Analysis and Strategies for Huskies Football Team

Summary

Team strategies are essential to the success of the team, because it automatically promotes our performance when we are handling with complicated problems. Therefore, we take football game as an exemplar and choose to analyze the data of dynamic of the Huskies. To help the head coach train the team more specifically, we are required to create networks of motif, model the indicators affecting the result of game, and provide the coach suggestions.

We developed the **basic model** to analyze the interactions among players and the influence of each indicators to the result of game. Based on our mode, we made suggestions for the team coach on strategy choosing for the future seasons.

We build a **Ball Passing Network** to display the positions of the players, number of passing between the players, and the performance of each player in the field. Based on historical research, we mainly focused on detecting 2-node and 3-node motif and finally found that the subnetwork that occured most frequently is 3-node type 6 motif. We chose the top 11 players according to their total number of passing in 38 games. Total ball passing between two players indicated that player F2, M1, and M3 have more possession percentage, which result in better performance. By analyzing Match 9 and Match 14, we found that Huskies may get better outcome if they change the initial formation (4,5,1) to more offensive formation when facing different strategies of the opponents.

We also build the **Analysis Hierarchy Process (AHP)** model to analyze the influences of each indicators to the result of game. It shows that the Team Flexibility is the most important indicator and the Strength of Opponents is less important to the result of the game and the Passing Strategy is the least important indicator. And within each indicator, similar passing number for each player, relatively small average time to generate a passing event, facing the relatively weak team make the major contribution to win the game.

Keywords: Team Strategies; Ball Passing Network; Analytic Hierarchy Process

(AHP)

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Contents

1 Restatement of the problem

1.1 Background

Team activities have been a spirit of collaboration to achieve established goals, and it automatically promotes our performance when we are handling with complicated problems. Thus, team strategies are crucial to the success of the team. To analyze the team processes, we take one of the most competitive sports as an exemplar. In football game, instead of individuals' performances, the win depends more on the football team strategies, such as the amount of passing ball, the position of each player and their cooperation.

We analyze the dynamic of the Huskies for its coach by using mathematical models. We use the data of all 38 games they played with 18 opponents to explore how the interactivities between players influence the result of games. Also, visualization of motifs helps interpret each player's performance. Therefore, the coach could train the team more specifically.

1.2 Literature Review

To simplify the complex interactions among players on the field, and analysis team dynamics, researchers constructed an average passing network that involve the number of passes and players' positions. *50-pass network*, which removed the impact on the number of passing, is used to reflect influence of formation during the match.[1] Others studied the motif types of a team and its opponents, and the correlation coefficient of the motif types with the balance of the match and difference in goals.[2]

To determine the key indicators of a football team to the result of the game, the researchers conducted several computationally intensive experiments. The researchers analyzed the indicators' data of both one specific game and the whole season. As a result, the researchers found that the result of the game is strongly correlated to the passing event. As the number of passing increases, the probability to win a game increased. By constructing a repertoire of classifier, the researchers also found that when the passing number of home team is relatively greater than the away team, the home team will have a greater chance to win the game. [3]

Some people quantifying the performance of individual players by using the normalized value of the logarithm of the player's flow centrality. Then, they use average of individual performance to represent the team performance. Also, they use network to visualize passing accuracy, arc centralization and player performance in

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[1] Buldú, J.M., Busquets, J., Echegoyen, I. et al. (2019). Defining a historic football team: Using Network Science to analyze Guardiola's F.C. Barcelona. Sci Rep, 9, 13602.

[2] GÜRSAKAL, N., YILMAZ, F., ÇOBANOĞLU, H., ÇAĞLIYOR, S. (2018). Network Motifs in Football. Turkish Journal of Sport and Exercise, 20 (3), 263-272

[3] Cintia, P., Giannotti, F., Pappalardo, L., Pedreschi, D., & Malvaldi, M. (2015, October). The harsh rule of the goals: Data-driven performance indicators for football teams. In *2015 IEEE International Conference on Data Science and Advanced Analytics (DSAA)* (pp. 1-10). IEEE.

three knock-phase matches. [4]

1.3 The Task at Hand

- Create networks of ball passing between players by setting each individual as a node and each passing as a link between nodes for multiple scales and recognize network patterns.
- Model the indicators affecting the results of game. Besides, identify whether the strategies suit every situation or just Huskies.
- Give the coach of Huskies some suggestions to train the team according the model.
- Interpret the factors improving the team performance for societies development and innovation. Then, summary how to create more efficacious teams.

2 Model Assumptions and Notations

2.1 Assumptions and Justifications

- The Adaptability of the team can be represented by the difference in the result of home games and away games.
- The Team Flexibility can is represented by the average time the team takes to generate one passing event.
- Passing number is strongly related to the game result. The more passing leads to the greater probability to win.
- Opponents' strength is determined by its average passing number.

- Players with passing numbers significantly lower than the average passing numbers are considered as bench players and generally do not have important influence on the outcome of the match.

