Understanding Manchester United's Tactics Under Ole Gunnar Solskjær: A Descriptive Study Using Graph Theory

Fakhrurrida Clarendia Widodo 13518091
Program Studi Teknik Informatika
Sekolah Teknik Elektro dan Informatika
Institut Teknologi Bandung, Jl. Ganesha 10 Bandung 40132, Indonesia
13518091@std.stei.itb.ac.id

Abstract—**In December of 2018, Ole Gunnar Solskjær was officially appointed as Manchester United's interim coach to replace Jose Mourinho. Under Ole's reign, Manchester United's playing style seems to be transforming. The team plays as if they are playing under Sir Alex Ferguson. The impact is very clear. In his first 10 matches as a coach, he successfully won all ten. Even though the impact is very easy to be seen, the tactical difference is still something that is difficult to explain. Therefore, a descriptive study using graph theory is needed to analyze Manchester United's tactical change brought by the Norwegian coach.**

Keywords—**Football, Tactics, Graph, Manchester United.**

I. INTRODUCTION

Ole Gunnar Solskjær has started his Manchester United career emphatically with the vast majority of his games in charge resulting in wins and overseeing a significant shift in mentality and approach away from that favored by his predecessor, Jose Mourinho. The changes instituted appear not only to have energized the side, but also brought the best out of marquee players like Paul Pogba and Marcus Rashford.

Picture 1.1. Ole Gunnar Solskjær Celebrated as Manchester United Beat Paris Saint-Germain 3-1 to Secure a Place in UEFA Champions League Quarter-Final
https://sport.detik.com/

Solskjær has been tactically flexible, using a variety of systems. He has shown a slight preference for an attacking 4-3

3, with one midfielder sitting slightly deeper, but has also used the 4-2-3-1 and a sort of midfield diamond set-up, while recent games have also featured a lop-sided 4-4-2, with a deep central midfield and one midfielder tucking in to play higher and in the channel.

Picture 1.2. Manchester United Destroyed Cardiff City 5-1 to Give Ole Gunnar Solskjær Dream Start
https://www.eurosport.com/

He's also instigated more of a pressing game at United than his predecessor, and has encouraged his players to defend with a higher line. This means that the front three or lone striker are less isolated, as the side is more horizontally compact. This compactness is crucial as it makes United harder to break down, but also allows them to transition from the defensive phase to the attacking phase more easily.

II. BASIC THEORY

A. Graph Definition

A graph is a structure amounting to a set of objects in which some pairs of the objects are in some sense "related". The objects of the graph correspond to vertices and the relations between them correspond to edges. A graph is depicted diagrammatically as a set of dots depicting vertices connected by lines or curves depicting edges. [1]

B. Basic Terminology and Types of Graph

1. Oriented Graph

An oriented graph is a directed graph in which at most one of (x, y) and (y, x) may be edges of the graph. That is, it is a directed graph that can be formed as an orientation of an undirected graph. However, some authors use "oriented graph" to mean the same as "directed graph".[2]
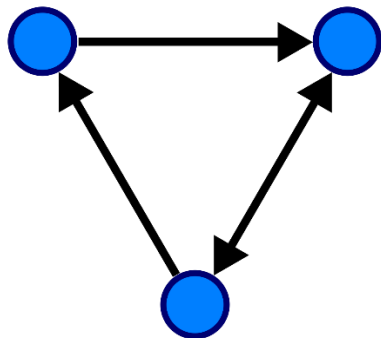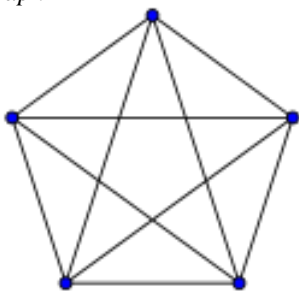

Picture 2.1 An Oriented Graph
https://www.imgbin.com/

2. Regular Graph

A regular graph is a graph in which each vertex has the same number of neighbors, i.e., every vertex has the same degree. A regular graph with vertices of degree k is called a k-regular graph or regular graph of degree k. [2]

