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MANAGERIAL DECISIONS ON THE TECHNICAL PERFORMANCE EFFICIENCY: THE IMPACT ON ELITE ENGLISH PREMIER LEAGUE CLUBS

Decisiones de gestión sobre la eficiencia del rendimiento técnico: El impacto en los clubes de élite de la Premier League inglesa

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ABSTRACT: The key, authoritative figure in a football club, entrusted with the responsibility of achieving the sporting, and the financial success of the club, is the football club's Manager. They are required to perform at an acceptable, pre-defined standard, often in very high-pressure scenarios. When these managers underperform, their position is put in a state of uncertainty. We, therefore, aim to determine the possible effects of managerial succession on sporting performance in the elite English Premier League by implementing a two-stage output-oriented Data Envelopment Analysis (DEA) model using fractional logistic regression to analyze the impact of managerial decisions on teams' efficiency and their handling of the risk management process. The findings contribute to the literature in the field by outlining a key link between managerial decisions and sporting performance. Results show that managers who preferred *4-3-2-1*, *4-4-1-1* and *5-3-2* formations have a positive and strong impact on the performance efficiency of their teams, whilst those preferring *3-5-2, 3-1-4-2*, *3-4-1-2, 4-2-3-1, 4-3-1-2, 5-4-1* formations significantly reduce the teams' performance. Therefore, in any decision on whether to dismiss a manager, consideration should be given to whether managers *have* a significant and positive impact on both the match results and the performance efficiency of their teams.

KEYWORDS: Football; Risk Management; Managerial Dismissal; DEA; Performance; Efficiency

RESUMEN: *La figura clave y con autoridad de un club de fútbol a la que se le confía la responsabilidad de lograr el éxito deportivo y financiero del club, es el entrenador-manager. Se le exige que actúe con un estándar aceptable y predefinido, a menudo en escenarios de gran presión. Cuando estos entrenadores-managers no rinden lo suficiente, su posición se ve sometida a la incertidumbre. Por lo tanto, nuestro objetivo es determinar los posibles efectos de la sucesión del entrenador-manager en el rendimiento deportivo en la élite de la Premier League inglesa, mediante la aplicación de un modelo de Análisis Envolvente de Datos (DEA) orientado a la producción en dos etapas, utilizando la regresión logística fraccional para analizar el impacto de las decisiones del entrenador-manager en la eficiencia de los equipos y su gestión del proceso de gestión de riesgos. Los resultados contribuyen a la literatura sobre el tema, ya que ponen de manifiesto un vínculo clave entre las decisiones de los directivos y el rendimiento deportivo. Los resultados muestran que el entrenador-manager que prefiere las formaciones 4-3-2-1, 4-4-1-1 y 5-3-2 tiene un impacto positivo y fuerte en la eficiencia del rendimiento de su equipo, mientras que el que prefiere las formaciones 3-5-2, 3-1-4-2, 3-4-1-2, 4-2-3-1, 4-3-1-2, 5-4-1 reduce significativamente el rendimiento del equipo. Por lo tanto, a la hora de decidir si se destituye a un entrenador-manager, hay que tener en cuenta si el entrenador-manager tiene un impacto significativo y positivo tanto en los resultados de los partidos como en la eficacia del rendimiento de sus equipos.*

PALABRAS CLAVE: Fútbol; gestión de riesgos; despido del entrenador-manager; DEA; rendimiento; eficiencia

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1. Introduction

Football is the largest, most popular sport on the planet, which has developed into an industry that directly influences billions of individuals across the globe. According to Deloitte, which actively monitors the football industry with their 'Deloitte Football Money League' report, in 2017/18, the Premier League, England's leading football league, had a record valuation of 25 billion sterling, with the top five football leagues in Europe generating over 15.6 billion Euros in revenue in that year alone. In their 2019/2020 report, Deloitte noted that the world's Top 20 teams generated 9.3 billion Euro worth of revenue in 2018/19 alone, an accumulation of wealth that totals more revenue than the IMF's recorded estimates of the nominal Gross Domestic Product (GDP) of 46 different nations (Deliotte, 2020).

Football is a major industry that faces many risks, especially in sports and financial results (Karataş *et al.*, 2017). Risk management is fundamental for organizations to prudently identify, assess and control potential risks and threats which may affect the organizations' ability to achieve their goals and objectives (Bezzina *et al.*, 2014). The position of head coach (or Manager) at a football club is the key, authoritative figure who is entrusted with the responsibility of achieving sporting success – and also, indirectly, financial achievement – and hence the organizational objectives of the entire football club (Villa & Lozano, 2016; Karataş *et al.*, 2017). This requires the individual holding the position to perform at an acceptable and pre-defined standard. When these head coaches are deemed to be underperforming, it is not uncommon for their position at the club's helm to quickly enter a state of uncertainty, and if underperformance continues, they will likely 'face the sack'.

