

Brazil national soccer team pass to goal networks

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1. Introduction

A. Background

The FIFA World Cup is one of the biggest sports events in the world. Every four years nations come together to watch and cheer for their national soccer teams, in the hope that they might win the World Cup. Until the world cup of 2022, Brazil is still the number one ranked country in FIFA, and CONMEBOL, with the highest points, determined by FIF's model "SUM" which "adds/subtracts points won or lost for a game to/from the previous point totals" (FIFA, n.d.). So far, with 21 completed events, Brazil is the only country to have participated in all of them and the only team to hold five titles, having won in 1958, 1962, 1970, 1994, and in 2002. During all those years Brazil has had many extraordinary players who had great performances with impressive ball maneuver and tricks, which placed them as individuals and as a team on the spotlight. From Pelé to Neymar, people around the world recognize Brazilian soccer players as soccer icons, and create an enormous anticipation to watch all of the outstanding Brazilian players play together in one team at the world cup.

For a country to be able to participate in the World Cup, they must first compete in the qualifiers matches, which are multiple matches between nations in their confederation. Each continent has its own confederation, that is, the organization responsible for all soccer related events in the member countries. CONMEBOL is the confederation responsible for South America, in which Brazil, Bolivia, Paraguay, Uruguay, Argentina, Peru, Colombia, Chile, Ecuador, and Venezuela are members. (*Members Association*, n.d.). The qualifiers start a year prior to the world cup and last until the year of the competition, with only 32 teams becoming eligible to compete at the group stage of the world cup.

There are many statistical analyses regarding the best teams, the best players, the team with the greatest chances of winning and with the growing popularity of the games

B. Research problem

Since there is more data available regarding previous matches, there are many statistical analyses on the performance of each team and of each player, generating predictions, and speculations on who will win each match, and who will win the world cup. Brazil always has a higher probability among the teams. Even though statistics are a reliable method of analyzing sport, there is the non-reliable side of it, with outliers and with the smallest probability of an event happening still becoming a true event. The dynamic of the team, how they work in sync with different schemes, formations and players is also an important factor that should be more carefully studied and analyzed, as it shows the best and functional dynamic that the team should have when facing different. This qualitative analysis can be achieved with network analysis, and it can provide important insight for the coaches.

Most of the network analysis made are of soccer clubs, such as Real Madrid, Barcelona, Manchester United, and Paris-Saint Germain, where all the well-known soccer stars play at and stay for longer periods of time, in comparison to the world cup. And there is a more consistent data outflow, since the tournaments happen annually. So, there is little network analysis made on the world cup, especially with a focus on only one team, which also includes an analysis on the qualifiers matches. With the 2022 Qatar World Cup happening, and given the high expectations of Brazil, this becomes an in-depth qualitative analysis of the current Brazilian soccer team, on

how they behave on the pitch and what are the common strategies that lead them to score a goal in a match.

C. Research objective

The qualifiers provide a preview of what the world cup national team will be like, as they are the most recent games prior to the world cup, apart from the amicable games. Therefore, it makes it possible to have a better comparison and analysis between players and their plays that lead to a successful goal. Since the world cups happen every four years it leaves a big gap for a change in the players, in their dynamics, and the official national team could have significant changes from world cup to world cup.

So instead of doing an analysis on outdated data, from 2018, in which the players have not been active in any recent games after 208, and there is no record of the new players who are rising in soccer, and currently playing with the CBF (Brazilian Football Confederation), analyzing the qualifiers brings recent data and information. A social network analysis in CONMEBOL qualifiers and in the group stage of the 2022 world cup can provide more information on how the Brazilian national team create their momentum and passes to score a goal, how they generally play, the position that each player has during the attack, and possibly find a pattern in it.

In a soccer game each player has a different role, and they should all work in harmony in order to be successful. There are four main positions: goalkeeper, defender, midfielder, and forward (Garcia, 2022). The defender can be divided into centre-back - central defender to stop the opponent attack; sweeper - help to cover gap in defense and assist the goalkeeper (Garcia, 2022); full-back - stays on the side of defense and supports the wide midfielder while marking

the opponent's wingers; wing-back - variation of full back who passes the ball towards the other side of the field. The midfielders are centre midfield - win the ball back from attacks and provide coverage when others move forward; defensive midfield, - distributes the ball to all of the other players who are ahead and set the team tempo; attacking midfield - create goal scoring chances for the attacker and usually shots from far; and wide midfield - provides protection and compresses opponent play. The forwards are the forward - assisting the striker; striker - closest player to the goal and the person responsible for scoring goals; and winger - attacker who comes from the sides of the pitch into the goal area, and provides crosses to the box. (*Soccer Positions Explained: Names, Numbers and What They Do, 2022*)



*Figure 1: Bundesliga soccer position explanation (*Soccer Positions Explained: Names, Numbers and What They Do, 2022*)*

2. Literature review

Even though there are soccer network analysis papers, they all focus on the pass maps, the pass network created by teams. Therefore, it was not possible to find a paper that showed a network for the passes that led to a goal, and the relationship between the players in them.

Not only that, but network analysis in soccer was being used to become a statistical tool to become a prediction mechanism, which in fact has little correlation in being a predictor. Instead of being a statistics tool, it can be more useful as a qualitative tool, and instead of predicting, it would be possible to find patterns in the plays that lead to a goal.

3. Methods

A. Data collection and description

To conduct this study, it was necessary to collect information and data about the player's positions on the pitch, the order of the events of the match, and eight different types of ball possession and events: a player's pass, shot on goal, ball recovery, throw in, corner kick, penalty kick, ball save, and turnover, all being successful events. The pass indicates the exchange of the ball between players; the shot on goal is the scored goal; ball save indicates when the goalkeeper is able to protect the goal from the shot; turnover is a turn of events where the opponent team is able to get the ball from whoever possess it; ball recovery is when home team is able to retrieve the stolen ball; throw in happens when the opponent team makes the ball go pass the white line on the sides; the corner kick happens when the home team makes ball go pass the white line where their goal is located; and penalty kick only happens when a foul takes place inside the goalkeeper area. These ball possessions are the base scenarios that happen in a match, and the most important factors to be able to extract the data of passes that lead to a goal.

Two main sources were needed to be able to extract the necessary data, one for the qualifiers and group stage matches. Since the CONMEBOL qualifiers is not a popular event, there was a lack of available data, so it was necessary to watch the matches on YouTube and record all of the important events. On the other hand, given the popularity of the world cup, the website “Who Scored” provided all the match information needed. Given the time of the scored goal, all of the prior events to it, going back up to 3 minutes, or the start of the ball possession of the scoring team, or any fouls, or throw in, or corner kick were saved and used in this study. As for penalty kicks, since the prior events do not matter for the analysis, only the penalty itself was considered as an event.

