

## Attributes of crosses and their impact on goal scoring in soccer leagues

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### Abstract

In team sports such as soccer, the percentages derived from game-related statistics can offer coaches valuable insights into a team's competitive potential and performance. This research aimed to assess the offensive strategies of soccer teams, focusing specifically on crosses originating from the sides with the intention of reaching the penalty area. **Methods:** Thirty-two soccer matches were meticulously observed, with a detailed analysis of long passes (crosses) occurring outside the penalty area, targeting a player positioned within the penalty area. The soccer field was divided into four zones (a, b, c, d). Zone "a" encompassed the left side and the exterior of the penalty area, zone "b" covered the right side of the penalty area, zone "c" extended to the right side and behind zone "b", and zone "d" spanned the left side and behind zone "a" up to the center of the field. The teams played with similar formation (4-4-2). Statistical analysis included frequencies, cross tabs analysis and Chi-squared (goodness of fit) tests. **Results:** In total, 672 crosses were analyzed, of which 424 (63.1%) were successful and 248 (36.9%) were unsuccessful ( $p \leq 0.05$ ). Most of the crosses (227, 33.8%) were performed from zone "a" ( $p \leq 0.05$ ), 176 (26.2%) from zone "b", 118 (17.6%) from zone "c" and 151 (22.4%) from zone "d". The analysis revealed that most successful crosses were performed from the left side (zone "d" = 70.8% and zone "a" = 68.3%,  $p \leq 0.05$ ), the least successful crosses were made from zone "d" (29.14%) and most unsuccessful crosses were made from zone "b" (48.3%). **Conclusion:** Regarding the success of the crosses performed, the majority of the crosses were performed from the side zones just outside the penalty area. Specifically, the crosses performed from the left side had been more effective than the right ones. Thus, a reorientation in the direction of training is needed to improve players' ability to perform successful crosses from both sides of the field outside the penalty area, in order to perform more effectively during the soccer matches.

**Key words:** performance analysis, pass, cross, tactics, goal scoring, football

### Introduction

In various team sports, recurrent patterns of specific movements, which significantly influence the outcome of matches, are often reported. Sports such as soccer, volleyball, and basketball rely heavily on game-related statistics and indicators, providing essential information to coaching staff about the team's performance and competitive potential (Mikes, 1987). Also, the integration of new technologies in sports offers valuable feedback (Reilly, 2005; Plakias et al., 2023a) and plays a crucial role in injury analysis and prevention in soccer (Rahnama et al., 2002). An effective method to objectively measure performance in soccer involves observation, recording, and analysis using computers or other electronic devices and game-related statistics platforms (Franks, 1988). This analytical approach facilitates the investigation and evaluation of both the technical skills and tactical behavior of soccer players (Grehaigne, 1991; Hagnes & Deverell, 1989; Hill & Hughes, 2001; Lanham, 1993). Key game elements such as ball possession, shots, passes, crosses, and other offensive and defensive indicators are gathered and analyzed during the game. This analysis of tactical behavior provides critical information for coaches to enhance team preparation and predict the technical and tactical behavior of the opponent team (La Rose, 1988). Numerous researchers have studied various soccer competitions, including the UEFA Champions League, World and European soccer cups, and national leagues of different countries (Alberti et al., 2013; Anwar et al., 2022; Augste & Prestel, 2021; Bamplekis et al., 2021; Bekris et al., 2013; Clemente et al., 2012; Coppola et al., 2019; Diaz-Serradilla et al., 2023; González-Ródenas et al., 2015; 2019; 2020; 2023; Gouveia et al., 2023; Izzo et al., 2020; Michailidis et al., 2013, 2018, 2023; Mitrotasios et al., 2019; Oliva-Lozano 2023; Plakias et al., 2022, 2023b, 2023c; Rumpf et al., 2017; Stafylidis et al., 2022; Tousios et al., 2018; Vergonis et al., 2019; Wang & Qin, 2020; Zainuddin et al., 2022).