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4 Duch J., Waitzman J.S., Amaral L.A.N. (2010). Quantifying the performance of individual players in a team activity. PLoS ONE, 5: e10937.

2.2 Notations

Symbol	Description
n	the number of nodes in a net work
A_{ij}	the number of passings from player i to player j
i	the player who passes the ball
j	the player who receives the ball
(F,D,M)	football formations: F-forward, D-defense; M- midfield
σ_p	the standard deviation of each game's passings number which generates by team Huskies
μ_σ	the mean of σ_p for the whole season (38 games)
t	the average time to generate a passing in the game which generates by team Huskies in each game
μ_t	the mean of t for the whole season (38 games)
P_o	the passings number of Opponents for each game
μ_p	the average passing number of team Huskies for the whole season (38 games)

3 The Basic Model of Teaming Strategies

3.1 The Design of The Model

In order to analyze the players performance and influence of several factors to the outcome of the game, we qualify the performance indicators by using Analytic Hierarchy Process (AHP) and building a network motif model to demonstrate the structure passing in the game.

Network Motifs:

Network Science has been widely used in analyzing football games, which involved the interactions between players, and potential structure changes across the game. To visualize better the tactic formations, dynamic changing and interactions of football players in the field, the complex network can be used to display the positions of the players, number of passing between the players, and the performance of each player in the field. A Network of n nodes can form multiple types of subnetwork, with different numbers of nodes. The network analysis accesses the statistical significance of the subnetwork; the subnetwork that occurs most frequently is detected as the network motif. Analysis of the main type motifs are critical in making tactic strategies that form better interactions among our own players and disrupt the flow of opponents.

Analytic Hierarchy Process (AHP):

This model is designed to analyze the influence of each indicators to the result of game. We provide a hierarchy diagram (Figure 3-a) and quantify the influence of each indicators to the upper level in the hierarchy diagram. The hierarchy diagram (Figure 3-a) has three levels. It separates the indirect influences into some direct influences which are easier to quantify and better on accuracy level. As we are analyzing the influence of the indicator to the result of the game. We set the top level of the hierarchy as winning the game and the bottom level of the hierarchy as *Passing Strategies*, *Team Flexibility*, and *Strength of Opponents*, which are the three indicators we are researching on. To analyzing these indirect influences, we provide another level which is the Adaptability of the team as an intermedia to connect the top level and bottom level. As team's adaptability to the environment can be measures as whether they have similar winning percentage between home game and away game, we set the middle level in the hierarchy to home game and away game to measure the adaptability of the game.

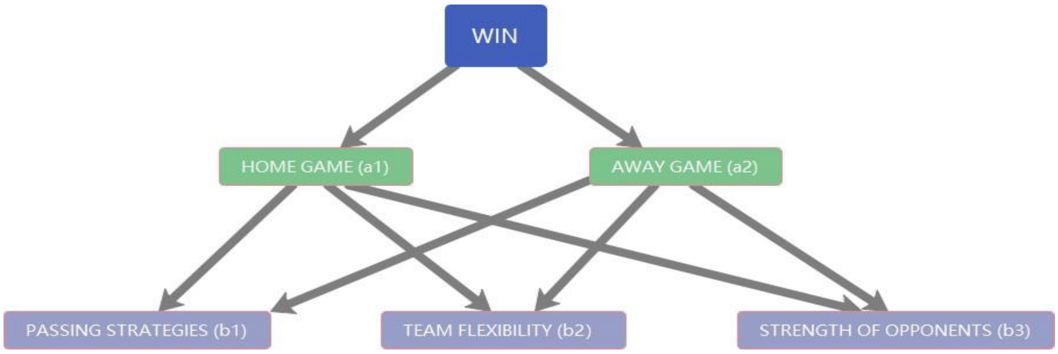


Figure 3.1-a: The Hierarchy Diagram

To quantify the three indicators, we defined several conditions:

As for *Passing Strategies,* we found that there are two main passing strategies.[5] We compare the standard deviation of each game's passings number which generates by team Huskies (**σ_p**) and the mean of σ_p for the whole season (**μ_σ**) to quantify these two strategies. The first one is that only few players take the most passing actions, while other players do not mainly take part in the passing actions. We quantify this strategy as: **$\sigma_p > \mu_\sigma$**

The second one is that all the players in the team share similar percentage on passing number. We quantify this strategy as: **$\sigma_p <= \mu_\sigma$**

As for *Team flexibility*, we divide the flexibility into two parts. Which is the comparison between **μ_t** and **t**. When $t <= \mu_t$, we define it as the flexibility is high because the average time to generate a passing in the game which generates by team Huskies in the game is relatively low. When $t > \mu_t$, we define it as the flexibility is low.

As for the *Strength of Opponents*, we divided it as relatively strong and relatively weak. After research, we found that the passing event has a huge influence on the game result. The more passing events occur, the greater chance the team will win the game. When $P_o <= \mu_p$, which means that the passings number of Opponents for the game is lower than the average passing number of team Huskies for the whole season, we define that the Opponent team is relatively weak. When $P_o > \mu_p$, we define that

5 Cintia, P., Giannotti, F., Pappalardo, L., Pedreschi, D., & Malvaldi, M. (2015, October). The harsh rule of the goals: Data-driven performance indicators for football teams. In *2015 IEEE International Conference on Data Science and Advanced Analytics (DSAA)* (pp. 1-10). IEEE.