3. Complete Graph

Picture 2.2 A Complete Graph
https://www.imgbin.com/

A complete graph is a graph in which each pair of vertices is joined by an edge. A complete graph contains all possible edges. [2]

4. Finite Graph

A finite graph is a graph in which the vertex set and the edge set are finite sets. Otherwise, it is called an infinite graph.
Most commonly in graph theory it is implied that the graphs discussed are finite. If the graphs are infinite, that is usually specifically stated. [2]

5. Connected Graph

In an undirected graph, an unordered pair of vertices {x, y} is called connected if a path leads from x to y. Otherwise, the unordered pair is called disconnected. A connected graph is an undirected graph in which every unordered pair of vertices in the graph is connected. Otherwise, it is called a disconnected graph. In a directed graph, an ordered pair of vertices (x, y) is called strongly connected if a directed path leads from x to y. Otherwise, the ordered pair is called weakly connected if an undirected path leads from x to y after replacing all of its directed edges with undirected edges. Otherwise, the ordered pair is called disconnected.

A strongly connected graph is a directed graph in which every ordered pair of vertices in the graph is strongly connected. Otherwise, it is called a weakly connected graph if every ordered pair of vertices in the graph is weakly connected. Otherwise it is called a disconnected graph. [2]

6. Bipartite Graph
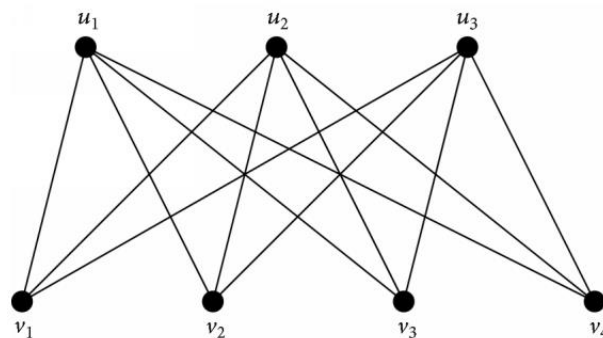
Picture 2.3. A Bipartite Graph
https://www.researchgate.com/

A bipartite graph is a simple graph in which the vertex set can be partitioned into two sets, W and X, so that no two vertices in W share a common edge and no two vertices in X share a common edge. Alternatively, it is a graph with a chromatic number of 2. In a complete bipartite graph, the vertex set is the union of two disjoint sets, W and X, so that every vertex in W is adjacent to every vertex in X but there are no edges within W or X. [2]

7. Path Graph

Picture 2.4. A Path Graph
https://www.mathworld.wolfram.com/
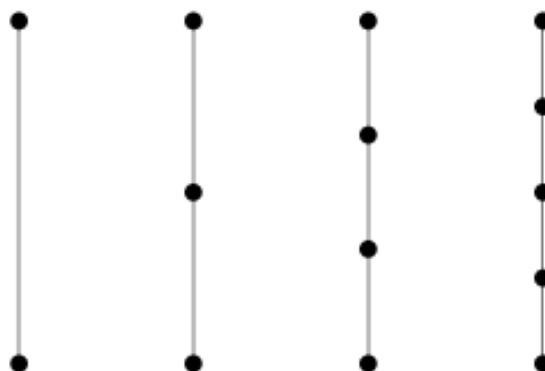
A path graph or linear graph of order n ≥ 2 is a graph in which the vertices can be listed in an order $v_1, v_2, ..., v_n$ such that the edges are the $\{v_i, v_{i+1}\}$ where i = 1, 2, ..., n − 1. Path graphs can be characterized as connected graphs in which the degree of all

but two vertices is 2 and the degree of the two remaining vertices is 1. If a path graph occurs as a sub-graph of another graph, it is a path in that graph. [2]

8. Planar Graph
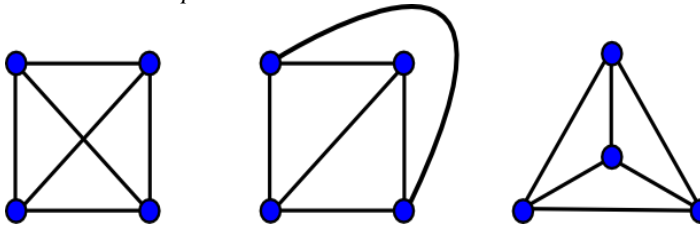
Picture 2.5. A Planar Graph
https://www.imgbin.com/

A planar graph is a graph whose vertices and edges can be drawn in a plane such that no two of the edges intersect. [2]