Reep & Benjamin (1968) analyzed 578 matches from 1953 to 1967 and 48 World Cup matches from 1954 to 1966, discovering that six out of ten goals were scored after recovery of ball possession in the attacking third. Coaches should gather and evaluate match data to adjust tactics during the match or in subsequent games. The objective recording of teams' behavior for technical and tactical variables can be achieved through the observation method (Franks & Miller, 1991; Armatas et al., 2005). However, observing all game-related

statistics during a soccer match can be challenging due to the vast amount of information received by the coach (Franks & Miller, 1991), and as a result a systematic evaluation of technical and tactical parameters is necessary. This analysis can be conducted by a coach assistant, a performance analysis coach, or a member of the coaching staff, either by recording data to a computer or through observation with notes and symbols, a method known as notational analysis (Rahnama et al., 2003).

Regarding soccer training, coaches often divide the field into zones to enhance player efficiency and understanding of their positioning during the game. For analytical purposes, the field is divided into different zones, such as 18 zones for analyzing passing, shooting, running, and dribbling (Rahnama et al., 2003; Borrie et al., 2002), or into defensive, central, and offensive zones (Papadimitriou et al., 2001). Counter-attacking analysis in soccer is also performed in three zones: offensive, central, and defensive (Naris & Elefantis, 2001), and McGarry & Franks (1995) utilized a computer observation system to analyze gameplay that led to successful tactics. Passes and crosses, both short and long, are classic moves in soccer, and researchers have investigated their frequency, zone, and influence on goal scoring (Doggart et al., 1991; Hungen et al., 1988; Olsen, 1998; Pettit & Hughes, 2001). For instance, during the 2002 World Cup, the Brazilian national football team executed an average of 398 passes per game, 297 short and 101 long, while the Danish national team averaged 463 passes, 346 short and 117 long (Bangsbo & Peitersen, 2004). In the 2006 World Cup in Germany, 143 goals were scored in 64 games, 47.0% of which were scored following a pass (Sajad & Rahnama, 2007). Passing is a fundamental technical skill in soccer and should be trained from an early age to achieve excellence, as the right pass in the right area can enable a striker to showcase their skills and potentially influence the game's outcome.

Modern soccer teams often rely on team tactics and zone systems. Crosses, particularly those made by the attacking team towards the opposing team's penalty area, are crucial for goal scoring. Any action towards the penalty area is considered a goal-scoring opportunity, e.g., executing crosses from the sides is expected to be effective, especially when the attacking players are able to prevail in aerial duels (Vermuelen, 2003). The accuracy and frequency of crosses inside the penalty area increase the likelihood of scoring, as demonstrated in the studies by Casamichana et al. (2013) and Liu et al. (2015).

Information regarding the passes and crosses made in the penalty area are essential for coaches to design training sessions effectively. Analyzing successful and unsuccessful game-related statistics allows coaching staff to identify team mistakes and plan interventions in gameplay. The aim of this study was to observe the offensive behavior of soccer teams using a zone system and analyze the crosses made towards the penalty area creating goal scoring opportunities.

## Methods

### *Sample*

The study's sample comprised of 32 matches involving 8 teams, each participating in four matches. These teams were selected from the top eight positions in the ranking tables of both the second and third divisions of the Greek national soccer league. The matches, chosen randomly, took place from September 2021 to January 2023. Notably, the selected teams consistently employed a similar formation and style of play throughout the duration of the study, predominantly utilizing a zone system and adhering to a 4-4-2 formation.

### *Instruments*

The observation of the matches was performed by video recording and video analysis. All soccer matches were video recorded with a digital camera and analyzed using a computer and spreadsheets, as in other similar studies (Armatas, Yiannakos, & Sileloglou, 2007; Izzo et al., 2020; Papadopoulos et al., 2021; Szulc, 2019; Szulc, 2017; Tenga et al., 2010; Vogelbein, Nopp, & Hökelmann, 2014). The research was based on the researchers' personal observation. Data were initially imported in excel and statistical analysis was performed using the statistical program SPSS. This method provided the researchers with the flexibility to record and analyze various soccer actions deemed pertinent to the study. The analysis spreadsheets detailed every pass and cross executed during the matches, including the type of cross by zone-area, effectiveness (successful or unsuccessful), and where the ball ended up after the cross. The analysis was repeated 3 weeks after the initial analysis by the same researchers, mirroring the protocols of previous studies (Stafylidis et al., 2022; Vogelbein et al., 2014). This reevaluation confirmed the intra-class correlation coefficient (ICC), which was found to be satisfactory (Cronbach's  $\alpha = 0.90$ ).