B. Data analysis technique and procedure

The tutorial provided by Działowski on the blog “Działowski” was used to extract the data from “whoscored” and generate different data frames containing the world cup matches information.

	id	minute	second	playerId	x	y	endX	endY	teamId	type	x	y	outcomeType
0	2.488192e+09	0	0.0	NaN	0.0	0.0	NaN	NaN	423	{"value": 32, "displayName": "Start"}	0.0	0.0	{"value": 1, "displayName": "Successful"}
1	2.488192e+09	0	0.0	NaN	0.0	0.0	NaN	NaN	409	{"value": 32, "displayName": "Start"}	0.0	0.0	{"value": 1, "displayName": "Successful"}
2	2.488192e+09	0	0.0	317630.0	49.8	50.0	29.9	37.6	423	{"value": 1, "displayName": "Pass"}	49.8	50.0	{"value": 1, "displayName": "Successful"}
3	2.488192e+09	0	9.0	297390.0	45.8	45.1	42.1	66.5	423	{"value": 1, "displayName": "Pass"}	45.8	45.1	{"value": 1, "displayName": "Successful"}
4	2.488192e+09	0	11.0	243534.0	43.2	67.8	43.5	84.8	423	{"value": 1, "displayName": "Pass"}	43.2	67.8	{"value": 1, "displayName": "Successful"}
...
1646	2.488207e+09	95	54.0	NaN	0.0	0.0	NaN	NaN	409	{"value": 30, "displayName": "End"}	0.0	0.0	{"value": 1, "displayName": "Successful"}
1647	2.488207e+09	0	0.0	NaN	0.0	0.0	NaN	NaN	423	{"value": 30, "displayName": "End"}	0.0	0.0	{"value": 1, "displayName": "Successful"}
1648	2.488207e+09	0	0.0	NaN	0.0	0.0	NaN	NaN	409	{"value": 30, "displayName": "End"}	0.0	0.0	{"value": 1, "displayName": "Successful"}
1649	2.488181e+09	0	0.0	NaN	0.0	0.0	NaN	NaN	409	{"value": 34, "displayName": "FormationSet"}	0.0	0.0	{"value": 1, "displayName": "Successful"}
1650	2.488181e+09	0	0.0	NaN	0.0	0.0	NaN	NaN	423	{"value": 34, "displayName": "FormationSet"}	0.0	0.0	{"value": 1, "displayName": "Successful"}

Figure 2: Brazil against Switzerland match data frame example

Python has a library named “mplsoccer” which enables an in-depth soccer analysis and visualization. With mplsoccer it is possible to “plot football/soccer pitches on nine different pitch types, plot radar charts, plot Nightingale/pizza charts, plot bumpy charts for showing changes over time, and plot arrows, heatmaps, hexbins, scatter, and (comet) lines” (*Mplsoccer*, 2022). Mplsoccer was used in the data frames to shorten them to the moments prior to a goal.

	id	minute	second	playerId	x	y	endX	endY	teamId	type	x	y	outcomeType
1422	2.488205e+09	81	45.0	88526.0	28.6	89.7	NaN	NaN	409	BallRecovery	28.6	89.7	{'value': 1, 'displayName': 'Successful'}
1423	2.488205e+09	81	46.0	88526.0	28.6	89.7	35.9	64.2	409	Pass	28.6	89.7	{'value': 1, 'displayName': 'Successful'}
1424	2.488205e+09	81	47.0	338780.0	35.9	64.2	NaN	NaN	409	BallTouch	35.9	64.2	{'value': 1, 'displayName': 'Successful'}
1425	2.488205e+09	81	50.0	347862.0	37.4	62.2	NaN	NaN	409	TakeOn	37.4	62.2	{'value': 0, 'displayName': 'Unsuccessful'}
1426	2.488205e+09	81	50.0	89401.0	62.6	37.8	NaN	NaN	423	Tackle	62.6	37.8	{'value': 0, 'displayName': 'Unsuccessful'}
1427	2.488205e+09	81	55.0	347862.0	46.4	39.2	64.0	10.6	409	Pass	46.4	39.2	{'value': 1, 'displayName': 'Successful'}
1428	2.488205e+09	81	59.0	337879.0	71.7	5.8	72.2	14.9	409	Pass	71.7	5.8	{'value': 1, 'displayName': 'Successful'}
1429	2.488205e+09	82	3.0	364315.0	73.8	17.8	64.1	23.5	409	Pass	73.8	17.8	{'value': 1, 'displayName': 'Successful'}
1430	2.488205e+09	82	5.0	338780.0	64.2	28.4	63.2	54.5	409	Pass	64.2	28.4	{'value': 1, 'displayName': 'Successful'}
1431	2.488205e+09	82	8.0	101949.0	70.0	70.8	82.3	91.7	409	Pass	70.0	70.8	{'value': 1, 'displayName': 'Successful'}
1432	2.488205e+09	82	13.0	337782.0	80.3	71.7	80.3	60.2	409	Pass	80.3	71.7	{'value': 1, 'displayName': 'Successful'}
1433	2.488205e+09	82	14.0	347862.0	80.3	60.2	89.1	63.3	409	Pass	80.3	60.2	{'value': 1, 'displayName': 'Successful'}
1434	2.488205e+09	82	16.0	88526.0	87.3	63.3	NaN	NaN	409	Goal	87.3	63.3	{'value': 1, 'displayName': 'Successful'}

Figure 3: Brazil data frame of one minute prior to the goal example

To record all of the data from the soccer match videos “FCPython” YouTube visualizer was used to collect the average location of the players in the field, and all the passes were manually recorded in excel, to generate a dataframe in figure 4.

	source	target	type	pass_count	x	y	endx	endy	width
0	Danilo	Bruno Guimarães	directed	1	58	1	75	38	18.0
1	1Bruno Guimarães	Marquinhos	directed	1	75	38	69	29	18.0
2	Marquinhos	Thiago Silva	directed	1	69	29	70	51	18.0
3	Thiago Silva	Fabinho	directed	1	70	51	56	53	18.0
4	Fabinho	Marquinhos	directed	1	56	53	69	29	18.0
5	Marquinhos	Fabinho	directed	1	69	29	56	53	18.0
6	Fabinho	Neymar	directed	1	56	53	40	41	18.0
7	Neymar	Bruno Guimarães	directed	1	40	41	29	24	18.0
8	2Bruno Guimarães	Richarlison	directed	1	29	24	13	31	18.0
9	Richarlison	GOL	directed	1	13	31	0	50	18.0

Figure 4: Brazil against Chile data frame made from YouTube video

As the players move along the pitch, it was necessary to find the average of their positions and use them to create the networks. And since the passes have a direction, they go from one person to another, all of the events were named as directed.

With this method, it became possible to create a limited and specific passmap that also includes the shots in goal, as passmaps only involve the passes, shown in **FIFA World Cup 2022 - Group Stage** analysis. Gepic was another important tool used, as it makes the networks more clean and easy to see the dynamics.

4. Results

CONMEBOL Qualifiers

Brazil vs. Bolivia

In march 2022 Brazil played its last qualifier game against Bolivia, which they won 4-0. The team played with a 4-2-3-1 strategy and the players in this match were:

Goalkeeper: Alisson

Defenders: Marquinhos, Alex Telles, Dani Alves, Thiago Silva, Danilo, Eder Militão, Guilherme Arana

Midfielder: Lucas Paquetá, Fabinho, Bruno Guimarães, Arthur

Forward: Neymar, Richarlison, Vinícius Junior, Antony, Rodrygo, Martinelli

(CONMEBOL, 2022) (*Bolivia Vs Brazil: TV Channel, Live Stream, Team News & Preview | Goal.com*, n.d.)