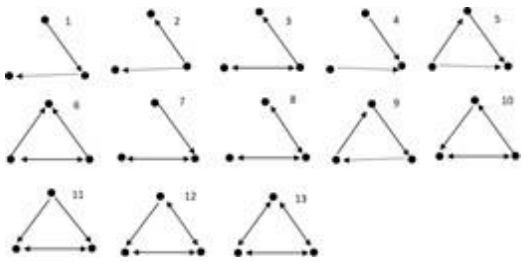
the Opponent team is relatively strong.

For all those three indicators, we define one specific condition each to represent b1, b2, and b3. b1 is when $\sigma_p <= \mu_\sigma$, b2 is when $t <= \mu_t$, b3 is when $P_o > \mu_p$.

3.2 Sub Models

3.2.1 Complex Network in Football

In football, number of passing is a critical parameter that often used to build a weighted network. As the number of nodes increase, total possible paths of flow increase, indicating more complex interactions between two and more points. Based on the historic studies conducted by Necmi, Firat, and Halil, combing with the analysis of the given problem, we suggest that subnetworks with 2-nodes and 3-nodes structure potentially serve as the driver motifs, given its flexibility in changing the directions of passing that have more influence on the dynamic formation of a team.[6]
In the complex network of a football game, each player is represented by a node; the width of the edge is proportional to the number of passing between two players. By analyzing the data, we noticed that more than 11 players are involved in most of the games. Since several players have a passing number way below the average passing number of the whole team, we consider those as the bench players. To eliminate the influence of substitution of players to the game and create a formal network displays the passing flows of 11 players, we choose the top 11 players according to their total number of passing in 38 games.



Network (n Nodes)	2 nodes	3 nodes	4 nodes
Directed	1	13	199
Undirected	1	2	6

Figure 3.2.1a directed 3-nodes motifs **Table 3.2.1b** Number of Network Motifs of n-nodes

DestinationPlayer OriginPlayer	Huskies_D1	Huskies_D2	Huskies_D3	Huskies_D4	Huskies_D5	Huskies_F2	Huskies_G1	Huskies_M1	Huskies_M3	Huskies_M4	Huskies_M6	Grand Total
Huskies_D1	2	59	105	73	57	49	107	92	51	26	21	851
Huskies_D2	62	2	49	39	47	56	62	46	44	22	12	580
Huskies_D3	98	35	5	59	14	50	120	47	54	30	23	727
Huskies_D4	57	30	35	2	1	66	25	62	63	33	30	569
Huskies_D5	36	40	15	0	6	97	27	75	69	29	67	625
Huskies_F2	55	33	56	64	84	5	6	117	58	50	58	859
Huskies_G1	76	29	49	14	22	22	2	24	19	7	10	473
Huskies_M1	85	63	60	79	79	182	20	7	143	72	77	1255
Huskies_M3	74	46	56	88	67	63	12	168	0	27	44	887
Huskies_M4	30	26	18	28	23	50	5	71	26	8	34	497
Huskies_M6	16	13	12	50	71	52	1	54	28	24	3	508

Table 3.2.1c Number of passing for 11 players in 38 games

[6] GÜRSAKAL, N., YILMAZ, F., ÇOBANOĞLU, H., ÇAĞLIYOR, S. (2018). Network Motifs in Football. Turkish Journal of Sport and Exercise, 20 (3), 263-272

3.2.2 Analytic Hierarchy Process (AHP)

In the AHP model, we quantify the different influence level into several matrices. We evaluate each elements of the matrix by comparing them to each other two at a time, with respect to their impact on an element above them in the hierarchy. We create three matrices, A, B1, and B2 (Figure 3.2.2-a). For each matrix, we quantify the influence level into 9 degrees (integer from 1 to 9). We define that, the smaller the number is, the less important the indicator is on influencing the upper level. And as the number increase, the importance of the indicator increased.

$$B1 = \begin{bmatrix} b1/b1 & b1/b2 & b1/b3 \\ b2/b1 & b2/b2 & b2/b3 \\ b3/b1 & b3/b2 & b3/b3 \end{bmatrix} \quad B2 = \begin{bmatrix} b1'/b1' & b1'/b2' & b1'/b3' \\ b2'/b1' & b2'/b2' & b2'/b3' \\ b3'/b1' & b3'/b2' & b3'/b3' \end{bmatrix} \quad A = \begin{bmatrix} a1/a1 & a1/a2 \\ a2/a1 & a2/a2 \end{bmatrix}$$

Figure 3.3.2-a The matrices

To quantify the indicators, we sort the data into Figure 3.2.2-b. In this figure, we sperate home game and away game into two main categories. In each category, we divided into three conditions, which is: the number of winning and non-winning games when satisfied b1 is when $\sigma_p \le \mu_\sigma$, b2 is when $t \le \mu_t$, b3 is when $P_o \ge \mu_p$.