### *Research procedures*

The research was based on the researchers' personal observation, after video -recording and analyzing through computer all the crosses that were performed in selected games. The camera was positioned directly in the extension of the penalty area straight line and at 8 meters high in the stands, in a fixed position so that the entire length and width of the half field could be clearly recorded.

Observation and recording were carried out during the match, while the team was attacking and crossing the line of the center of the field or taking a cross aimed towards the penalty area. A successful cross was considered a long pass-cross that targeted a teammate inside the penalty area, regardless of whether or not a goal was scored, and an unsuccessful cross was considered a long pass-cross that did not end up to a teammate and either was blocked by an opponent or was not accurate. The zones in which the soccer field was divided are shown below (Figure 1).

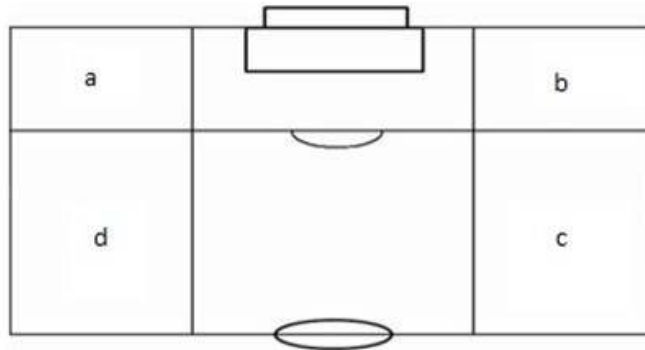


**Figure 1.** Zones of the field.

The soccer field was divided into 4 zones-areas (a, b, c, d), where zone "a" was bounded to the left side and outside of the penalty area (near the corner), zone "b" to the right side of the penalty zone respectively, zone "c" to the right side and behind zone "b", and zone "d" to the left side and behind zone "a" up to the center of the field. A similar zone system has been also used by other researchers who analyzed similar variables (James et al., 2022).

#### *Statistical analysis*

The statistical analysis was conducted using SPSS 26.0 software. This analysis employed frequencies and crosstabs statistical methods, complemented by Chi-square ( $\chi^2$ ) goodness of fit tests. To determine the effect size (ES) and statistical power, G\*Power software: Statistical Power Analyzes for Windows, Version 3.1.9.7 (Faul et al., 2007), was utilized, adhering to the criteria established by Cohen (1992, 2013). Prior to the research, the analysis for a medium effect size (ES = 0.25), with an alpha level of 0.05 and an anticipated statistical power (power  $\geq$  0.80), resulted in the requirement for sample collection of N = 200 passes. Ultimately, the study analyzed over 200 passes (N = 672) that took place in 32 games involving 8 teams. The analysis was repeated 3 weeks after the initial analysis by the same researchers and the intra-class reliability was satisfactory (Cronbach's  $\alpha$  = 0.90). The level of statistical significance was set at  $p \leq 0.05$ .

#### **Results**

The analysis showed that of the 672 crosses performed, 424 were successful (63.1%)  $\chi^2(1, N=672)=46.09$ ,  $p<0.001$ , i.e., they ended up to a player of the same team and 248 crosses (36.9%) were classified as unsuccessful as they did not end up in a teammate or were blocked (Table 1).

**Table 1.** Total Crosses.

| Crosses      | Frequency | Percentage (%) |
|--------------|-----------|----------------|
| Successful   | 424*      | 63.1*          |
| Unsuccessful | 248       | 36.9           |
| Total        | 672       | 100.0          |

\* $\chi^2(1, N=672)=46.09$ ,  $p<0.001$

Most of the crosses [227 (33.8%),  $\chi^2(3, N=672)=37.70$ ,  $p<0.001$ ] were made from zone "a", 176 (26.2%) crosses were made from zone "b", 118 crosses (17.6%) from zone "c" and 151 (22.4%) crosses from zone "d" (Table 2).

