



A comparative performance analysis of games played on artificial (Football Turf) and grass from the evaluation of UEFA Champions League and UEFA Cup.

Introduction

Following on from our initial technical study - using ProZone match analysis from the Blackburn Rovers Vs Red Bull Salzburg UEFA Cup matches – FIFA are continuing to use objective match analysis data to quantify playing patterns on FIFA RECOMMENDED 2 STAR football turf surfaces.

This second case study includes ProZone analysis from an additional 12 European games, captured from UEFA Champions League Group B matches during the 2006-07 competition. Examination of this additional data from matches played on FIFA RECOMMENDED 2 STAR football turf and top quality natural grass will bring us closer to answering the fundamental question: Does the game change on football turf?

Aim

The aim of this second study is to further analyse the potential impact that artificial turf may have on the pattern of a game and therefore performance, and in doing so provide further informed and objective feedback around the use of artificial turf playing surfaces in football.



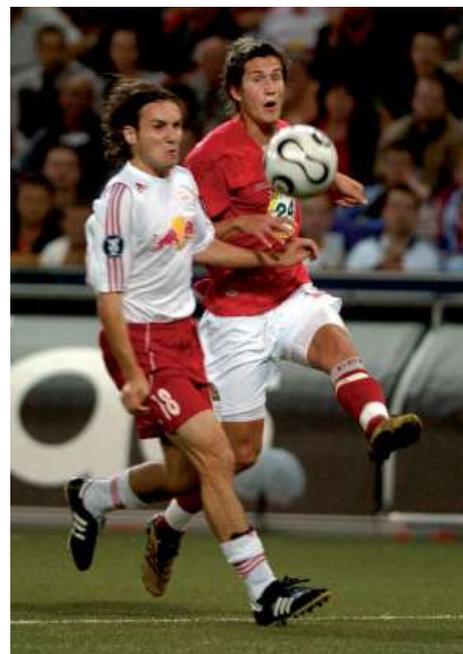
Methods

Data was collated from the 12 Group B UEFA Champions League matches involving Inter Milan, Bayern Munich, Sporting Lisbon and Spartak Moscow, 2006-07 competition season. Analysis from the 2 UEFA Cup ties between Red Bull Salzburg Vs Blackburn Rovers FC (September 2006) were also added to the dataset for comparison. Red Bull Salzburg play their competitive matches on football turf at the Red Bull Stadium, while Spartak Moscow play their competitive matches on football turf at the Luzhniki Stadium. Blackburn Rovers FC, Inter Milan, FC Bayern Munich and Sporting Lisbon play their games on natural football turf. There were therefore 10 games played on natural grass (20 sets of team data, 276 sets of individual data) and 4 games played on artificial turf (8 sets of team data, 101 sets of individual data), providing 14 games in total involving 377 sets of player data.

Matches were analysed using the computerised ProZone MatchViewer and ProZone3 systems (ProZone Group Ltd UK, independently validated by Di Salvo et al. 2006). MatchViewer enables a range of tactical information to be extracted from a single camera source through plotting all on-the-ball actions (event, player and pitch position). ProZone3 provides a range of physical outputs (in addition to the tactical analysis supplied by MatchViewer) from the tracking of every outfield player via ProZone's proprietary capture methodology. Given that ProZone3 data was only available at Ewood Park (Blackburn Rovers FC, where a fixed ProZone installation had been undertaken), only MatchViewer technical data was used for the purpose of this comparative analysis.

Over 2,500 ProZone 'events' were analysed per game using the ProZone MatchViewer system, providing a range of tactical and technical data. Single-match information was then exported to ProZone's Trend application which allowed for a comprehensive multi-game analysis of the 14 game dataset. Additional tactical data was exported from ProZone's centralised database, so comparisons could be made against the following benchmarks:

1. Data from games played on natural grass turf Vs data from games played on artificial grass turf in this study.
2. UEFA Champions League averages from games played on natural grass.
3. UEFA Cup averages from games played on natural grass.