	Winning	Non-winning		Home(a1)					Away(a2)			
Home	10	9			$\sigma_p \le \mu_\sigma$	$t \le \mu_t$	$P_o \le \mu_p$			$\sigma_p \le \mu_\sigma$	$t \le \mu_t$	$P_o \le \mu_p$
Away	3	16			b1	b2	b3			b1	b2	b3
				Winning	4	9	5		Winning	0	3	2
				Non-winning	7	5	3		Non-winning	11	9	5

Figure 3.2.2-b The game results in each condition

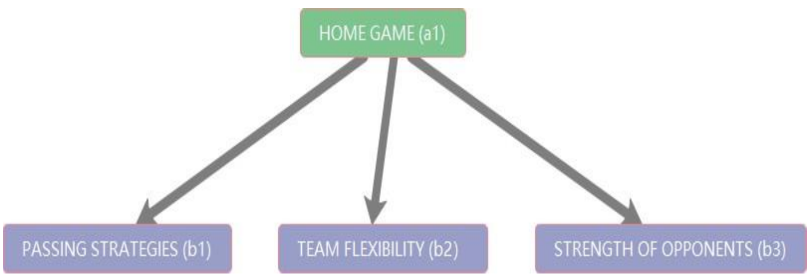


Figure 3.2.2-c The meaning of matrix B1

B1 is a 3*3 matrix which shows how the indicators, which represents by b1, b2, and b3 is going to influence a1(Figure 3.2.2-c). We are going to quantify the number b1, b2, b3 by the percentage of winning games (w) divided by all home games (s) with the degrees we defined, which is:

bn = Ceiling ((w/s)*9), so:

$$B1 = \begin{bmatrix} 1 & 4/6 & 4/6 \\ 6/4 & 1 & 6/6 \\ 6/4 & 6/6 & 1 \end{bmatrix}$$

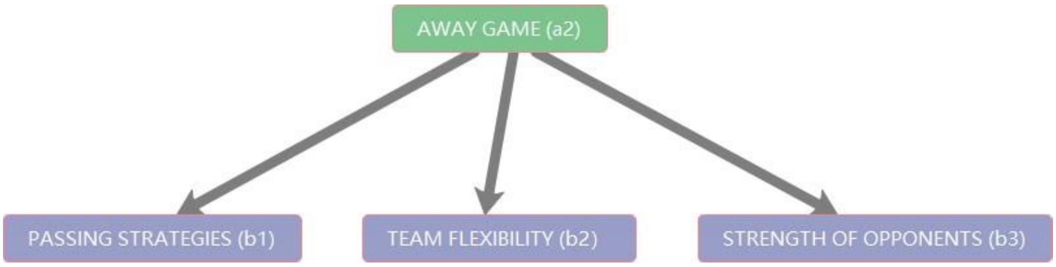


Figure 3.2.2-d The meaning of matrix B2

B2 is a 3*3 matrix which shows how b1, b2, and b3 is going to influence a2 (Figure 3.2.2-d). We are going to quantify the number b1', b2', b3' by the percentage of winning games (w') divided by all away games (s') with the degrees we defined, which is bn = Ceiling ((w'/s')*9), so:

$$B2 = \begin{bmatrix} 1 & 1/3 & 1/3 \\ 3/1 & 1 & 3/3 \\ 3/1 & 3/3 & 1 \end{bmatrix}$$

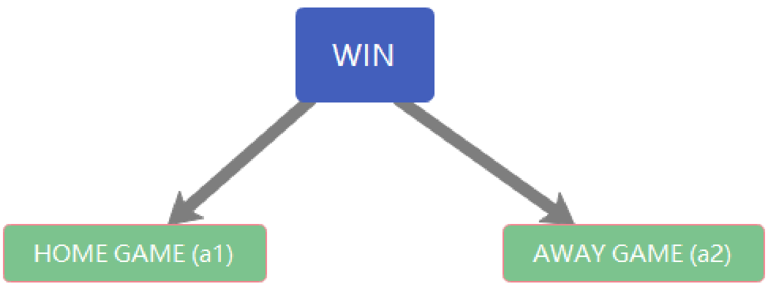


Figure 3.2.2-e The meaning of matrix A

A1 is a 2*2 matrix which shows how a1, a2 is going to influence *Win*. We are going to quantify the number a1, a2 by the percentage of winning games (W) divided by all 38 games (Z) with the degrees we defined, which is bn = Ceiling ((W/Z)*9), so:

$$A = \begin{bmatrix} 1 & 5/2 \\ 2/5 & 1 \end{bmatrix}$$

3.3 The Result of The Model

3.3.1 Visualization of Network Motifs

Mode Motifs and the Best 3-Player Subnetwork

In the analysis, we use 11 players passing data in Table 3.2.1c to generate three 11x11 matrix that contain the information of origin player ID, destination player ID, and the total passing between them as the weight. By using R igraph package, we generate the ball passing network between 11 players (Figure 3.2.1d). By analyzing the significance of different subnetwork and their occurrence, we find that type 6 appears in the network most frequently and thus is the mode motif in the passing network for Huskies. To determine the dynamic and triadic configurations, we calculated the number of balls passing from each player in the Huskies game with 19 opponents and using the maximum total number of balls passing among three players as an indicator of better cooperation.