Nevertheless, the implications of such research need not necessarily be limited to sporting organizations alone, with football clubs (which display a high volume of succession periods and accessible performance-related data) merely acting as a convenient case study to a potentially much larger question in relation to the risks associated with firing and hiring senior management staff in an organization.

This paper presents a quantitative, deductive approach to researching the possible effects of managerial succession on sporting performance in the English Premier League elite football clubs by implementing a two-stage output-oriented Data Envelopment Analysis (DEA) model using fractional logistic regression to analyze the impact of managerial decisions on teams' efficiency and on how they handle the risk management process. This paper aims to build a new framework for the assessment of the sportive efficiency field. This by delving into past research and using the data collected to test the various traditional succession theories. In doing this, we identify the potential relationships between managerial decisions and sporting performance. Moreover, since we have not encountered any studies linking managers' decision-making process to team efficiency and success, this paper contributes to the literature in this area.

2. The problem

Interestingly and unique about sporting organizations is that their success is not measured only by financial success but rather by sporting success, which is in the coaching staff's hands, and not that of the executive staff (Pinnuck & Potter, 2006). With sporting success being crucial to the objectives of a football club, Pinnuck and Potter (2006) also highlighted the significant relationship between on-field success and financial

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performance. This is one of the main reasons that the coaching staff of a football club seemingly work in a 'do-or-die environment.

With over fifty-two managers being sacked in England in the 2019-2020 season alone, managerial sackings in football have become the norm. This often results in a series of internal disruptions within clubs due to that succession and, especially in high-profile sackings, millions of euros being paid to the Manager in compensation due to the club opting for termination (Hope, 2003). Interestingly enough, however, although the volume of managerial sackings is consistently high in football, it is unclear whether the decision to sack a manager to replace him with another one is an effective risk management strategy or not.

Executive board members often decide to sack managers without enough conclusive research or developed evidence on the effects of managerial succession and, more importantly, its relation to sporting performance as a whole. Without the proper research in the field, it is very difficult for the executive board members of a football club to effectively and prudently identify, evaluate and prioritize the risks at hand when facing a potential business interruption crisis when failing to achieve sporting objectives. The monitoring and minimization of the risks related to managerial staff selection and succession cannot be prudently achieved without more data being developed in the field (Hope, 2003).

Ultimately, such a lack of research also hinders the ability of executive officers, from a sporting perspective, to mitigate the potential risks faced by the club when developing projects and strategically investing in a long-term, culture-led project; centred around managerial staff and strong interpersonal relationships within the organization. It is still unclear whether underperforming managers should be sacked immediately or if their contracts should be respected. Moreover, it is unclear if sticking to a manager in the long-term yields beneficial results. It is uncertain if repeatedly sacking managers yields a performance boost, a negative effect on performance, or no effect.

Therefore, given the limited literature and research on this area of study, our aim with this study is to contribute to the literature on a manager's influence on a team's efficiency through specific, measurable managerial decisions. Literature in the field currently uses results to evaluate a manager's performance, not the team's efficiency. As Dawson and Dobson (2002) state, tactics – formations – and selection of a team are the managers' decisions, or in other words, their direct contribution to the team.

A critical common need for research in this area is to develop an approach that demonstrates the impact of a manager's decisions. This study uses their chosen formations and tactical changes as decisions that lead to the football team's performance efficiency. Limiting the definition of effectivity to a team's efficiency and relating that said efficiency to a manager's decision making will allow us to clearly outline if a manager improved, worsened, or did not affect a team's overall efficiency and enable us to understand better the overall impacts of managerial succession in a football club.

3. Conceptual background

In football, a club manager occupies a position that could be easily compared to that of a senior operating officer in other industries (Hughes *et al.*,2010). S/he holds the responsibility for ensuring the organization's overall success in reaching its goals. The football manager is undoubtedly the individual most entrusted with delivering the *sporting success* of the entire football club. Therefore, is the individual tasked with the

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most responsibility in attempting to make the year a successful one for everyone at the club.

In football, a successful year is defined by a club's ability to convert human resources, talent and financial capital into league points. Its performance in the league defines a club's overall performance in a year compared to the other teams playing in the said league. This means that, just like many other industries, the version of a football club is not simply a matter of the performance of a single club. Still, the entire league as a whole and the performance of a club may only be properly assessed with the rest of the league in mind. Ultimately, however, the overall off-field financial, and social success of a football club is very much dependent on the overall on-field success enjoyed by the club, with on-field success being directly correlated to the financial success and overall reputation of the club itself (Pinnuck & Potter, 2006).

