Qualitative observation tools to analyse soccer

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Over the last 10 years, there has been a growing interest in match-analysis of soccer. Usually, notational analysis uses numerical data to study and assess the quality of a match. But as far as the analysis of the tactical aspects of the game is concerned, there is a dearth of published research with regards to their theoretical bases. The purpose of this presentation is to contribute to the construction of a knowledge base about soccer using some qualitative observational tools. In a soccer match, structures and configurations of play should be considered as a whole rather than examined a piece at a time. Systems with many dynamically interacting elements can produce of rich and varied patterns of behaviours which are clearly different from the behaviour of each component considered separately. To that effect, effective space game, action zone, and configurations of play will be examined to show that this type of analysis is complementary more than opposed to the numerical data analysis systems.

We shall also pay special attention to the study data bases about the evolution between two or more configurations of play. To deal with such data, we used a methodology that makes possible the qualitative study of configurations of play.

Observation tools for the analysis of team sports, such as the one discussed in this presentation seem to offer a viable and pertinent basis for explaining the evolution of the rapport of strength during a match.

1 Introduction

Over the last 10 years, there has been a growing interest in match-analysis of soccer. Usually, notational analysis uses numerical data to study and assess the quality of a match. But as far as the analysis of the tactical aspects of the game is concerned, there is a dearth of published research with regards to their theoretical bases. The purpose of this paper is to contribute to the construction of a knowledge base about soccer using some qualitative observational tools. In a soccer match, structures and configurations of play should be considered as a whole rather than examined a piece at a time. Systems with many dynamically interacting elements can produce rich and varied patterns of behaviours that are clearly different from the behaviour of each component considered separately. To that effect, effective Play-space, action zone, and configurations of play will be examined to show that this type of analysis is complementary more than opposed to the numerical data analysis systems.

We shall also pay special attention to the study data bases about the actions of a player. To deal with such data, we used a methodology that makes possible the qualitative and quantitative study of a player with the support of a nomogram.

2 Static grid of a pitch

The simplest grid that can be used consists in considering, on the one hand, a defence half pitch and, on the other hand, an attack half pitch.

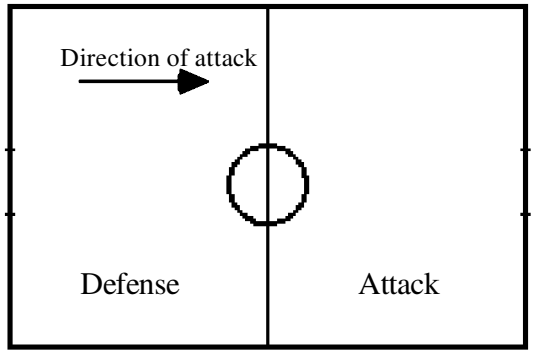

Figure 1. The simplest grid

For the sake of our presentation, the tools presented below will be used in reference to a soccer pitch but they could as well be used for European handball, basket-ball, field hockey, and other invasion team sports.

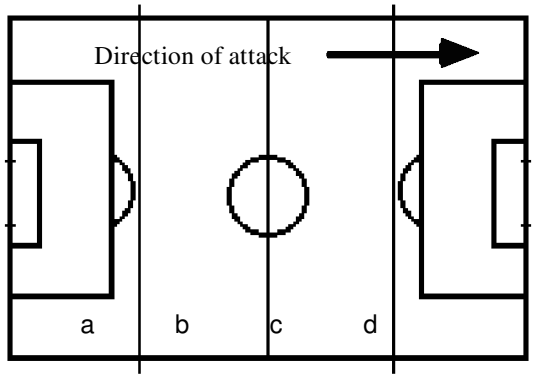

Figure 2. Four Observation areas

Another type of grid approach consists in considering four observation areas: (a) defensive; (b) pre defensive; (c) pre offensive; and (d) offensive.