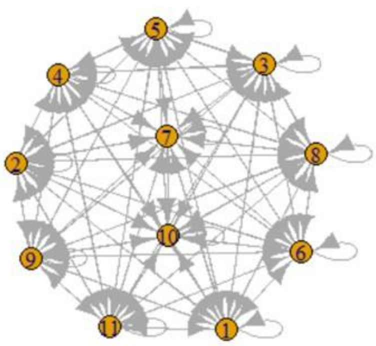


Figure 3.3.1a Ball Passing Network of 11 players in Huskies

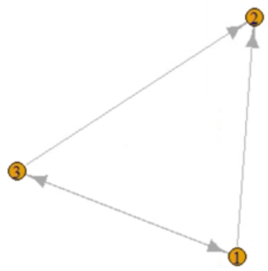


Figure 3.3.1b Mode motif in the passing network of Huskies

Based on the information in Figure 3.2.1f, we know that player M1 has the maximum number of balls passed to others; further investigations indicate that he is also the player who received most of the balls, especially from player F2. The interactions (ball passing) between them is 299, which is 199% of the average interactions in the whole team (average amount of interactions is 100). Moreover, Player M3 has relatively more interactions with both F2 and M1; therefore, Player F2, M1, and M3 are considered as the best 3-player subnetwork in most of the games.

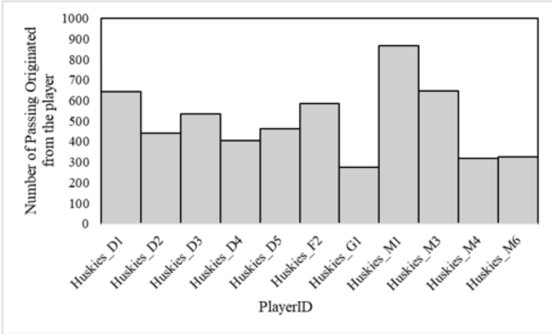


Figure 3.3.1c Histogram of ball passed by players in Huskies

Visualization of the Most Common Football Formation of Huskies

Given the x and y coordinates of players when passing the ball, we can calculate the average of the location when all players in Huskies made the passing of the ball. In Figure 3.3.1d, the positions of point represent those average locations. To study the effects of different formations on the outcome, Match14 and Match9 were selected to analyze the outcome related to formation; two team's formations are displayed in Figure 3.3.1e.(circular node -players in Huskies, cross nodes – players in opponent team)

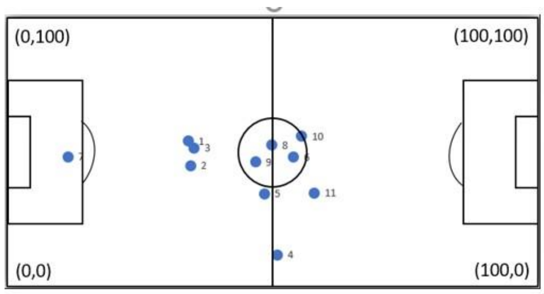


Figure 3.3.1d Football Passing Network and Formation

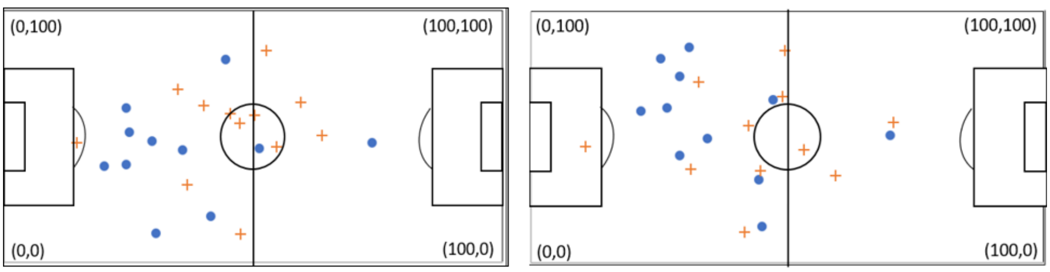


Figure 3.3.1e Match 9 and Match 14

The most common formation in Huskies is (5,4,1), in which player D1, D2, D3, D4, D5 are the defender, player M1, M3, M4, M6 are midfielders, and player F2 is the forward. The number of players in the backcourt in (5,4,1) formation is more than the number of midfielder and frontcourt players. However, after the offensive and defensive transition, various situations such as (3,4,3) and (4,5,1) can occur depending on opponent's strategies.