**Table 2.** Crosses per zone.

| Zone  | Frequency | Percentage (%) |
|-------|-----------|----------------|
| a     | 227*      | 33.8*          |
| b     | 176       | 26.2           |
| c     | 118       | 17.6           |
| d     | 151       | 22.4           |
| Total | 672       | 100.0          |

\* $\chi^2(3, N=672)=37.70$ ,  $p<0.001$

In detail, 155 [(68.3%),  $\chi^2(3, N=424)=36.34$ ,  $p<0.001$ ] successful and 72 [(31.7%),  $\chi^2(3, N=248)=19.00$ ,  $p<0.001$ ] unsuccessful crosses were performed from zone "a", 9 (51.7%) successful and 85 (48.3%) unsuccessful crosses from zone "b", 71 (60.2%) successful and 47 (39.8%) unsuccessful crosses were performed from zone "c" and 107 (70.8%) successful and 44 (29.1%) unsuccessful crosses were performed from zone "d" (Table 3).

**Table 3.** Crosses per zone (successful / unsuccessful).

| Zone  | Successful crosses | Percentage (%) / area | Unsuccessful crosses | Percentage (%) / area | Total |
|-------|--------------------|-----------------------|----------------------|-----------------------|-------|
| a     | 155*               | 68.3%                 | 72**                 | 31.7%                 | 227   |
| b     | 91                 | 51.7%                 | 85                   | 48.3%                 | 176   |
| c     | 71                 | 60.2%                 | 47                   | 39.8%                 | 118   |
| d     | 107                | 70.8%                 | 44                   | 29.1%                 | 151   |
| Total | 424                | 100.00%               | 248                  | 100.00%               | 672   |

\* $\chi^2(3, N=424)=36.34, p<0.001$ , \*\* $\chi^2(3, N=248)=19.00, p<0.001$

Statistical tests regarding the wing-side channel (right/left) the successful crosses were made (Table 4), showed that the majority and the most successful crosses were performed from the left side (zones "a" and "d", 68.3% and 70.8%, respectively),  $\chi^2(1, N=672)=10.50, p<0.001$ .

At the same time, crosses closer to the penalty area were performed more frequently from zones "a" and "b"  $\chi^2(1, N=672)=26.72, p<0.001$  and were more successful  $\chi^2(1, N=424)=10.90, p<0.001$ . Specifically, 246 successful crosses were performed from zones "a" and "b" in comparison to zones "c" and "d" (178 crosses), (Table 4).

**Table 4.** Crosses per side (successful / unsuccessful).

| Zone               | Successful crosses | Unsuccessful crosses | Total |
|--------------------|--------------------|----------------------|-------|
| Right Side - b & c | 162                | 132**                | 294   |
| Left Side - a & d  | 262*               | 116                  | 378†  |
| a & b              | 246†*              | 157††                | 403   |
| c & d              | 178                | 91                   | 269   |

\* $\chi^2(1, N=424)=23.58, p<0.001$ , \*\* $\chi^2(1, N=248)=1.03, p<0.31$ , † $\chi^2(1, N=672)=10.50, p<0.001$ ,

†† $\chi^2(1, N=424)=10.90, p<0.001$ , †† $\chi^2(1, N=248)=17.56, p<0.001$

## Discussion

This research yielded insightful findings regarding the offensive strategies of soccer teams and especially crosses originating from the sides with the intention of reaching the penalty area. By segmenting the offensive zone into four distinct areas extending from the cross area to the opponent's goal area (penalty area), a comprehensive analysis was conducted. The data revealed a predominant execution of crosses from zones "a" and "b", located towards the corner, with a total of 403 crosses. Specifically, 227 crosses originated from zone "a", and 176 from zone "b". A notable distinction was also observed between the right (zones "b" and "c", 294 crosses) and left (zones "a" and "d", 378 crosses) sides of the field.