The first goal was scored by Lucas Paquetá, who was assisted by Bruno Guimarães. In this case, there is a strong relationship between Paquetá and Guimarães, who have exchanged more passes than the other players, and it is the first relationship that can be created between both of them, as their constant interaction led to the goal. And Bruno Guimarães becomes the most important and influential player in this case, as if he had not seen Paquetá's availability to score, the pass would not have been made. In this play Paquetá has the highest centrality as it has the most connections in comparison to the other players.

Brazil vs Bolivia - CONMEBOL 2022 World Cup Qualifiers

Brazil first goal - Paquetá

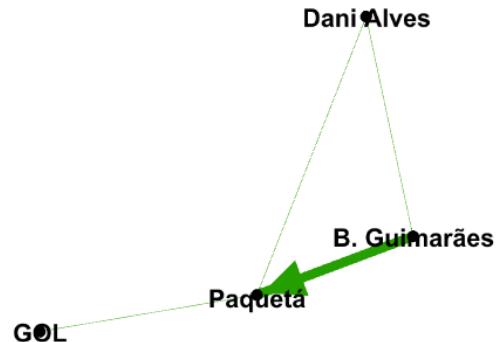
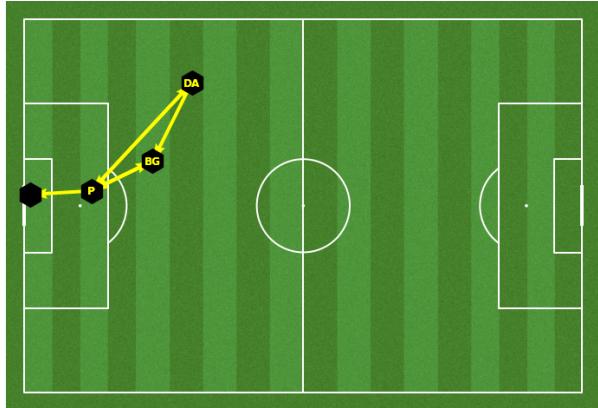


Figure 5: Brazil vs Bolivia first goal network

The second goal was scored by Richarlison, who was assisted by Antony. This type of map becomes very frequent, where the players pass the ball among themselves moving forward, without multiple exchanges between the same players. All the players have the same number of edges and it is possible to see the ball transfer from the midfielders to the forwards.

Brazil vs Bolivia - CONMEBOL 2022 World Cup Qualifiers
Brazil Second goal - Richarlison

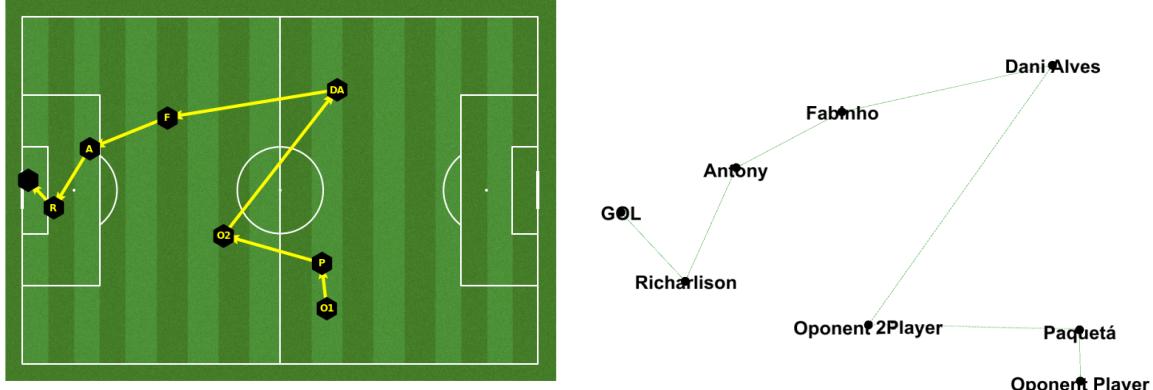


Figure 6: Brazil vs Bolivia second goal network

For the third goal, it also started with the opponent's ball possession, by the goalkeeper, and a turnover for Brazil by Martinelli, who made it possible for Guimarães, a midfielder, to score the goal. In this case, each player also has the same number of node connections, apart from the starting player.

Brazil vs Bolivia - CONMEBOL 2022 World Cup Qualifiers
Brazil Third Goal - B. Guimarães

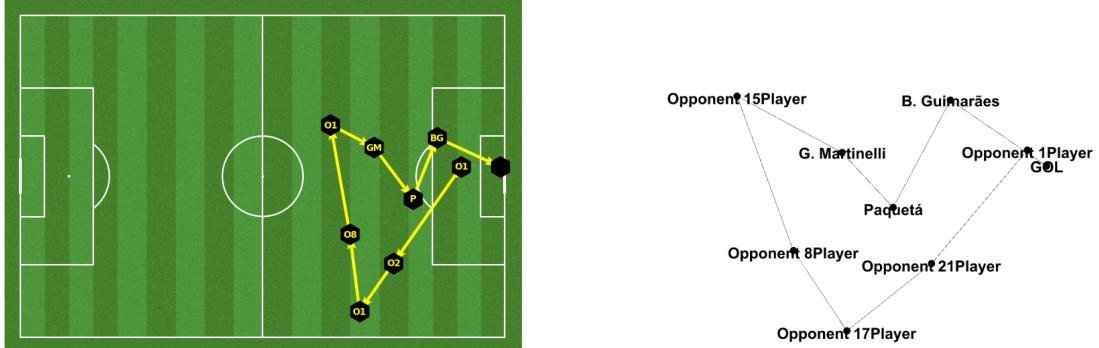


Figure 7: Brazil vs Bolivia third goal network

The last goal was also scored by Richarlison, with the assistance of the rebound of the ball shot by Rodrygo. As a striker in this match, Richarlison was able to play his role well as the main player to score goals. This also means that the other players responsible for getting the ball to reach Richarlison also had a great performance.

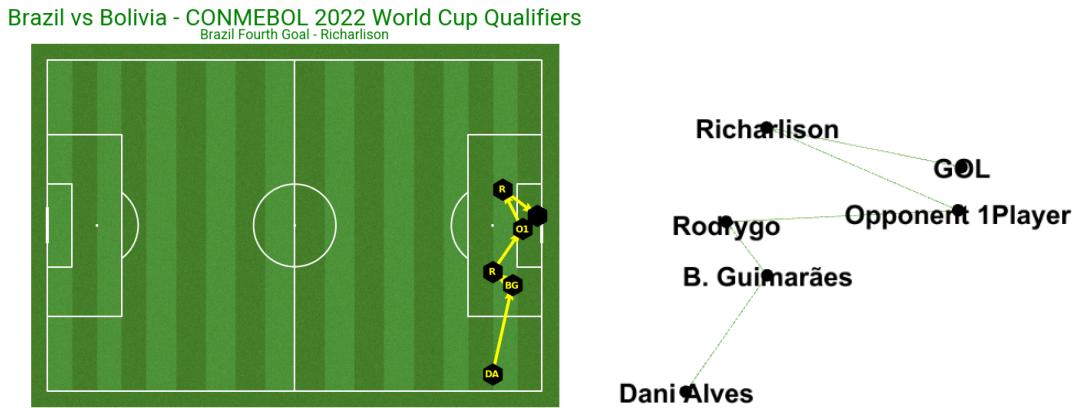


Figure 8: Brazil vs Bolivia fourth goal network

In all of the networks it is possible to see an important participation of Richarlison (appears in 2/4 networks, scoring in both of them), Bruno Guimarães (appears in ¾ networks, scores in one, and assisted in one), Paquetá (appears in ¾ networks, scores in one, steals the ball in one), and Dani Alves (appears in ¾ networks).