In Match 9, Huskies played with opponent 9 and resulted in 2-5, loss of 3 points. Huskies used the (5,4,1) defense formation, while opponent 9 used (4,4,2), an offensive formation. From Figure 3.2.1h, we can see that players in Huskies tend to be more gathered while the offensive formation used by opponent 9 tried to cover the width of the court as much as possible when attacking, and fully oppressed the opponent to reduce Huskies chance of controlling the ball. As a result, the total ball passing in Huskies is 137, which is only 35% of the total ball passing in opponent 9.

In Match 14, Huskies played with opponent 14 and resulted in 4-0. This time Huskies used the (4,4,2) offense formation, while opponent 14 used (4,3,3). From Figure 3.3.1e, we can see that players in Huskies tend to be more dispersed and prevent the opponent from controlling the ball. Using (4,4,2) formation, Huskies performed well, with the total ball passing greater than that in opponent team. The initial formation does have essential influence of the ball passing, which directly related to the outcome, however, the dynamic change in the team formation are also important. Although defense formation is used more frequently by the Huskies, it may get better outcome if the team change to more offensive formation when facing different strategies of the opponents.

3.3.2 The Influence of the Performance Indicators

3.3.2.1 The Influence of the Performance Indicators to Team's Adaptability

According to the model of Analytic Hierarchy Process (AHP), we gain the matrixes of B1, B2, B3, A1, A2. Then, we use MATLAB to do consistency check. We find CR <0.1, it is determined that the matrices have satisfactory consistency, and the degree of inconsistency is acceptable.

We also get the weight of b1, b2, b3 against A1, the weight of b1, b2, b3 against A2, and the weight of A1, A2 against win. The results are following:

The weight of b1, b2, b3 against A1 = [0.25, 0.375, 0.375]

The weight of b1, b2, b3 against A2 = [0.15936, 0.47809, 0.36254]

The weight of A1, A2 against win = [0.71429, 0.28571]

Therefore, we know the order of weight of A1, A2 against win is A1>A2.

Thus, we conclude it is more likely to win at home than away.

3.3.2.2 The Influence of Team's Adaptability

To get the weight of b1 against win, we times the weight of b1 against A1, A2 with the weight of A1, A2 against win.

So,

The weight of b1 against win = 0.25×0.71429+0.15936×0.28571=0.224103

Similarly,

The weight of b2 against win = 0.375×0.71429+0.47809×0.28571=0.404454

The weight of b3 against win = 0.375×0.71429+0.36254×0.28571=0.37144

Therefore, the weight vector of b1, b2, b3 against win = {0.224103, 0.404454, 0.37144}.

In conclude, the order of weight of b1, b2, b3 against win is b2>b3>b1, which means team flexibility(b2) is the most important indicator for the win of game, strength of opponents(b3) is less crucial, and passing strategy(b1) is the least consequent.

3.3.3 The Influence of Different Strategies

Although we know the order of importance of these three indicators, we do not know how to make decision to promote passing strategy, team flexibility and face opponents. As a result, we calculate the possibility of win when $\sigma_p <= \mu_\sigma$, $\sigma_p > \mu_\sigma$, $t <= \mu_t$, $t > \mu_t$, $P_o <= \mu_p$, and $P_o > \mu_p$.

$$P(\sigma_p <= \mu_\sigma) = 9 \div 16 = 0.56$$

$$P(\sigma_p > \mu_\sigma) = 4 \div 22 = 0.18$$

$$P(t <= \mu_t) = 12 \div 26 = 0.46$$

$$P(t > \mu_t) = 1 \div 12 = 0.08$$

$$P(P_o <= \mu_p) = 7 \div 15 = 0.47$$

$$P(P_o > \mu_p) = 7 \div 13 = 0.26$$

By comparing P($\sigma_p <= \mu_\sigma$) and P(($\sigma_p > \mu_\sigma$), we find when $\sigma_p <= \mu_\sigma$, which means concentrating ball pass on a few players, it is more likely to win. Similarly, when $t <= \mu_t$, which means speeding up ball pass to increase team flexibility, it is more likely to win, and when $P_o < \mu_p$, which means the opponents are weaker, it is more likely to win.

4 Strengths and Weaknesses

4.1 Strengths

The directed network model is efficient in demonstrating the interactions among players; the weight in the model can indicate number of balls passing between two players, which is the most commonly used factor to evaluate the importance of each player. The motif analysis method is flexible and could be applied to different football teams. The method allows Huskies to detect the mode motif of opponents, which are critical for the winning, both regards of disrupting opponents' strategies and learning the successive passing types to improve own performance. Moreover, the network model combined with position information intuitively demonstrate formation of two teams; the visualization of game situation provide convenience in making teaming strategies.

The AHP model is efficient in determine the influence of the indirect relations. It is a systematic analysis method to separate the complex system into pieces and use comparison method to get a quantitative result. It's simple and practical and universal for a team to determine the influence of the indicators and make decisions. The model we designed can help the team manager to get the importance of several indicators in a direct and fast way without too much complex calculation which might cause a huge error.