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Table 1

Main Events Table comparing the per match individual and total team average for games played on artificial and natural grass turf

Tactical Overview	Grass		Artificial	
	Individual	Team	Team	Individual
Total Headers	5.7	56	68	7.3
Tackles	2.9	28	28	2.9
Fouls	1.5	16	15	1.3
Blocks	1.6	15	16	1.6
Interceptions	12.1	110	130	13.8
Clearances	2.4	22	22	2.0
Possession Won	19.7	203	230	21.6
Possession Lost	18.9	211	238	21.9
Average Number Touches	2.61	-	-	2.57
Dribbles	0.88	9.65	9.38	0.92
Passing Overview	Grass		Artificial	
	Individual	Team	Team	Individual
Total Passes	33.2	336	341	34.6
Successful Passes	27.4	275	268	27.3
Unsuccessful Passes	5.8	61	73	7.3
Total Pass Completion %	82.6	82	79	78.9
Balls Received	35.4	373	374	36.6
Passes Forwards	15.4	152	159	16.5
Passes Backwards	6.1	68	76	7.1
Passes Sideways	11.7	117	107	11.1
Pass Attempted Own Half	17.4	165	181	18.9
Passes Attempted in Opposition Half	15.8	171	160	15.7
Total No Short Passes	7.5	83	91	9.0
Total No Medium Passes	18.1	179	172	17.5
Total No Long Passes	7.6	74	79	8.1
Attacking Overview	Grass		Artificial	
	Individual	Team	Team	Individual
Goals	0.06	1.0	1.4	0.13
Total Number of Shots	1.04	12.9	14.1	1.39
Shooting Accuracy	39.7	41	39.8	39.3
Final Third Entries	6.5	65	71.3	7.0
Penalty Area Entries	2.7	29.4	33.3	2.8
Total Corners	0.33	4.3	4.9	0.50
Crosses	1.29	12.8	12.0	1.00
Offsides	0.20	2.70	3.25	0.27





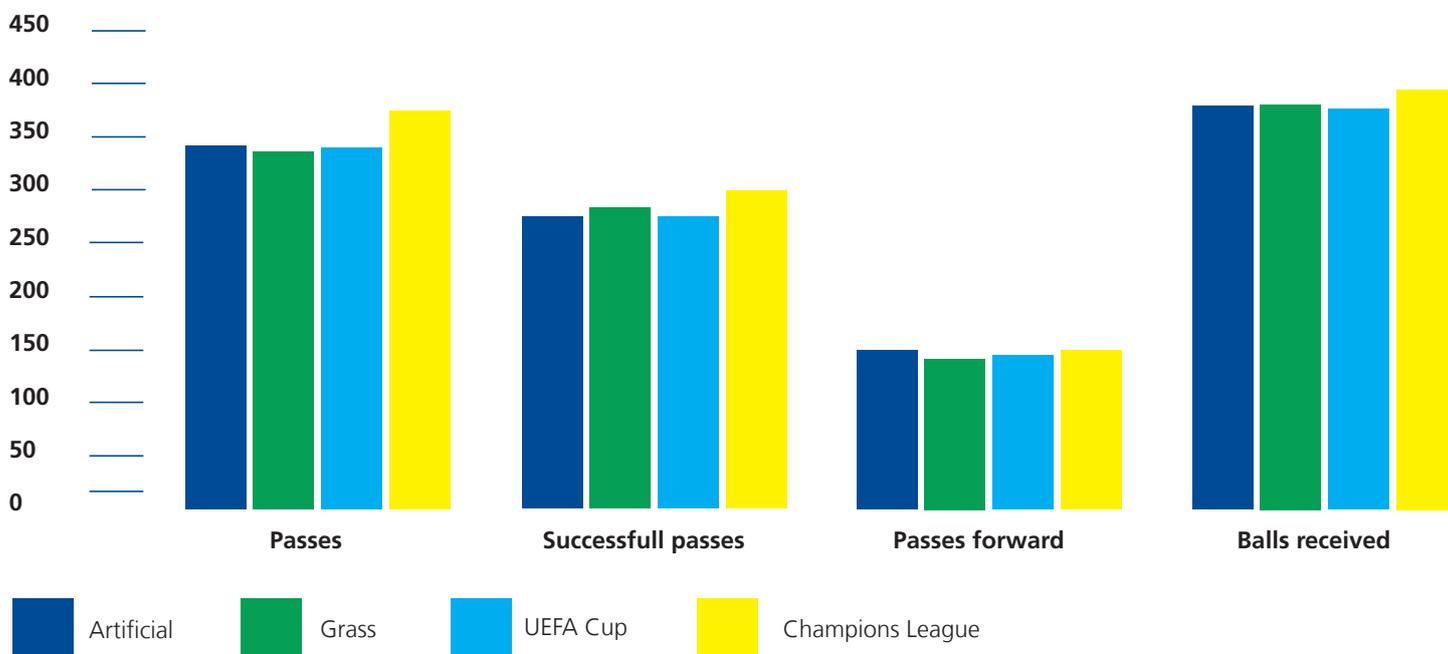
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Table 2