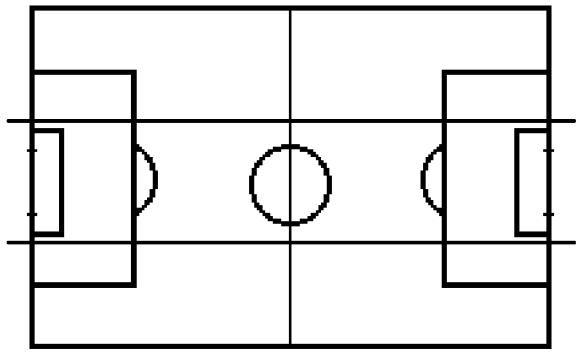

Figure 3. The central corridor

One could also consider the central corridor of the pitch and the two bordering corridors. This would make it possible to note play actions conducted in the axis "attacked goal / defended goal" and others carried in the peripheral channels.

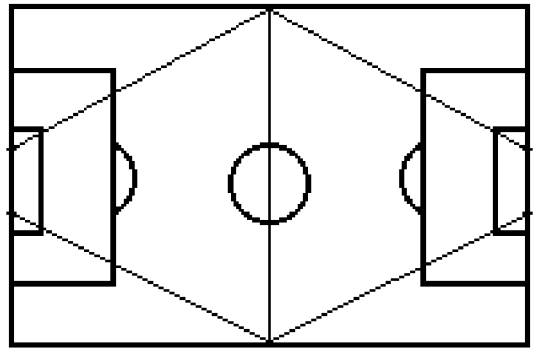

Figure 4. The direct play-space

A fourth type of grid might consider the direct play-space with a vertical target as in soccer or handball for instance. Due to the verticality of the target, the apparent target area varies according to the shooting angle.

If one combines all previous grids, one obtains the observational grid presented below.

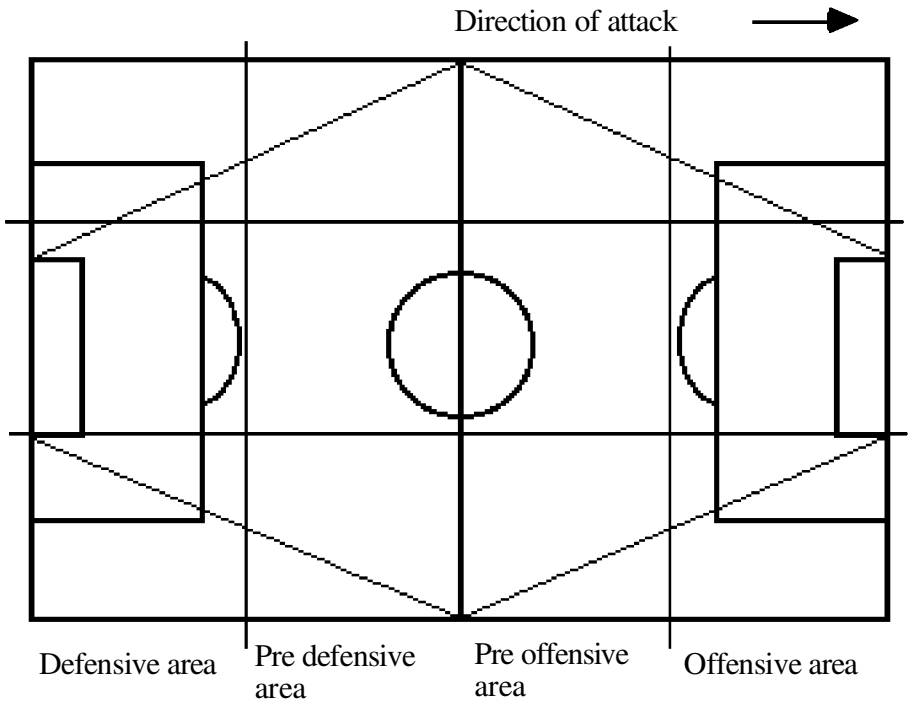

Figure 5. Static observational grid

3 Dynamics-sensitive tools

An important feature of these tools is that they give some idea of the dynamics of the play. We shall successively discuss the effective play-space, the main dimensions of the play, and the prevalent distribution of the players on the pitch.