The analysis further indicated a tactical bias towards the left side, which exhibited a higher percentage of successful crosses into the opponent's penalty area. This could be attributed to the presence of players adept in using their left foot, underscoring a technical proficiency in this area. Conversely, the right side of the field warrants attention from coaching staff, as despite the presence of technically skilled players, the effectiveness of crosses into the penalty area was less pronounced, highlighting a need for enhanced technique under pressure.

These results, reporting a 63.1% success rate across 672 crosses, resonate with existing literature that emphasizes the tactical importance of crosses in soccer. This aligns with the findings of Casamichana et al. (2013) and Liu et al. (2015), who highlighted the utility of crosses, especially when teams are trailing. The strategic use of specific field zones for crosses, as observed in this study, highlights the critical role of spatial awareness in soccer, as discussed by Borrie et al. (2002) and Rahnama et al. (2003).

Contrasting with Lauffer's (1993) view for short-range passes, this study found a significant number of passes (403) originating from zones "a" and "b", near the penalty area, and 269 from zones "c" and "d", closer to the center of the field. Notably, area "d" exhibited the highest success rate (70.8%) in comparison to zones "a" (68.3%), "b" (51.7%), and "c" (60.2%). The high rate of successful crosses (63.1%) further confirms the effectiveness of playing with two central strikers, enhancing the team's ability to dominate aerial duels and capitalize on crosses from the sides, as posited by Vermuelen (2003).

The data's emphasis on successful crosses from areas "a" and "d" suggests a strategic inclination towards utilizing the sides for creating scoring opportunities. This observation aligns with Reep & Benjamin's (1968) findings on the importance of ball possession in the attacking third for goal scoring. The current study extends this understanding by quantifying the effectiveness of crosses from different zones, offering a nuanced perspective on offensive strategies.

Moreover, the study highlights the significance of technical and tactical analysis in modern soccer, as discussed by Franks & Miller (1991) and Armatas et al. (2005). The role of performance analysis in enhancing team success and predicting opponent behavior, highlighted by La Rose (1988), is exemplified in the study's

findings. The detailed analysis of successful and unsuccessful crosses provides invaluable insights for coaching staff to refine strategies and training objectives.

The study also corroborates the trend towards zone-based tactics in soccer, emphasizing the effectiveness of crosses in creating goal-scoring opportunities. This aligns with the tactical evolution of the game, where teams leverage player strengths in specific field zones, a strategy supported by extensive research in various soccer competitions (Alberti et al., 2013; Anwar et al., 2022).

However, the effectiveness of a pass is influenced not only by the player's skill but also by the teammate's ability to receive the ball, as noted by Wein (2004). Therefore, in soccer, the focus should not solely be on the area of attack but also on its effectiveness, which hinges on the individual technical and tactical abilities of players, the team's tactical performance, and the defensive capabilities of the opposition.

## Conclusions

In summary, this analysis of crossing strategies in football has elucidated that a significant proportion of crosses, precisely 63.1%, were executed successfully, with zones "a" and "d" demonstrating the highest success rates at 68.3% and 70.8%, respectively. The distribution of successful versus unsuccessful crosses across various zones revealed a notable strategic preference for executing crosses from the left side, which were most conducive to successful outcomes. These findings contribute a detailed understanding of the tactical use of crosses in soccer, integrating seamlessly with existing scholarly work to provide a robust framework. This framework is invaluable for coaches and analysts, offering guidance to augment team performance and formulate strategic interventions that are in sync with the evolving dynamics of modern soccer.

The importance of meticulously observing and recording performance-related data in every soccer match cannot be overstated. The analysis of such data is instrumental in enabling coaching staff to refine training objectives, thereby optimizing individual technical-tactical skills as well as enhancing the team's overall performance. Future research could provide coaches with deeper insights, particularly in the realms of passes, crosses, set-pieces, and other strategic game-related indicators executed from both left and right sides.

## Conflicts of interest

The authors declare any conflicts of interest.

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