Comparison of total team averages for the 4 games played on artificial, 10 games played on grass and UEFA Cup / UEFA Champions League averages

	Artificial	Grass	UEFA Cup	UEFA Champions League
Passes	341	336	339	374
Successful Passes	268	275	267	300
Passing Success %	79%	82%	79%	80%
Passes forward	159	152	155	161
Balls received	374	373	368	390
Headers	68	56	67	53
Tackles	28	28	28	29
Interceptions	130	110	136	120
Crosses	12	13	15	14
Shots	14	13	13	13





Discussion

Overall analysis of the data shows that effective playing time was not affected by the playing surface with both artificial and natural turf producing a ball in play average percentage of 59% (which equates to 39 minutes 16 seconds out of play on grass and 38 minutes 31 seconds out of play on artificial). From the first multi-game objective analysis of effective [ball in-play] match time on varying surfaces; we can therefore conclude that there were no significant differences found between grass and artificial turf.

Tactical Analysis

On average, exactly the same number of tackles was made by teams on artificial and grass (team match total = 28, individual average 2.9 per player per match). The similarity found is in line with the initial study (where 44 tackles on artificial and 43 tackles on grass were reported). The data is also comparable to the UEFA Cup and UEFA Champions League averages (28 Vs 29 respectively).

Further, similar numbers of blocks were reported (1.6 blocks on average per player per match on both artificial and grass). Unsurprisingly, therefore, the average number of fouls reported per match was also alike (16 on grass Vs 15 on artificial). The average number of fouls committed per player per match was 1.5 on grass Vs 1.3 on artificial, which may suggest that players are more inclined to stay on their feet on artificial turf rather than sliding into challenges.

Table 3

Average effective playing time comparison of matches played on grass and artificial turf

	Grass Time (mins)	%	Artificial Time (mins)	%
1st half ball out of play	17.37	38%	20.04	44%
2nd half ball out of play	20.37	44%	18.51	40%
Effective Playing Time	55.59	59%	55.42	59%



Figure 1: Fouls Committed by Moscow Vs Munich on Grass



Figure 2: Fouls Committed by Munich Vs Moscow on Artificial

Interestingly, more interceptions were made on artificial than on grass (130 Vs 110 on average), which equates to approximately 15% difference. It would follow that many of these interceptions were the result of headers, with 12 additional headers being reported on average per team on artificial (68 Vs 56 in total) in this study. The UEFA Cup grass average for heading is, however, 67 which would suggest that the fewer headers reported on grass in this study is a reflection of the competition level (predominantly Champions League matches) rather than the playing surface. Indeed the Champions League average for heading is 53, which would compliment this assertion and suggest that the incidence of headers

in matches is not affected by the playing surface. On comparison of the interceptions data in this study (130 on artificial Vs 110 on grass) against other benchmarks reveals similar findings; Vs 136 UEFA grass average Vs 120 Champions League grass average). So although there were more interceptions reported on artificial surface in this specific study, we can see that the findings are in line with those witnessed in UEFA Cup and Champions League.