Brazil vs. Chile

In March 2022 Brazil played against Chile, where they also won 4-0. The team played with a 4-2-3-1 strategy and the players in this match were:

Goalkeeper: Alisson

Defenders: Thiago Silva, Marquinhos, Arana, Danilo

Midfielder: Lucas Paquetá, Fred, Bruno Guimarães, Casemiro, Philipe Coutinho, Fabinho

Forward: Neymar, Richarlison, Vinícius Junior, Antony, Martinelli (CONMEBOL, 2022)

The first goal against Chile was a penalty kick by Neymar, as he is the best player at scoring those goals among the team. He is a versatile player who usually plays as a midfielder, to score and to assist, but also as a forward to score goals.



Figure 9: Brazil vs Chile first goal network

The second goal also originated from a stolen ball from the opponent team, with multiple direct passes until the ball reached the forward Vinícius Junior who scored the goal. It was assisted by Antony, who crossed the ball to the other side of the goal box.



Figure 10: Brazil vs Chile second goal network

The third goal was also a penalty kick, scored by Coutinho.

Brazil vs Chile - CONMEBOL 2022 World Cup Qualifiers
Brazil Third Goal - P. Coutinho

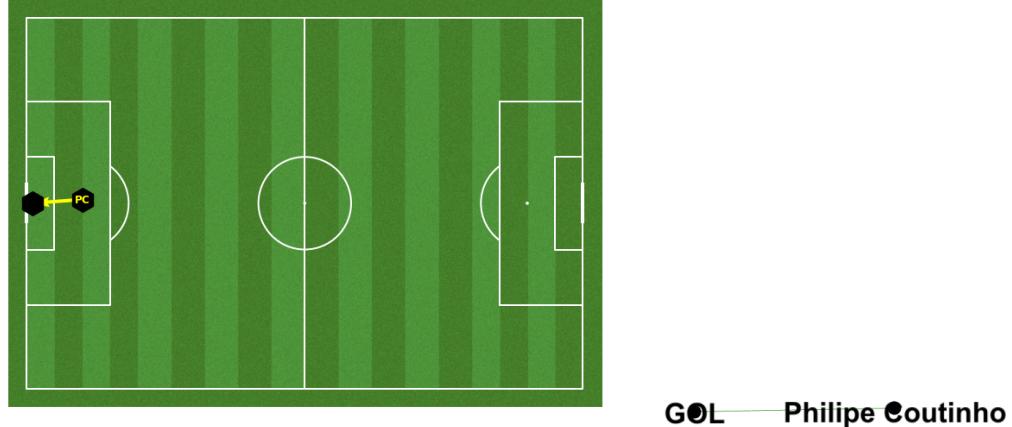


Figure 11: Brazil vs Chile third goal network

The last goal started in Brazil's side of the field, where the players shared a few passes before passing the ball to the opponent side of the field. Once the ball passed the mid campus mark, there were only forward direct passes leading the ball to the forward players to score, in this case, Richarlison.

Brazil vs Chile - CONMEBOL 2022 World Cup Qualifiers
Brazil Fourth Goal - Richarlison

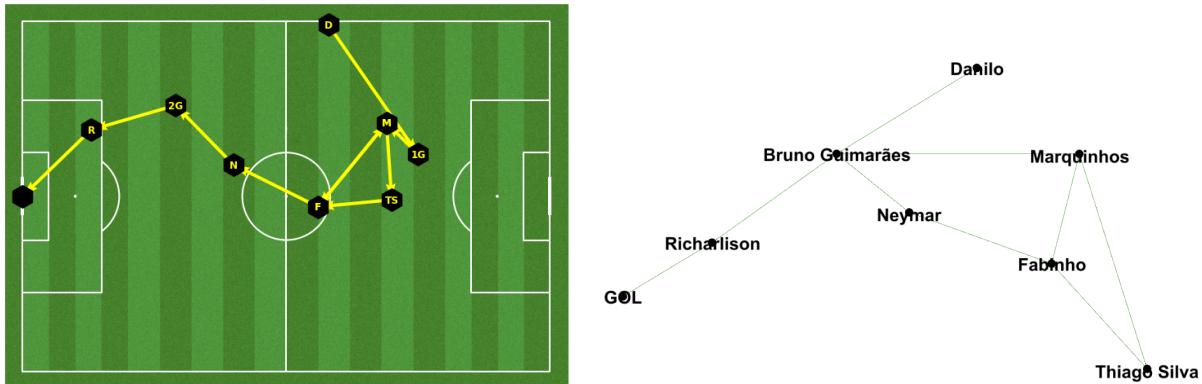


Figure 12: Brazil vs Chile fourth goal network

Brazil vs. Ecuador

In January 2022 Brazil played against Chile, where they tied 1-1. The team played with a 4-4-2 strategy and the players in this match were:

Goalkeeper: Alisson

Defenders: Thiago Silva, Emerson, Alex Sandro, Eder Militão, Gabriel Barbosa,

Midfielder: Raphinha, Fred, Casemiro, Vinícius Junior, Gabriel Jesus, Antony

Forward: Matheus Cunha, Philipe Coutinho, Dani Alves (CONMEBOL, 2022)

Before the ball started in the corner kick, made by Coutinho, the ball started with Alisson, and the defenders worked the ball so the other players could position themselves among the opponent's field. That is why Thiago Silva and Militão have a thicker edge, since they exchanged more passes between each other than the other players. Philipe Coutinho in this match had more centrality compared to the other matches, as he had more connections with multiple other players, and he was a key pass to the goal score.

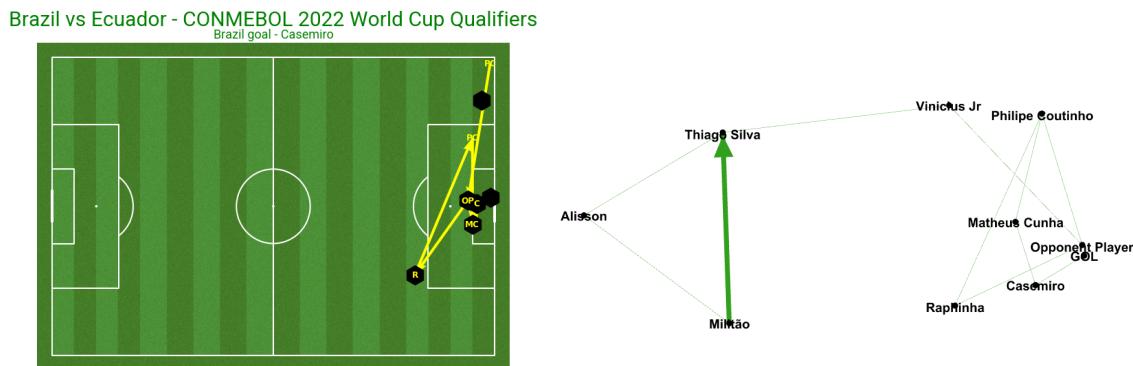


Figure 13: Brazil vs Ecuador goal network

Brazil vs. Uruguay

In October 2021 Brazil played against Chile, where they also won 4-1. The team played with a 4-2-3-1 strategy and the players in this match were:

Goalkeeper: Ederson

Defenders: Thiago Silva, Emerson, Alex Sandro, Lucas Verissimo,

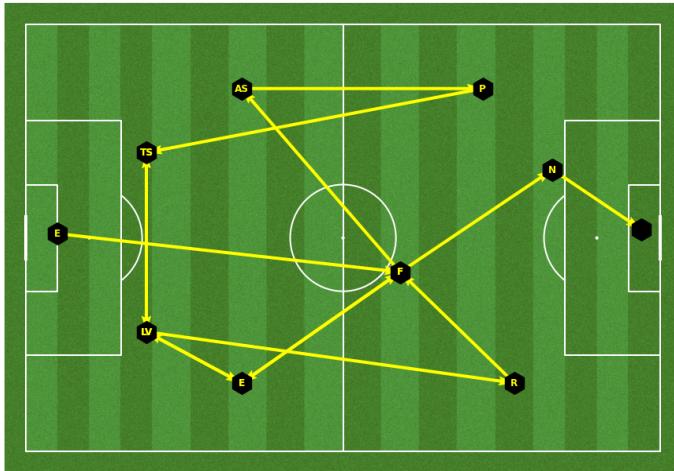
Midfielder: Fabinho, Raphinha, Fred, Neymar, Lucas Paquetá, Antony, Edenilson,

Douglas Luiz, Everton Ribeiro

Forward: Gabriel Barbosa, Gabriel Jesus (CONMEBOL, 2022)

The first goal started back with Alisson and the defenders worked on the ball before passing it to the other half of the field, where Neymar was able to score the goal. That is why Thiago Silva and Lucas Verissimo have a thicker edge, as they exchanged more passes between each other. And Fred also had the higher number of connections, with five different other players, as he was in a key position at the center of the field, where he could connect both sides of the players.

Brazil vs Uruguay - CONMEBOL 2022 World Cup Qualifiers
Brazil first goal



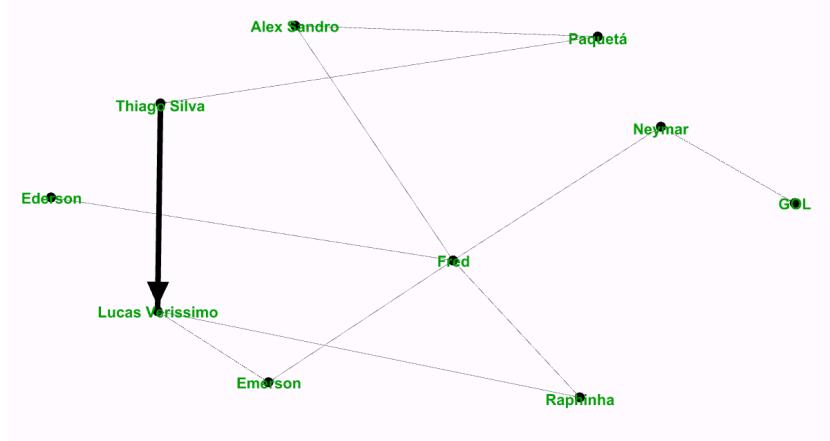


Figure 14: Brazil vs Uruguay first goal network

The second goal presents a pattern already seen in the other previous matches, where each player only has one touch at the ball, as they pass it onwards to the players who are ahead, closer to the goal.

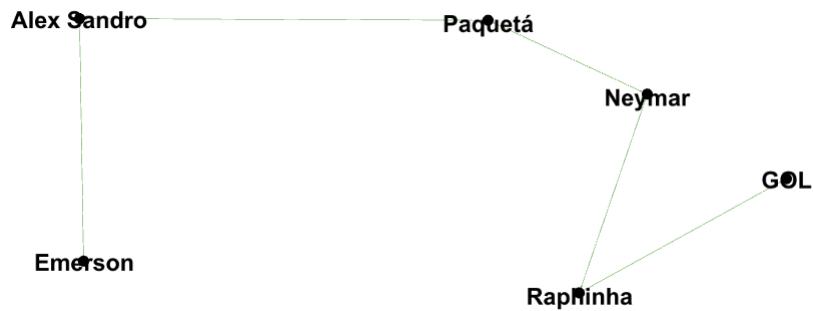
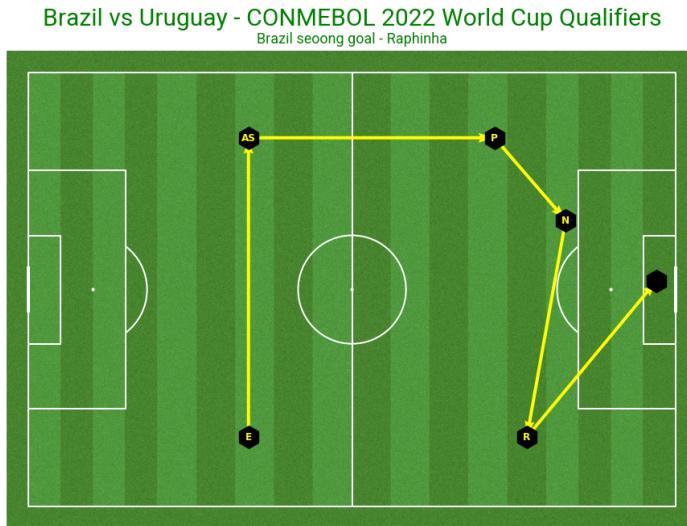


Figure 15: Brazil vs Uruguay second goal network

The third goal required a lot more strategy and players to be finalized. As the ball started with Ederson, it had to make its way to the other side of the pitch, and it is possible to see that there were multiple exchanges between the defenders and midfielders, especially between Alex Sandro and Fabinho. And Fabinho is the player with the most connections, passes, between other players.

Brazil vs Uruguay - CONMEBOL 2022 World Cup Qualifiers
Brazil third goal - Raphinha