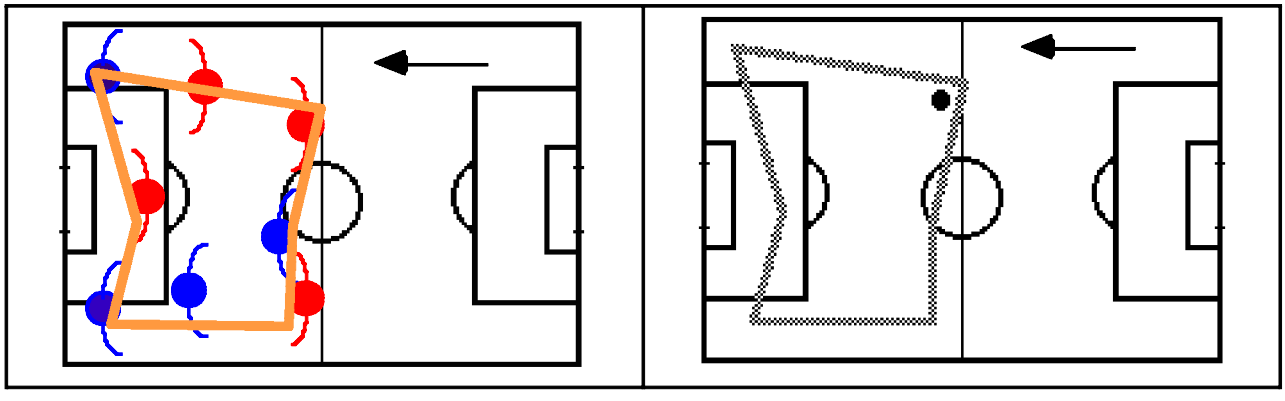

Figure 6. Effective play-space and location of the ball.

If one considers a given configuration of play as the one illustrated above, one can summarise it using the notion of effective play-space (Mérand, 1976; Gréhaigne, Billard & Laroche, 1999). The effective play-space (EP-S) may be defined as the polygonal area that one obtains by drawing a line that links all involved players located at the periphery of the play at a given instant. In the example illustrated here, the ball is at the rear of EP-S.

Concerning the position that the ball can take in relation to the effective play-space,

we shall assign it to one of five categories.
By convention:

- ✓ B1 is a ball located in a central position (in the corridor defined by the "attacked goal / defended goal" axis), ahead of the effective play-space represented by the principal axis.
- ✓ B2 is a ball located in a central position, in the middle of the effective play-space.
- ✓ B3 is a ball located in a central position, at the rear of the effective play-space.
- ✓ B4 is a ball located in a flank position (on the left or right periphery of the pitch), ahead of the effective play-space.
- ✓ B5 is a ball located in a flank position (on the left or right periphery of the pitch), at the rear of the effective play-space.