Also related to the 'interception' event are the changes of possession findings, with more transitions occurring on artificial turf than on grass (230 Vs 203 on average for 'possession won' by teams and





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238 Vs 211 for 'possession lost' respectively). This was also true of the initial technical study undertaken involving Blackburn and Red Bull Salzburg, and perhaps suggests that the 6 teams found it easier to control and maintain possession of the ball on grass.

The average number of dribbles performed per team, coupled with average touches per possession, provides key objective information for player-ball interaction and therefore comparisons of artificial and natural turf playing surface. We can see from the data that no clear differences were reported, with teams collectively performing an average of 9.65 dribbles on grass compared with 9.38 on artificial. A closer look at the individual player averages (involving players who have played the full 90 minutes) actually reveals a slight tendency to dribble more on artificial turf (0.92 Vs 0.88 per player per match), with players taking less touches per possession (2.57 Vs 2.61). This could suggest that players were more comfortable carrying the ball on artificial turf, perhaps due to perceptions around artificial turf being a superior playing surface (no 'bobbles' or diverts in the surface). The findings may also suggest that players were able to control and release the ball quicker on artificial turf than on grass. The important finding pertinent to this study, however, is that differences in the dribbles and average touches data collated from artificial were insignificant.

Passing Analysis

An analysis of passing reveals that similar patterns emerged from the total number of passes attempted in the games played on artificial and grass (2215 and 4811 respectively).



Figure 3: Showing where and how possession was regained by the Bayern Munich midfield players



Figure 4: Inter Milan possession regains



Figure 5: Inter Milan possession losses

A review of the total passes completed on average per team per game shows comparable data, with 341 on artificial turf and 336 on grass (compared to 339 on average in the UEFA Cup). The Champions League benchmark for total passing is 374 per game, which is around 10% higher than reported in this study. Given that this was the case for games on both artificial and grass, this is likely to be a reflection of the pattern of play in this specific qualifying group rather than the playing surface. For players who played the full 90 minutes, slightly more balls were received on artificial than on grass (on per average 36.6 Vs 35.4

match respectively), although no significant differences were found.

The highest number of passes attempted on grass was 497 (Bayern Munich Vs Sparkak Moscow), while the highest number on artificial turf (478 in total) was attempted by Spartak Moscow Vs Inter Milan (which was the second highest passing total overall across the 20 games). Slightly higher passing success rates were recorded on grass (82% Vs 79%), which is similar to the findings from the initial study undertaken from the Blackburn Vs Red Bull Salzburg UEFA Cup ties (80% on artificial Vs 83%





on grass). This would suggest that players are able to successfully maintain possession on grass, although - rather than looking at this data in isolation - it is important to benchmark with additional data. Indeed the UEFA Cup and Champions League average for successful pass completion is 79% & 80% respectively, suggesting that the high success rate observed on the grass pitches in this study were more a reflection of the quality of distribution amongst the teams involved (notably Bayern Munich was reported an average of just over 85% successful pass completion as a team on grass) rather than playing surface.

In terms of passing direction, artificial turf seemed to promote slightly more forwards (on average 159 Vs 152 per team per match) and backwards (76 Vs 68) distributions, while a tendency towards sideways passing was more prevalent on grass (117 Vs 107). Of greater significance perhaps is the success rates attributed to these varying passing categories. No clear differences were found in relation to backwards (91.9% success on artificial Vs 92.7% on grass) and sideways (89.6% success on artificial Vs 89.4% on grass) pass completion. These findings would suggest that artificial turf encourages a more positive style of play and possibly that players found it more difficult to control forward passes on artificial turf. The findings could, however, also be linked to the style of play utilised by the teams during the 4 artificial games (for example Sporting Lisbon's forward passing success rate was 53.4%, which would have negatively affected the overall average). Hence a larger dataset would be required before being able to draw concrete conclusions as to whether artificial surfaces affect

the success of forward passing in game situations.