9. Cycle Graph

A cycle graph or circular graph of order n ≥ 3 is a graph in which the vertices can be listed in an order v1, v2, ..., vn such that the edges are the {vi, vi+1} where i = 1, 2, ..., n − 1, plus the edge {vn, v1}. Cycle graphs can be characterized as connected graphs in which the degree of all vertices is 2. If a cycle graph occurs as a sub-graph of another graph, it is a cycle or circuit in that graph. [2]

10. Tree

A tree is an undirected graph in which any two vertices are connected by exactly one path, or equivalently a connected acyclic undirected graph. A forest is an undirected graph in which any two vertices are connected by at most one path, or equivalently an acyclic undirected graph, or equivalently a disjoint union of trees. [2]

11. Polytree
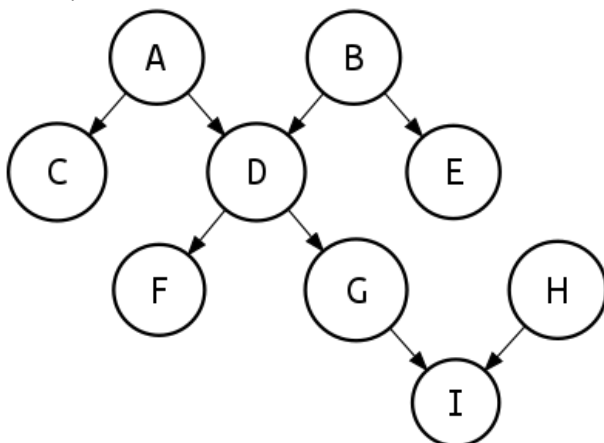
Picture 2.6. A Polytree
https://www.revolvy.com/

A polytree (or directed tree or oriented tree or singly connected network) is a directed acyclic graph (DAG) whose underlying undirected graph is a tree. A polyforest (or directed forest or oriented forest) is a directed acyclic graph whose underlying undirected graph is a forest. [2]

C. Football

Picture 2.7. A Football Match between Manchester United and Inter Milan
https://www.internationalchampionscup.com/

Football is a sport that uses a ball that is mostly made of leather and is played by two teams. Each team is consisted of eleven players. In the 21st century, football has been played by more than 250 million people in 200 countries, making it the most popular sport in the world. The aim of this sport is to score as many goals as possible by putting the ball into the opponent's goal. Football is played in an open rectangular field, on grass or synthetic grass.

In general, only the goalkeeper that is allowed to touch the ball with his hands or arms in the area of his net, while the other ten players are allowed to use his whole body except the hands, usually with the legs to kick, the chest to control, and the head to head the ball. The team that scores the most goals at the end of the match wins. If until the end time is still ended in a draw, a coin toss, extra-time or penalty shoot-out should be held, depending on the format of the championship. In a league competition, 3 points are awarded to the winning team, 0 points to the losing team and 1 point each to the two teams that draw. [3]

The rules of the game are annually updated by the international soccer organization (FIFA).[4]

D. Football Pitch
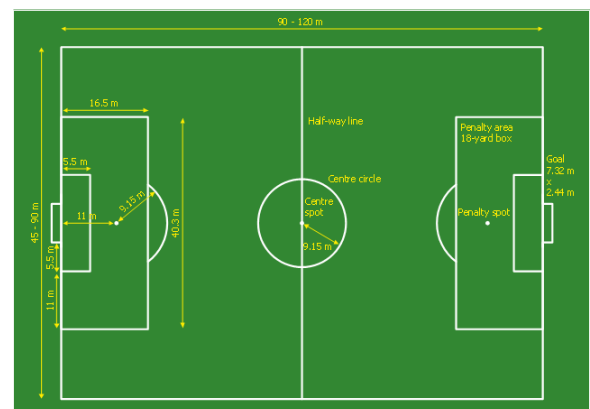
Picture 2.8. Pitch Dimensions
https://www.news.bbc.co.uk/

For adult international matches, the soccer field used has a length in the range of 100 to 120 meters and a width in the range of 65 to 75 meters. At the front of the goal there is a penalty area 16.5 meters away from the goal. This area is the limit for the goalkeeper to catch the ball with his hand and to determine whether the attacking side gets a penalty kick or not.[5]