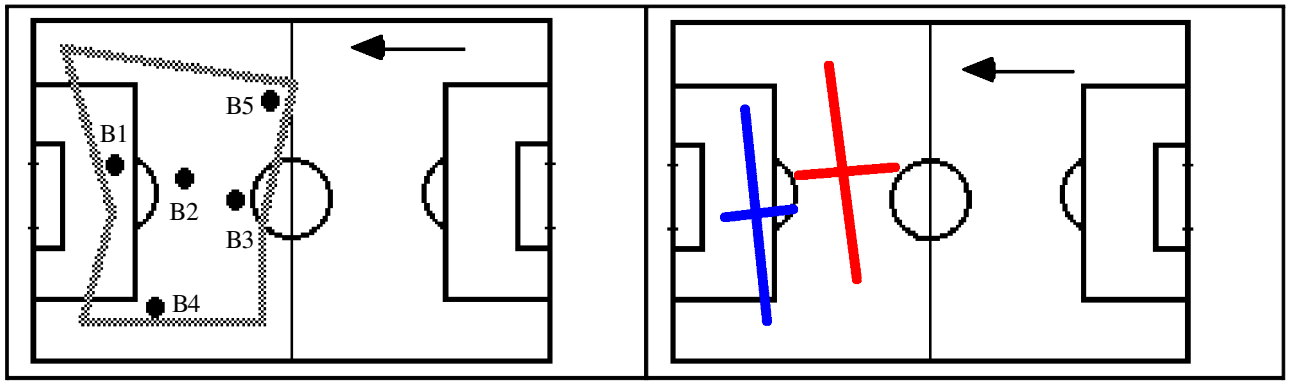

Figure 7. Location of the ball and principal axes

A given cloud of points can be characterised by its centre of gravity and its two principal axes (PA). This type of analysis is particularly useful in research because the reciprocal positions of the centres of gravity appear to constitute an important indication in characterising the notion of "in block" or "in pursuit" for the defence (Gréhaigne, Bouthier & David, 1997). The principal axes of inertia serve to sum up the dimensions and the surface of a *cloud of points* representing the attack or the defence.

The axes can be studied according to their length and their prevalent direction in relation to the dimensions of the field, that is its width or its depth. In our example, attack and defence are mainly spread widthwise rather than lengthwise.
Movement of the ball

4 The players' action zone

In a previous paper we have studied the effective covered space of a player. The observable variables are the player's positions, recorded once every thirty seconds [we tested other intervals (ten, fifteen seconds) before selecting the one used here (Grehaigne, 1988; Winkler, 1984). This gives us a cloud of 180 points per each player. By joining together the positions around the outside of the cloud of points we delimit what is by definition the space effectively covered by the player. But this analysis is still too general since it cannot distinguish the difference between spaces that are heavily or lightly occupied. So, to study the cloud of points (Fig. 1) more closely, we cut the field up into forty equal squares, named A1, A2, A3, etc., and H3,

H4, H5 (Gréhaigne, 1989). We would like to push further this idea by analysing the action zone of each player of a team.

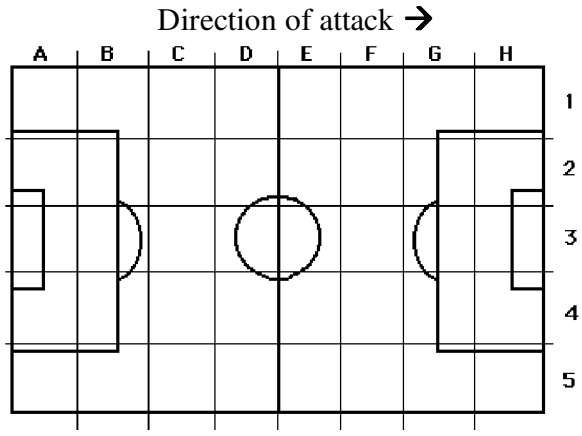

Figure 8. Field with 40 equal squares

In a square represents a frequency of appearance between 0 and 10 points.

In a square represents a frequency of appearance between 11 and 20 points.

In a square represents a frequency of appearance between 21 and 30 points.

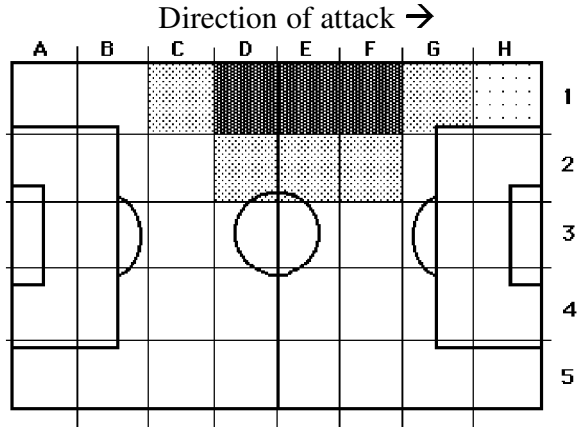

Figure 9. Example of Auxerre's left forward

We can try to find a better approximation of the space covered by players on professional teams by considering that the space is organised around a preferential space for each player. We shall call this, the player's "action zone" and define it as the zone made up of those squares where the player's frequencies of appearance are highest. To study this idea, let us further define the zone as being made up of those squares where the player's frequency of appearance is equal to 80%(+/- 5%) of the points. This is an arbitrary choice, but it seems to us that it reflects the dominant space coverage rather well. We assume that the remaining 20% are points outside the bounds of the player's action zone and correspond to spots where the player executes tasks that are either ancillary to his position or infrequent. Even if a match can very often be won or lost in these 20%, it does not reflect in the description of dominant