4.2 Weaknesses

The most important weakness of the model is that we ignore the influence of player's substitution when calculating the number of balls passing and the position of players. Since bench players' performance may have influence on the interactions among others, either on the ball passing or changing the initial formation, the probability of winning could be different than we expected. Another deficiency is that using number of passing as the only factor may not be very accurate, especially when the clustering coefficient and centrality distribution is not normal in special cases.

We made several assumptions which follows the result of other research papers. Although all those researches we used are analyzing the indicators of football games, which share a great similarity of our topic, we still didn't examine whether the results of other researches are universal or if it can strongly fit our research. Also, the AHP method is relatively qualified but not quantified compared to other models. These two point might cause a small error in the accuracy of our research.

5 Conclusion

5.1 Suggestions

Since understanding the historical performance of opponent players is necessary in determining the teaming strategies, we suggest the coach analyze the ball passing network of opponents and find the mode motif for each team. We recommend the coach analyze the interactions among Player F2, M1, and M3 to understand how personal strength and 3 player's cooperation contribute to the performance of whole team. Taking the pattern of 3-player subnetwork, the coach should promote the coordination among multiple subgroups of three players to improve the overall fluency of the ball passing. Additionally, the coach should consider more offensive formation such as (4,4,2) and (4,3,3). For instance, Real Madrid's common formation (4,4,3) makes the offensive line closer and connected when attacking. The team relies on the high possession percentage of the three midfielders to assist the forward in completing the offense. The forward has both a strong offensive ability and can retreat to the midfield to participate in defense, changing the formation to (4,4,2).[7] We suggest the

[7] "A Complete Tactical Profile of Real Madrid Midfielder Luka Modric", last modified July 2,2016, https://bleacherreport.com/articles/2649702-a-complete-tactical-profile-of-real-madrid-midfielder-luka-modric

coach try different formations, studying the how characteristics of individual skills and team cooperation influence the offensive and defensive balance.

As the result of our AHP model, the Team Flexibility is the most important indicator and the Strength of Opponents is less important to the result of the game and the Passing Strategy is the least important indicator. Within each indicator, we also found that for the Passing Strategy, when each player shares similar passing number, it’s more likely for the team to win the game. For the Team Flexibility, when the average time to generate a passing event is relatively small, it’s more likely for the team to win the game. For the Strength of Opponents, we found that when facing the relatively weak team, it’s more likely for the team to win.

According to our research, we want to suggest the head coach of Huskies team to focus more on the Team Flexibility in training and preparing for the next season. The head coach should pay huge attention on shortening the average time to generate one passing event during the game. When training the team, the coach can provide some practice for the players to ensure that the players can shorten the time average time to generate one passing event during the game for future seasons. The coach can also encourage the players to share the ball with their teammates during the game, which can ensure that each player share a similar passing number in each game. What’s more, the coach can provide therapy to the players before facing the relatively strong team to encourage them a better performance.

For society, analysis of team strategies is also necessary for success. Our model of Analytic Hierarchy Process (AHP) and Network also suits other teamwork, so the leader of team could use these methods to design better team. For instance, to analyze the interactions between co-authors for manuscript published, network could visualize their link flow and author flow. Meanwhile, by using AHP, indicators affecting the quality of manuscript could be modelled and the leader could get the weight of these factors against the quality. Therefore, it is better for leader to model and analyze team performance first and establish the team according to the result.

5.2 Future Plans

In the future, we try to take MatchPeriod and EventTime into consideration so that the coach can divide the game into several period and make more objective assessment of the players’ performance by corresponding ball passing network and mode motifs. We can also make a series of graph to show the change of formation during the game, which indicate the changing strategies in different situations. The size of the nodes can be represented by the relative importance of a player, which involve more parameters such as shooting accuracy, shortest-past length, and clustering coefficients.

We will also try to combining the data of more seasons instead of only one season to increase the accuracy level of the model. We want to combine more parameters and calculate the harmonic mean of those parameters to measure each indicators to decrease the error level. Besides the passing events, we still want to combine more events when measuring, such as points, goals, and attempt. These can help us to perfect our model and make it more practical for Huskies team to use.