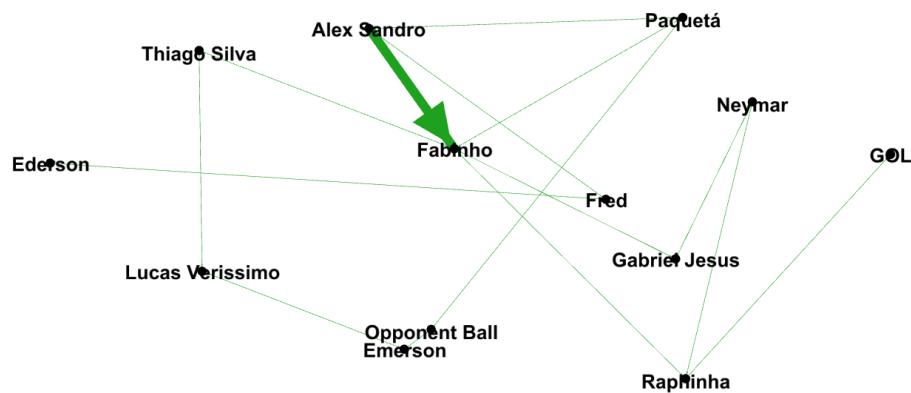
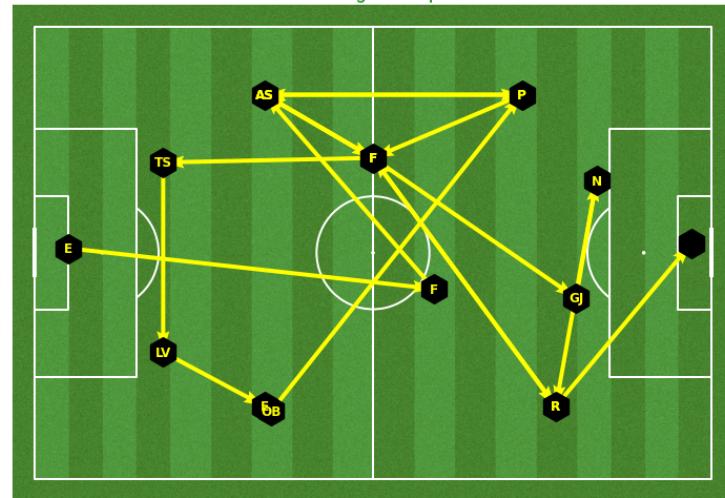


Figure 16: Brazil vs Uruguay third goal network

The last goal was scored by Barbosa, and the ball once again had to be maneuvered forward and backwards in order for the team to find the right opening to shoot at the goal. In this

case, Gabriel Barbosa has the greatest centrality as he was the one who shared most passes with other players, and has a higher pass count.

Brazil vs Uruguay - CONMEBOL 2022 World Cup Qualifiers Brazil third goal - Raphinha

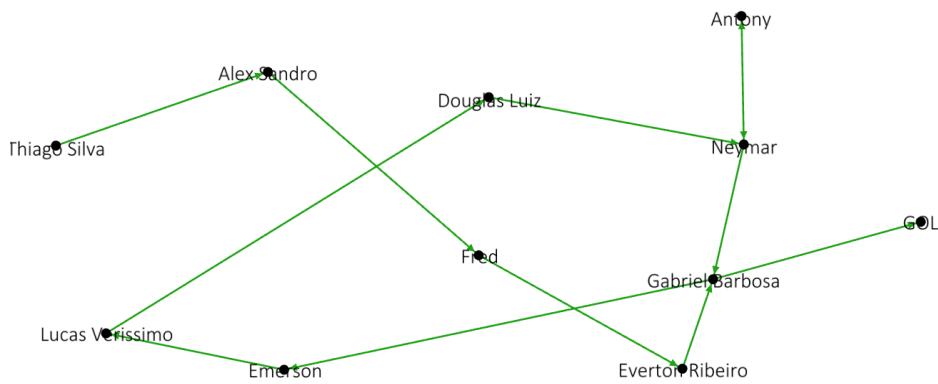
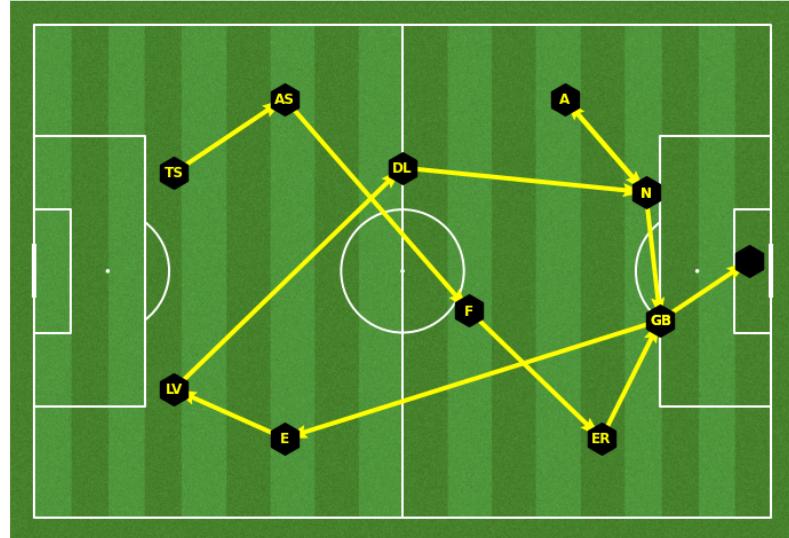


Figure 17: Brazil vs Uruguay fourth goal network

With Uruguay, Brazil had to work more on the ball internally before being able to attack and score a goal.

FIFA World Cup 2022 - Group Stage

For the World Cup matches, the pass map is to indicate the overall exchange of passes among the team members, followed by the pass to goal network. As the world cup advances, teams get more competitive and the difficultness of the matches also increases. So, it is possible to see that the number of goals scored decreases as the opponent team gets stronger, and also, surprisingly, some “zebra” teams also go against all statistics and manage to win a match.

Brazil vs. Serbia (Brazil 2-0)

For the first game in the world cup, the Brazilian team played with a 4-3-3 setup, where the players were:

Goalkeeper: Alisson

Defenders: Thiago Silva, Marquinhos, Alex Sandro, Danilo

Midfielder: Casemiro, Neymar, Lucas Paquetá

Forward: Raphinha, Richarlison, Vinícius Junior (GE, 2022a)

All of these players had already interacted in previous matches, such as in the qualifiers mentioned before, therefore, as the first match of the world cup, it was a compilation of all the best players who could create a momentum to score goals, and have a high pass exchange between them.

For the overall pass exchange in the game, the ball was mostly concentrated with the defenders and midfielders. This can be due to the aggressive attack of the Serbian team, and it provides a safer ball possession for the Brazilian team.

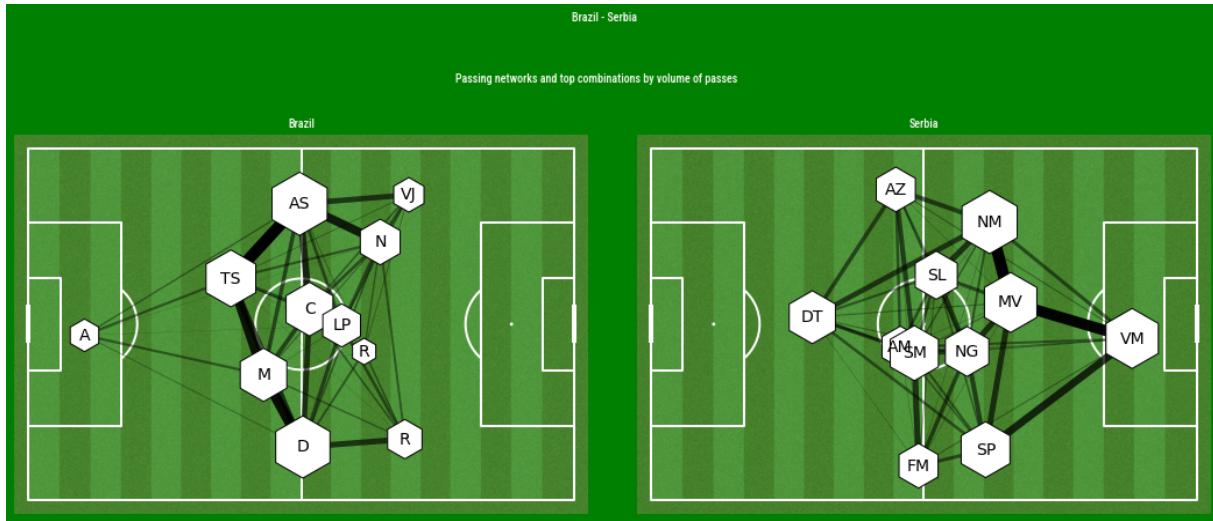


Figure 18: Brazil vs Serbia pass network

As there were many fouls in the game, depending on the location, they were a great advantage for the team. For the first goal, Thiago Silva started with the ball, after a foul, and Casemiro was the key player to cross the ball over to Vinícius, who made it possible for Richarlison to score. This is a clear interaction between defender, midfielder, and attackers, and all players only have two connections, with two other players, those who passed the ball and those who they passed the ball to.