space, which is currently the subject of our study. Using this method, we have analysed the behaviour of Auxerre's team. For the purpose, we have grouped the points by tens for each player, up to a total of 145+/-5, to obtain 80% of the points. Data have been collected from the Auxerre's team. The interest of this research is the possibility of transcription of different players' action zone to obtain objective data to analyse the organisation of Auxerrre's team.

5 A nomogram

The instrument is made of three different scales (Gréhaigne, Godbout & Bouthier, 1997):

1. *The efficiency index scale*. On the left hand side of the instrument, one finds the efficiency index scale. To build this scale, we have used samples totalling 45 players in soccer and we have found that the efficiency index rarely exceeded 5. Should one player obtain an efficiency index value higher than 5, the 5 value is attributed.

2. *The volume of play scale*. The right hand side of each instrument presents the volume of play scale. Since 95% of players usually had a volume of play of 90 balls or less, we have retained a scale ranging from 0 to 90 with equal intervals.

3. *The performance score scale*. The middle scale of the instrument contains the performance score (or composite score) resulting from the two original indices. This scale has been established on the basis of the following formula which yields an equal weight to the efficiency index and to the volume of play.

A first step of the procedure consist of observing a player during a match and registering various occurrences in order to establish two complementary performance indices: the efficiency index and the volume of play. The data collected are:

1. *Conquering the ball* (CB): a player is considered having conquered the ball if he / she intercepted it, stole it from an opponent, or recaptured it after an unsuccessful shot on goal or after a near-loss to the other team.

After having gained possession of the ball, the player may dispose of it in one of four ways:

1. *Losing the ball* (LB): a player is considered having lost the ball when he/she loses it to the other team without having scored a goal.

2. *Playing an offensive ball* (OB): an offensive ball is a pass to a partner which puts pressure on the other team and, most often, leads to a shot on goal.

3. *Executing a shot* (SH): a shot at the target.

Once the match is over, the observer computes the total number for CB, LB, OB, and SH. Some of these totals are also combined to produce two additional pieces of information:

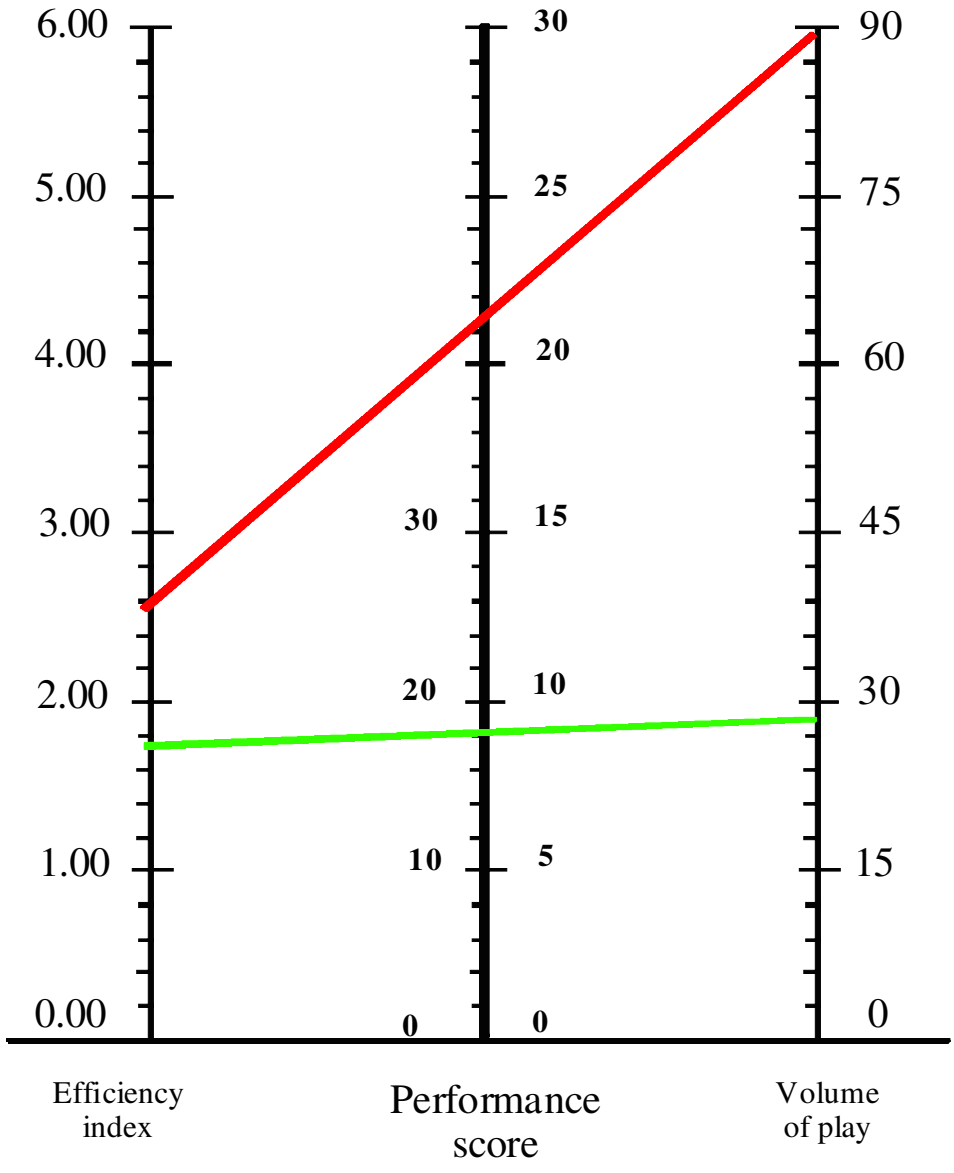

Figure 10. An example of nomogram with two performance scores according to the Table 1.

The *volume of play* (PB) represents the number of times the player has gained possession of the ball (PB, for played balls).

The performance score is computed on the basis of two indices: an *efficiency index* and the *volume of play*. We have just seen how one determines the volume of play; for its part the efficiency index is computed as follows:

$$\text{Efficiency index} = \frac{CB + OB}{10 + LB} \quad \text{or} \quad \frac{CB + OB + SH}{10 + LB}$$

To obtain this score for one given player, one pinpoints the efficiency index and volume of play for a player, and then draws a straight line joining these two points. The point of intersection on the middle scale represents the performance score attributed to the player.

Table 1. The indices of Boghosssian and Guivarc'h.

Boghossian	Guivarc'h
France Norway	France Norway
PB : 89	PB : 28
CB : 6	CB : 4
LB : 9	LB : 3
NB : 32	NB : 3
OB : 42	OB : 18
E. Index : 2.52	E. Index : 1.70

On the figure 10, one can note two performance score scales. Depending upon the place on the pitch, a player has more or less chance to gain possession of the ball. So, to neutralise this effect, two scales are used : on the one hand for more than 45 played balls and on the other hand for less than 45 PB.

7 Conclusion

The observation tools discussed in this paper appear to produce an objective, reliable and valid indication of players' overall offensive performance in team sports. For the nomogram, it should be clear that the two essential elements of the proposed assessment procedure are the efficiency index and the volume of play index. We have put forward the use of a nomogram as one way to combine their respective contributions.

Finally, using these tools and currently available models, research should be pursued to develop assessment instrument in the game of soccer with the help of video and electronic data.

8 References

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