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Appendix

Appendix of Simulation Code

```
b1=[1 4/6 4/6; 6/4 1 1; 6/4 1 1];
%% Consistency Check
[n,n]=size(A);
[v,d]=eig(A);
r=d(1,1);
CI=(r-n)/(n-1);
RI=[0 0 0.58 0.90 1.12 1.24 1.32 1.41 1.45 1.49 1.52 1.54 1.56 1.58 1.59];
CR=CI/RI(n);
if CR<0.10
CR_Result='Pass';
else
CR_Result='Not Pass';
end

%% Calculate the weighted vector
w=v(:,1)/sum(v(:,1));
w=w';

%% Result
disp(['Consistency Inticator:' num2str(CI)]);
disp(['Consistency Ratio:' num2str(CR)]);
disp(['Consistency Check Result:' CR_Result]);
disp(['Eigenvalue:' num2str(r)]);
disp(['Weighted Vector:' num2str(w)]);



clc
clear all
b2=[1 1/3 1/3; 3 1 1; 1 1 1];
%% Consistency Check
[n,n]=size(A);
[v,d]=eig(A);
r=d(1,1);
CI=(r-n)/(n-1);
RI=[0 0 0.58 0.90 1.12 1.24 1.32 1.41 1.45 1.49 1.52 1.54 1.56 1.58 1.59];
CR=CI/RI(n);
if CR<0.10
CR_Result='Pass';
else
CR_Result='Not Pass';
end

%% Calculate the weighted vector
w=v(:,1)/sum(v(:,1));
w=w';

%% Result
disp(['Consistency Inticator:' num2str(CI)]);
disp(['Consistency Ratio:' num2str(CR)]);
```

```
disp(['Consistency Check Result:' CR_Result]);
disp(['Eigenvalue:' num2str(r)]);
disp(['Weighted Vector:' num2str(w)]);


clc
clear all
A=[1 5/2 ; 2/5 1];
%% Consistency Check
[n,n]=size(A);
[v,d]=eig(A);
r=d(1,1);
CI=(r-n)/(n-1);
RI=[0 0 0.58 0.90 1.12 1.24 1.32 1.41 1.45 1.49 1.52 1.54 1.56 1.58 1.59];
CR=CI/RI(n);
if CR<0.10
CR_Result='Pass';
else
CR_Result='Not Pass';
end

%% Calculate the weighted vector
w=v(:,1)/sum(v(:,1));
w=w';

%% Result
disp(['Consistency Inticator:' num2str(CI)]);
disp(['Consistency Ratio:' num2str(CR)]);
disp(['Consistency Check Result:' CR_Result]);
disp(['Eigenvalue:' num2str(r)]);
disp(['Weighted Vector:' num2str(w)]);
```

```
library(igraph)
d <- data.frame(c1 = c(1,1,1,1,1,1,1,1,1,1,1,
2,2,2,2,2,2,2,2,2,2,2,
3,3,3,3,3,3,3,3,3,3,3,
4,4,4,4,4,4,4,4,4,4,4,
5,5,5,5,5,5,5,5,5,5,5,
6,6,6,6,6,6,6,6,6,6,6,
7,7,7,7,7,7,7,7,7,7,7,
8,8,8,8,8,8,8,8,8,8,8,
9,9,9,9,9,9,9,9,9,9,9,
10,10,10,10,10,10,10,10,10,10,10,
11,11,11,11,11,11,11,11,11,11,11),
c2 = c(1, 2, 3,4,5,6, 7,8,9,10,11,
1, 2, 3,4,5,6, 7,8,9,10,11,
1,2, 3,4,5,6, 7,8,9,10,11,
1,2, 3,4,5,6, 7,8,9,10,11,
1,2, 3,4,5,6, 7,8,9,10,11,
1, 2, 3,4,5,6, 7,8,9,10,11,
1,2, 3,4,5,6, 7,8,9,10,11,
1, 2, 3,4,5,6, 7,8,9,10,11,
1, 2, 3,4,5,6, 7,8,9,10,11,
1, 2, 3,4,5,6, 7,8,9,10,11,
1, 2, 3,4,5,6, 7,8,9,10,11),
wt = c(2,59,105,73,57,49,107,92,51,26,21,
62,2,49,39,47,56,62,46,44,22,12,
98,35,5,59,14,50,120,47,54,30,23,
57,30,35,2,1,66,25,62,63,33,30,
36,40,15,0,6,97,27,75,69,29,67,
55,33,56,64,84,5,6,117,58,50,58,
76,29,49,14,22,22,2,24,19,7,10,
85,63,60,79,79,182,20,7,143,72,77,
74,46,56,88,67,63,12,168,0,27,44,
30,26,18,28,23,50,5,71,26,8,34,
16,13,12,50,71,52,1,54,28,24,3))

g <- graph.data.frame(d,directed = TRUE)
plot(g,edge.width=E(g)$wt)
graph.motifs(g, size=3)
plot(graph.isocreate(size=3,number =13))
```

Other Tables

	PlayerID	AveragePosition_x	AveragePosition_y	AveragePosition_x (scale to field size)	AveragePosition_y (scale to field size)
1	Huskies_D1	34.30	54.08	41.16	48.68
2	Huskies_D2	34.74	45.16	41.69	40.65
3	Huskies_D3	35.47	51.57	42.56	46.41
4	Huskies_D4	50.72	12.53	60.86	11.27
5	Huskies_D5	48.32	34.86	57.99	31.38
6	Huskies_F2	53.72	48.19	64.47	43.37
7	Huskies_G1	12.18	48.31	14.61	43.48
8	Huskies_M1	49.72	52.62	59.66	47.36
9	Huskies_M3	46.70	46.40	56.04	41.76
10	Huskies_M4	55.24	55.83	66.28	50.25
11	Huskies_M6	57.57	35.13	69.08	31.62

Figure 6 Average Position of Huskies players in 38 matches