E. Foul

Picture 2.9 Foul in a Football Match
https://www.premierleague.com/

If a player commits a foul, the referee can give a warning with a yellow card or a dismissal with a red card. The match will be stopped for a moment and the referee shows the card to the offending player then records his name in the book. Yellow cards are warnings of violations such as unsportsmanlike act, constantly breaking rules, quarreling with words or actions, delaying matches, entering and leaving the game without the referee's approval, or not keeping a distance from the opposing players who are taking free kicks or throw-in. Players receive two yellow cards will be rewarded a red card and must leave the match.

Players who get a red card must leave the match without being replaced by other players. Some examples of actions that can be rewarded with red cards are serious violations that endanger or cause serious injury to the opponent such as spitting, committing a violence, violating opponents who are trying to score goals, intentionally touching the ball with their hand to prevent goals (except the goalkeepers), and using offensive language or gesture.[6]

III. TACTICAL ANALYSIS

A. Formation
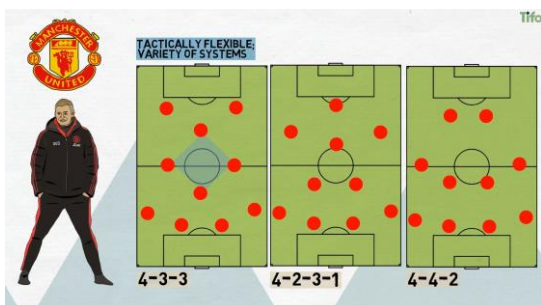
Picture 3.1. Ole Gunnar Solskjær's Formation of Choices
https://www.tifofootball.com/

Solskjær has been tactically flexible, using a variety of systems. He has shown a slight preference for an attacking 4-3-3, with one midfielder sitting slightly deeper, but has also used the 4-2-3-1 and a sort of midfield diamond set-up, while recent games have also featured a lop-sided 4-4-2, with a deep central midfield and one midfielder tucking in to play higher and in the channel.

He's also instigated more of a pressing game at United than his predecessor, Jose Mourinho, and has encouraged his players to defend with a higher line. This means that the front three or lone striker are less isolated, as the side is more horizontally compact. This compactness is crucial as it makes United harder to break down, but also allows them to transition from the defensive phase to the attacking phase more easily.

B. Attacking Style
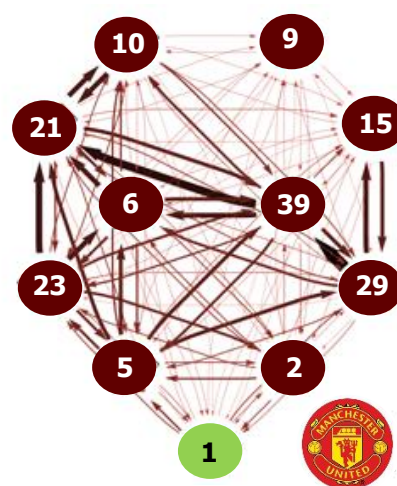
Picture 3.2. Graph Network Showing Number of Passes between Manchester United's Players in the Match Against Chelsea (11th August 2019)
https://www.whoscored.com/

From the graph network above, we can observe that whenever Manchester United is building the attack, the centre-backs, especially Victor Lindelöf (2), carry the ball up through the first line of an opposition press to either pass the ball to Daniel James (21) or Andreas Pereira (15) later. This is often aided by one of the two deeper midfielders dropping off to provide a passing option. This allows United to generate forward momentum in the space between the first and second defensive lines of the opposition.

