find higher quality data than what is available at this moment.

## 4.3 Priority Vector

Table IX below shows the priority vector of each respondent position based on the filled questionnaire.

TABLE IX. PRIORITY VECTOR OF EACH RESPONDENT POSITION

| **Position** | **Respondent** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Top | 0.07 | 0.16 | 0.14 | 0.03 | 0.07 | 0.04 | 0.29 | 0.04 |
| Jungle | 0.52 | 0.10 | 0.02 | 0.08 | 0.12 | 0.04 | 0.16 | 0.35 |
| Mid | 0.02 | 0.09 | 0.07 | 0.16 | 0.17 | 0.23 | 0.44 | 0.39 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Bot | 0.14 | 0.36 | 0.52 | 0.17 | 0.61 | 0.14 | 0.08 | 0.07 |
| Support | 0.24 | 0.28 | 0.24 | 0.56 | 0.03 | 0.56 | 0.04 | 0.15 |

Table X below shows the weightage of skillset.

TABLE X. COMPOSITE WEIGHT OF EACH RESPONDENT SKILLSET

| **Level 2 Skillset** | **Respondent** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** |
| Combat | 0.1901 | 0 | 0.1114 | 0.1079 | 0.1344 | 0.1479 | 0.3006 | 0.1886 |
| Farming | 0.1558 | 0.1308 | 0.2930 | 0.2301 | 0.4420 | 0.0338 | 0.3819 | 0.1894 |
| Obj. Control | 0.2917 | 0.2418 | 0.2093 | 0.1922 | 0.1073 | 0.4039 | 0.0556 | 0.4537 |
| Survivability | 0.1640 | 0.3699 | 0.1770 | 0.0831 | 0.1821 | 0 | 0.0811 | 0.0293 |
| Vision | 0.1984 | 0.2574 | 0.2093 | 0.3867 | 0.1342 | 0.4145 | 0.1808 | 0.1391 |

### 4.4 Hierarchy Tree

Figure 2 below shows the hierarchy tree with the final weightage of position and skillset.

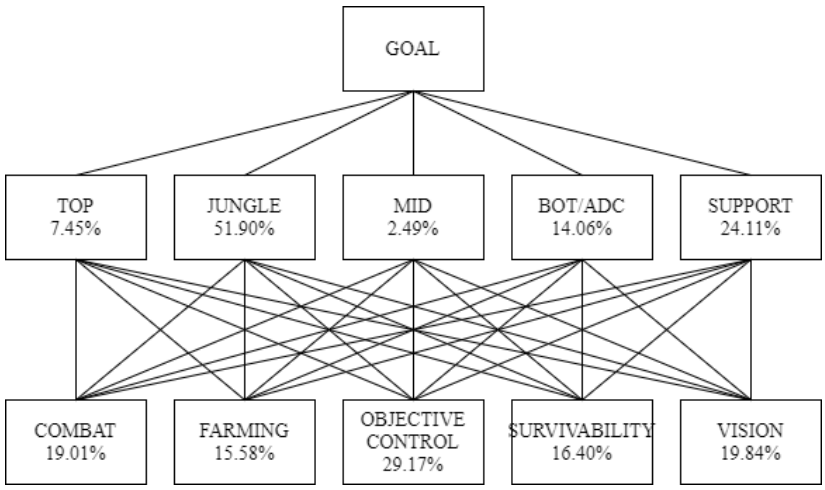


Figure 3. Hierarchy tree with the composite weight of position and skillset

## 5 Discussion

From the results, we have shown that AHP can be used in quantifying weight of position and skillset of players in League of Legends. The weightage can be condensed into a hierarchy tree, which helps decision makers visualize the best players to have in a given team. In Budak, Kara and Iç (2017) paper, the coaches would need

to use a "decision making methodology to use the obtained weights". In simple terms, the results obtained from this AHP is "used as main parameters of decision models developed for team formation problems" (Budak *et al.*, 2017).

From the results obtained, we can now infer some points worthy to be discussed.

## 5.1 Expert Judgment

The expert opinion can be from an individual expert or a collective group of experts. By obtaining an expert's opinion, the consistency of the result would be much better. The experts would know which positions are important and what skillsets are important for each position. The quality of data will also be improved due to the improved consistency index and consistency ratio.

## 5.2 Respondent Preferences

From the pairwise comparison, respondent 3 has their comparison of skillset for Jungle and Mid player at a value of 0.2 for every skillset. All the values are in the middle between each comparison which shows that the respondent is saying that every skillset have the same level of importance. Each role in a League of Legends has a certain skillset required to master that is more important compared with other skillsets. Added to the fact that every role has its own pool of champions that can be selected, it is very unlikely that a champion's role can have an equal skillset required to play in any of the position.

It is known that respondent 1 mainly plays in the Jungle position and has the most knowledge on that role. In a way, there can be a bias seen from the filled questionnaire; respondent 1 has Jungle position with the highest priority vector.

## 5.3 Best of each position and skillset

From the data obtained, 3 out of the 8 respondents say that Bot position is the most important position among the 5. The other respondents have Bot as their 2nd or 3rd most important position. This is a good indicator that most of the respondent sees the importance of Bot. The Bot role is mainly used to deal high amounts in a fight and can help the team as a whole especially later in the game by being able to fight multiple enemy champions with minimal assistance.

Top position has Farming and Survivability tied at 3 each. As a Top player, they join teamfights less compared with other positions so Farming is important to them. When they do join teamfights, Survivability is a necessary skillset for the team to win a teamfight. In Jungle position, most respondents agree that Objective is important. This is true in the case of securing monster objective such as Dragon and Baron which gives the whole team an improvement in power. Jungle can also help by ganking, meaning helping an allied teammate in any of the 3 lanes to pressure the enemy in order to kill the enemy or damage the defending turret.

For Bot, most respondents have Farming as the most important skillset. Bot champions require a lot of gold to buy items in order to perform well. By being able to buy items, they can deal the damage necessary to win any fight. As for Support, all the respondents agree that Objective and Vision or both are important for the position. The support mainly helps in making sure Bot is safe while gaining vision on the map to protect the lane while informing their team the possible location of the enemy, especially the enemy Jungle. In terms of Objective, a support can roam to help Mid lane or secure an objective, mainly Dragon together with their own Jungle teammate.

# 6 Conclusion and Future Work

This paper successfully showed us how to solve a team formation problem of League of Legends using Analytic Hierarchy Process. The judgment of respondents has been quantified and calculated to achieve our objective.

One of the challenges during the research is the ability to find an expert. This requires time and money to have one available to obtain professional opinion. Having a personal assistant to help with extracting information out of the data collected would have helped in finding out the little things that may improve the quality of findings and insights obtained from this research. It is hoped that Analytical Hierarchy Process can be applied into the esports industry to help the community to grow better in terms of team-building and improving the skills of the players by analyzing players' data. As the lack of League of Legends experts inhibits this research from obtaining high quality results, future work in procuring data from professional key people including but not limited to players, coaches and managers is necessary.

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