A throw in is another method to create the possibility of a goal. After the opponent team lost the ball, while they were attacking, Brazil had a throw in chance. Once again all of the players only had one single touch, and the network expanded to the Serbian side of the field. Here, the forwards, Neymar, Richarlison, and Vinícius were important to cut the ball to the inside of the goalkeeper box.

Brazil vs Serbia - FIFA World Cup 2022 Group Stage
Brazil First Goal - Richarlison

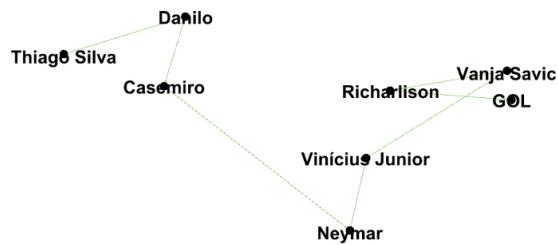
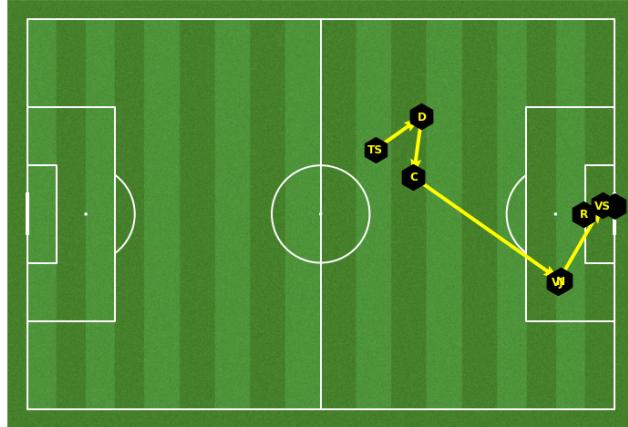


Figure 19: Brazil vs Serbia pass to goal network
Brazil vs Serbia - FIFA World Cup 2022 Group Stage
Brazil Second Goal - Richarlison

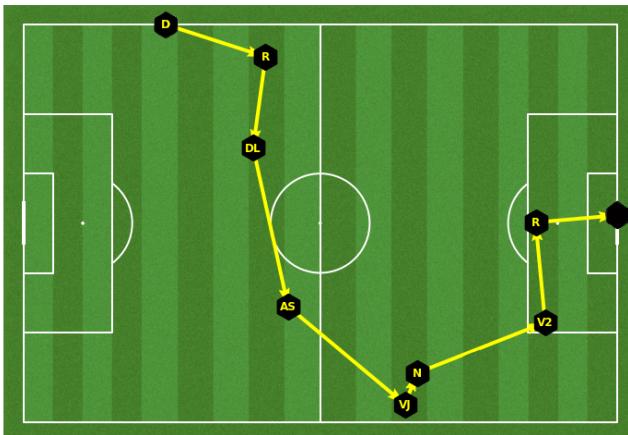


Figure 20: Brazil vs Serbia pass to goal network 2

Brazil vs. Switzerland (Brazil 1-0)

The second game against Switzerland was played with a 4-3-3 setup, where the players were:

Goalkeeper: Alisson

Defenders: Thiago Silva, Marquinhos, Alex Sandro, Éderson Militão

Midfielder: Casemiro, Fred, Lucas Paquetá

Forward: Raphinha, Richarlison, Vinícius Junior (GE, 2022)

The main chance from the first match was Neymar, and this generates multiple speculations as it said that Brazil cannot have a good outcome without Neymar.

From the pass networks, Brazil clearly had less ball possession when in comparison to Switzerland, which makes it harder for the team to score, which can be a reason as to why they only scored one goal. The forwards had little influence and low performance in this match, as it was mostly concentrated on the defenders.