Interestingly, teams attempted more passes in their own half of the field on artificial turf than on grass (on average 181 Vs 165 per team per game), with the opposite being true for passes attempted in the opposition's half (171 on grass Vs 160 on artificial turf). This would suggest that perhaps both teams defended deeper and enjoyed possession more on the artificial turf; whereas the latter finding is almost certainly linked to the fact that players were better at maintaining possession of forward passes in the first instance on grass (thus giving the opportunity to play subsequent passes in the opponent's half).

In terms of a passing distance comparison, there were slightly more long balls (>25m) played on artificial (on average 79 Vs 74 per team per match), although, interestingly, there were also more short (<10m) passes on artificial (on average 91 Vs 83 per team per match). It would follow that the inclination towards longer passing on artificial was directly linked to the greater incidence of unsuccessful passes, while the greater number of shot passes might suggest a quicker and more compact style of play on artificial turf. There was a greater frequency of medium passes (10-25m) on grass turf (an average of 18.1 Vs 17.5 per player per match), although no notable differences were found in relation to success rates (on average 89% Vs 87% per team per match).

Attacking Play

More goals were scored by teams on artificial turf (an average of 2.75 Vs 2 goals per match respectively), which seems to be the result of a greater incidence of attacking play on artificial turf. There were more attacking entries on artificial turf (71.3 Vs 65 final third entries and 33.3 Vs 29.4 penalty area entries) and – as a consequence - more offside decisions were reported on artificial turf (3.25 Vs 2.70 on average per match).

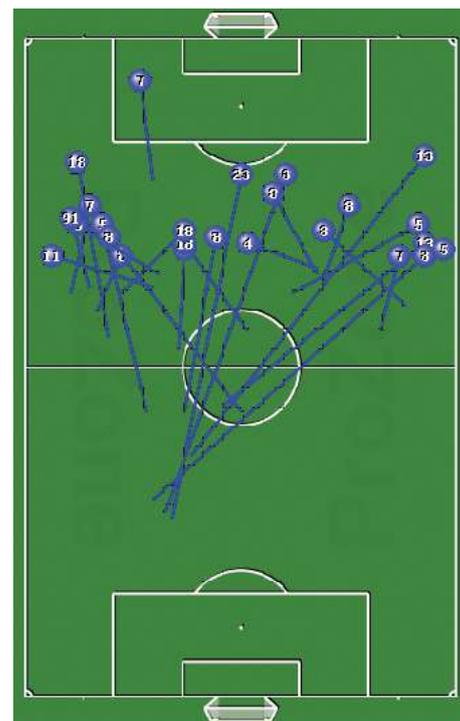


Figure 6: Successful Final 3rd Entries from passes (Inter Milan Vs Bayern Munich on grass)



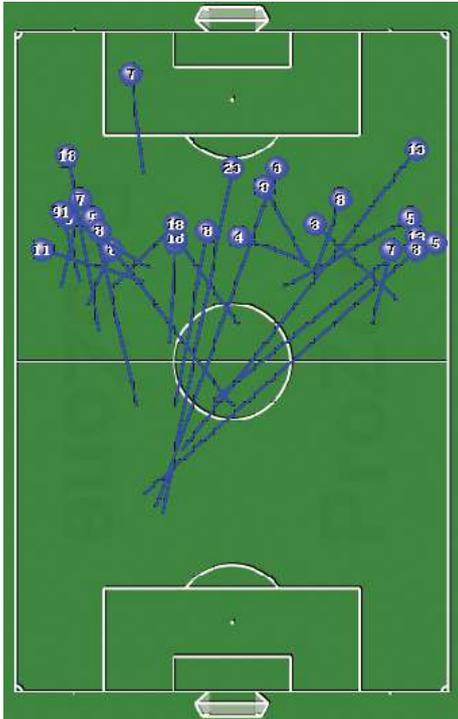


Figure 7: Successful Final 3rd Entries from passes (Spartak Moscow Vs S Lisbon on artificial)