There is also a greater degree of horizontal movement ahead with players like Andreas Pereira, Marcus Rashford (10), or Anthony Martial dropping off to find space, creating play between the opposition lines. This in turn creates opportunities for quick, dynamic interchanges of pass-and-move football between a highly technical, intelligent, and quick front line, assisted by Pogba (6) pushing forwards from his left-sided eight or ten hybrid role.

The full-backs generally push quite high to provide width, although it has been noticeable in the games where a 4-4-2 is used that they are more defensively minded. Nonetheless, Solskjær seems to have recognised that with Luke Shaw pushing up, Paul Pogba roaming in the left half space, and the combination play possible between players like Martial (9) and Rashford, this represents United's best way of taking a game to opponents and creating threatening chances. Paul Pogba has been perhaps the greatest beneficiary of Solskjær's emphasis on possession, movement, and quick, dynamic interchanges. Spared many of the defensive duties that shackled him under Mourinho, Pogba is free to find space, direct play, and surge into the box to provide a goal threat.

C. Defensive Style

Picture 3.3. Manchester United's 4-2-3-1 Defensive Structure
https://totalfootballanalysis.com/

While on the defensive line, Harry Maguire (5), Victor Lindelöf, Scott McTominay (39) and Paul Pogba stayed compact in the last third area and formed the last line of defense. Pogba and McTominay tried to limit spaces created in between and prevented Chelsea's attacking force from exploiting it. Meanwhile, four defenders screened the box and alerted to any possible long pass to drag the whole structure down.

By dragging every player to their own half and compacting before the opposition could circulate the ball high up the field, they have already outnumbered the opposition. They also could fill in every possible space and shift the structure along with the ball.

D. Passing Blocks

Picture 3.4. Manchester United's Passing Blocks
https://totalfootballanalysis.com/

When in possession, the players have the tendency of building attacks from the defensive line. Also, both wing-backs, Ashley Young or Luke Shaw (23) and Aaron Wan-Bissaka (29) usually intercepts a bit higher up the field, specifically inside the opposition's middle third.

They both exploit in the spaces that the opposition's wingers left behind when they moved into the opposition's half-space. At the same time, the movement also produce potential triangles on both flanks when two central midfielders partake in the attack.

Picture 3.5. Player's Attempt to Press and Create an Overload in Chelsea's Early Build Up
https://totalfootballanalysis.com/

The positioning of Manchester United players helped them created quick defending-attacking transitions. After the lower build-up from the defensive line, it only took them split seconds to bring the ball into opposition's half and then enter the opposition's final third. After that, they used quick and short combinations between the pacey attacking players like Marcus Rashford (10) and Daniel James (21) to press and reached opposition's goal.

IV. CONCLUSION

After analyzing Manchester United's tactic using graph analysis, we can conclude that the combination of proper formation of choice, fast build-up, quick transition, and dynamic interchanges of pass-and-move football is what Ole Gunnar Solskjær tries to emphasize in order to bring the glory back to the team.

V. ACKNOWLEDGMENT

REFERENCES

[1] Bang-Jensen, J.; Gutin, G. (2000). *Digraphs: Theory, Algorithms and Applications*. Springer.

[2] Fletcher, Peter; Hoyle, Hughes; Patty, C. Wayne (1991). *Foundations of Discrete Mathematics* (International student ed.). Boston: PWS-KENT Pub. Co. p. 463.

[3] "History of Football – The Origins". FIFA. Retrieved 30th November 2019

[4] "Laws of the game (Law 12)". FIFA. Archived from the original on 11 October 2007. Retrieved 1st December 2019.

[5] "Laws of the game (Law 1.4 – The Field of play)". FIFA. Archived from *the original* on 11 October 2007. Retrieved 1st December 2019.

[6] "Law 5: The Referee: Advantage" (PDF). *Laws of the Game 2010/2011*. FIFA. p. 66. Retrieved 4 March 2011.

PERNYATAAN

Dengan ini saya menyatakan bahwa makalah yang saya tulis ini adalah tulisan saya sendiri, bukan saduran, atau terjemahan dari makalah orang lain, dan bukan plagiasi.

Bandung, 1 Desember 2019

Fakhrurrida Clarendia Widodo
13518091