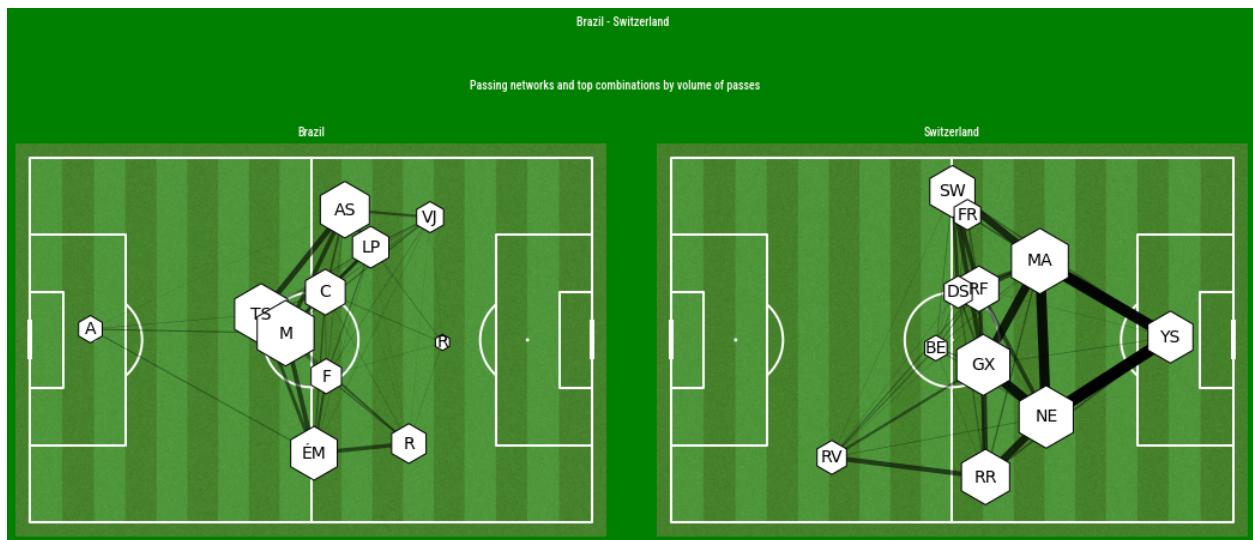


Figure 21: Brazil vs Switzerland pass network

Brazil vs Switzerland - FIFA World Cup 2022 Group Stage
 Brazil Goal - Casemiro

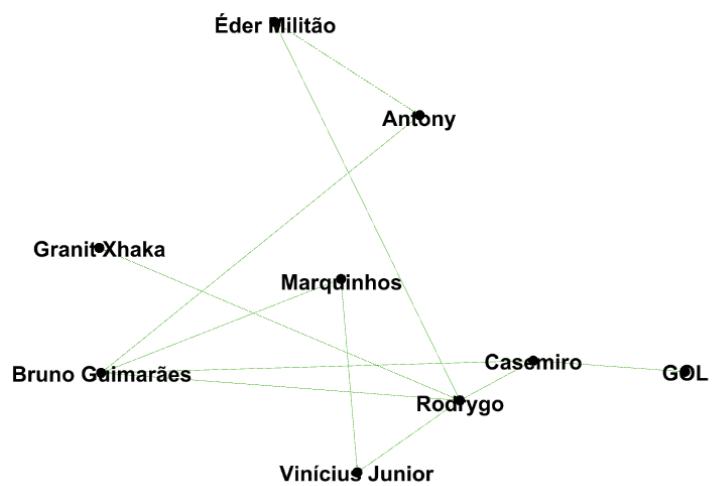
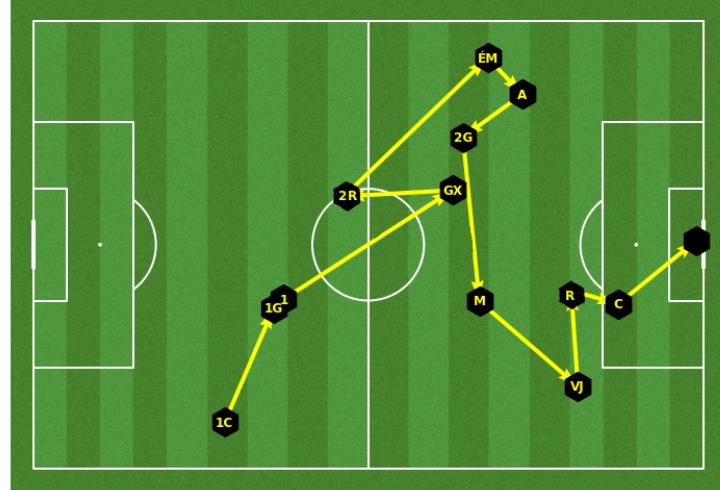


Figure 22: Brazil vs Switzerland pass to goal network

Brazil vs. Cameroon

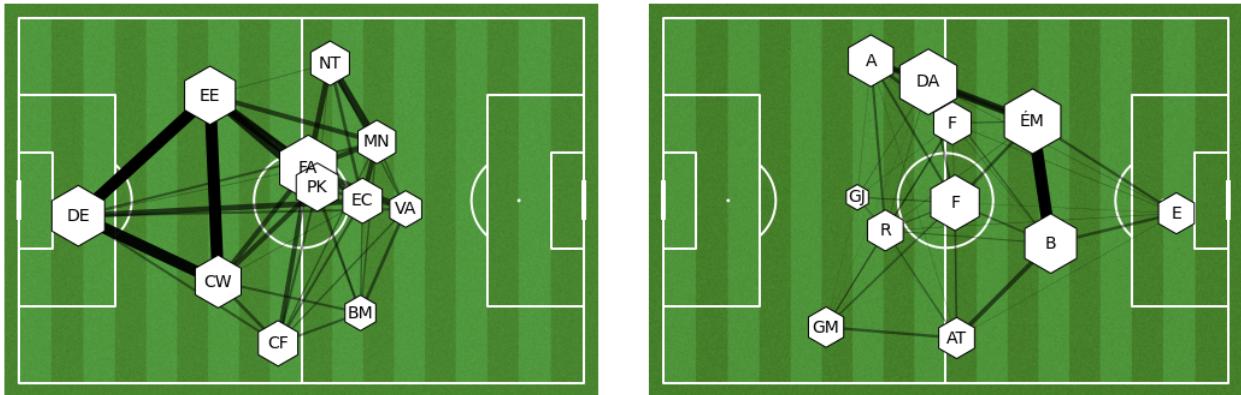


Figure 23: Brazil vs Cameroon pass network

From figure 23, it is possible to see that Brazil only worked on their defense. No goals were scored, and Brazil lost 0-1. The team line up was also different, being 4-2-1-3 with:

Goalkeeper: Ederson

Defenders: Dani Alves, Bremer, Alex Telles, Éderson Militão

Midfielder: Fabinho, Fred, Guimarães, Rodrygo, Ribeiro

Forward: Anthony, Gabriel Jesus, Pedro, Martinelli (Cassucci, 2022)

In comparison to the previous games, the players' setup was very different, which ended up compromising the dynamic of the team. Even though all players are good athletes, there were very different defenders and forwards, which could be a reason as to why they were not able to score and as to why the defense was lacking, and Ghana was able to score.

5. Conclusion and Discussion

The pass-goal network is not a dense network, as the passes that lead to the goal ultimately happen within seconds to a minute from the start of the team's ball possession. If the ball comes from the home team side of the field, before they move and run for an attack, they are

likely to pass the ball a couple of times in between their players in the back and then move forward. However, if the ball possession starts on the opponent team, there are direct passes between players who are ahead of each other, until the ball reaches the striker or a forward player to score the goal.

All networks have a low graph density, as not many players take a roll on the pass-goal network; they also have a diameter lower than 10, ranging from 5 to 7. It is possible to see a few patterns

- Having ball recoveries and of turnovers become goals
- Directed passes between different (without repeating) players until it reaches the attackers
- Important dynamic between:
 - Thiago Silva and the other players playing in defense at the other side of the box (Marquinhos, Veríssimo...)
 - Richarlison works great as a striker and can score by receiving the ball from both sides.
 - Richarlison - Neymar
 - Richarlison - Vinícius Junior
 - Are all common interactions that lead to the goal as even if they miss, they are able to get the saved ball
 - Bruno Guimarães has great centrality and importance in passing the ball to other mid/forward players in most of the games he has played.
 - The team is able to play without Neymar and have a positive outcome

- It is possible to see that the team attacks coming from the sides, instead of attacking from the direct center of the field. This gives more ball mobility as they are able to pass the ball along to the players on the outside and who are forward.

A. Implications

As it has been possible to see which players interact in a more efficient way with each other to generate pass to goal scenarios, this can be useful information to the coach, for him and his team to make the best team setup decisions. This can ultimately change the chances of Brazil's team winning, regardless of the statistics of the match, just based on the players who are playing together in the field. This can be used to maximize their performance,

B. Limitations

What the current 2022 FIFA World Cup has shown is that statistics and predictions are not always correct. As advanced as the technologies might be, the outliers can always turn it around and surprise everyone. The human factor of the game should not be forgotten. That is, the mental, emotional, and physical state of the players, and that sometimes the soccer players have bad days and not the greatest performance. Not only, but the setup chosen by the coach is the most important key factor, which determined how the team will act together, as it was possible to see in the networks.

This study is very limited in data, as only four matches of the qualifiers were used and there are eighteen games in total that could be studied, and it does not evaluate in great depth the performance of the players as individuals. The location of the players on the pitch is an approximate estimation of their real location. It would also be more beneficial to have a pass

network of the qualifier's games, and to further analyze the team's performance at the other Qatar matches. All the forwards players could also be analyzed separately and their most common successful shots in goal position could be used in the analysis as well.

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