In addition, more shots were reported on artificial turf (on average 14.1 Vs 12.9 per team per game respectively, equating to 1.39 Vs 1.04 shots per player per game) and this was true for both shots inside (6.63 on artificial Vs 5.65 on grass) and outside of the penalty area (7.50 on artificial Vs 7.25). It would follow, therefore, that, in general, artificial turf pitches may lead to slightly more attacking opportunities in games. Referencing the average shots per game benchmarks common in UEFA Cup and Champions League (both 13 per game) would support this contention, although analyses of more games would be required to draw solid conclusions. Shooting accuracy was 41% on grass and 39.8% on artificial,



Figure 8: Shot map (Sporting Lisbon Vs Bayern Munich, grass) highlighting the build up of one Munich attack



Figure 9: Shot map (Red Bull Salzburg Vs Blackburn Rovers, artificial) highlighting the build up of one Blackburn attack

suggesting that pitch surface did not impact players' ability to find the target.

Contradictory to these findings is the data on crossing, with slightly more crosses being delivered on natural turf than on artificial turf (12.8 Vs 12 team crosses on average per match respectively). This finding compliments the initial match UEFA Cup study - which also found that less crosses were delivered on artificial surface - and is further supported by the UEFA Cup (15 per game) and Champions League (14 per game) benchmarks. This may suggest that teams tend to build attacks via the flanks on grass, while artificial turf encourages more intricate play in the middle field. Additional research would need to be undertaken before such a concrete assertion could be made.

Positional analysis reveals almost identical outputs for centre-backs, centre midfields and attackers.

Attacker	Grass	Artificial
Minutes Played	90	90
Total Passes	22	22
Successful Passes	16	16
Passing Success %	73	75
Passes Forward	6	6
Balls Received	35	35
Headers	6	5
Tackles	1	1
Interceptions	3	3
Crosses	1	1
Shots	3	2

Table 3: Individual per match data comparison of attackers on grass and artificial turf

Some differences were apparent, however, with the wide players (full-backs and left/right-midfielders). From the comparison below, we can tell that right-midfielders were generally more involved in the game; receiving (43 Vs 38) and distributing (31 Vs 26) more passes. This contention would also explain the greater amount of crosses delivered from wide areas on grass turf.





TECHNICAL STUDY 2 with ProZone



Right Midfielder	Grass	Artificial
Minutes Played	90	90
Total Passes	31	26
Successful Passes	24	18
Passing Success %	75	71
Passes Forward	13	12
Balls Received	43	38
Headers	3	3
Tackles	2	4
Interceptions	8	7
Crosses	4	2
Shots	3	2

Table 4: Individual per match data comparison of grass and artificial turf right-midfielders

Artificial turf surfaces may affect certain playing positions more than others, which will merit further attention through additional research.

Conclusions

In the second objective study involving ProZone technical data, the impact of artificial and natural playing turf on the pattern of football matches was considered. 14 UEFA competition games were analysed using the ProZone MatchViewer system (4 on artificial and 10 on natural playing turf) and Champions League and UEFA Cup benchmarks were used to assess comparisons with average performances within these competitions.

In conclusion, this study reveals that:

- Artificial turf does not dramatically effect the pattern of a football match, with clear similarities in the data with games played on grass.

- Notably, no significant differences were found in the frequency of passes made, passes received, dribbles, tackles, clearances, blocks or average touches per possession.
- Certain facets of play, notably the higher incidence of possession transitions and interceptions reported on artificial turf, warrant closer attention through additional research.
- Some aspects of attacking play also alluded to some minor changes when games are played on artificial, including more final third entries, penalty area entries, shots and goals.
- The incidence of crosses, however, was greater on grass, suggesting that artificial surfaces might lead to more narrow attacking play. This was supported by the positional analysis, which showed that wide players were slightly less involved in games played on grass than 'central players' (centre-backs, centre midfielders and attackers).

The second investigation involving objective ProZone analysis provides further independent technical and tactical information on playing patterns exhibited by teams on artificial and grass playing surfaces, which will influence future implementation of FIFA RECOMMENDED 2 STAR football turf surfaces. Additional factors such as previous results (e.g. form); the approach of both teams (e.g. current standing within the competition group); formations utilised and leniency of the officials may also have affected the data. Additional quantitative

research - incorporating additional comparative data from games on artificial and grass turf – should therefore be undertaken.