Therefore, if a football manager is attributed with the significant responsibility of delivering the *sporting success* of the football club on the field, the Manager's ability to deliver the sporting success is also directly proportional to the extent of off-field success enjoyed by the club. Hence, the Manager has a direct and paramount effect on the club's ability to achieve its organizational and sporting objectives. Because of this, managers in the football industry are often attributed with high levels of criticism when deemed to be underperforming by the executives and fans of a club. They are often put under high-pressure scenarios when the club is experiencing a performance slump, with Pieper *et al.* (2014) showing that a run of poor performances raises the risk of dismissal for football managers.

However, although the financial burden of managerial dismissal in football clubs is considerable in value, research on managerial succession indicates that firing a manager and undergoing a succession period does not guarantee a positive effect on performance. Researchers such as Balduck and Buelens (2007), Balduck, Buelens, and Philippaerts (2010), Madum (2016), De Poala and Scoppa (2008) (Tena & Forrest, 2007), Koning (2003) and Cannella and Rowe (1995) all outlined the lack of correlation between managerial succession and overall sporting performance in their research. Research conducted by Flores et al. (2012), Bruinshoofd and ter Weel (2003) and Audas et al. (1997), on the other hand, pointed toward managerial succession having a negative impact on sporting performance. Even research such as González-Gómez et al. (2011), which noted a slight increase in performance following a succession period, still reported an underperforming status compared to clubs that did not undergo a succession.

Firing a manager to urgently kindle a boost in performance in the *short term* to potentially avoid missing out on achieving organizational and sporting objectives is often seen as a 'last resort' in decision making (Balduck & Buelens, 2017). However, if this final, last-resort decision has no impact on overall sporting performance and short-term results, the decision can risk causing more problems than solutions.

From a risk management perspective, the risk faced by the club is that an underperforming team may lead the club to a potentially undesirably low final league position, or worse, relegation, which may prove to be devastating to the club, both on a financial and an organizational level. Therefore, the mitigation chosen by most clubs as a potential method to address this risk is firing the current Manager who holds the responsibility for delivering sporting success on the field, intending to reinstate a new manager at the helm of the club, with the hope that an increase in performance levels can be experienced in the short-term to avoid the potential risks coming to fruition (Grusky, 1963; Gamson & Scotch, 1964). However, suppose no evidence of the correlation between managerial

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succession and increased sporting performance is found. This can have profound implications on the effectiveness of this standard practice within the industry and may also indicate ulterior motives behind the clubs' decision to fire a manager before the end of their tenure.

Gamson and Scotch's theories were developed in 1963 – Grusky's Two Way Casualty Theory, The Ritual Scapegoating Theory and Organisational Learning – and since then, there have been calls to extend research beyond these three theories (Balduck & Buelens, 2007). In his exploration of succession literature in sport, Giambatista et al. (2005) called for a bid to move beyond Gamson and Scotch's three traditional theories for managerial succession. Rowe et al. (2005) were one of the first pieces of research that responded to this call and built their research around Crossan et al.'s (1995) theory of Organisational Learning.

Finally, asking questions relating to the links between senior managers and performance is not just an essential question for the sports industry but is a relevant question that could arguably be applied to several industries, with the theories relating to the sport applying to industries outside the field of football and sports. Nonetheless, with the succession of football managers being a common and consistent issue faced by football clubs, this is an important question to be answered by the football industry. In addition, the field of football provides a relatively accessible, transparent, and saturated industry in which one may quantitatively assess the risks and results associated with sacking underperforming members of senior management in an organization by providing the industry with unambiguous and measurable objectives, with a high amount of dismissals for statistical analysis (Flores. et al. 2012).

With over fifty-two managerial successions in England in the 2019-2020 season alone, it is clear that club board members often see managerial succession as a viable tool in addressing disappointing performances in relation to the club's sporting objectives. Pep Guardiola and Jurgen Klopp, who has been in charge of their clubs for 4 and 5 years, respectively, were the two managers included in this paper who did not get sacked during their tenure at the top six clubs were therefore used as a control group within the study. Liverpool and Manchester City FC were the only two elite premier league (EPL) clubs that did not experience managerial dismissals. Together, Pep Guardiola and Jürgen Klopp managed a total of 296 games. Meanwhile, we analyzed the other four elite premier league clubs such as Arsenal FC, Chelsea FC, Manchester United FC and Tottenham FC. More specifically, in our control group, we investigated managers that were sacked after a certain period and replaced new managers. These are Unai Emery (2018-19 season) and Mikel Arteta (2019-20 season) for Arsenal FC; Antonio Conte (2017-18 seasons) and Maurizio Sarri (2018-19 season) for Chelsea FC; José Mourinho (2018-19) and Ole Gunnar Solskjær (2018-19 season) for Manchester United FC; and Mauricio Pochettino (2019-20 season) and José Mourinho (2019-20 season) for Tottenham FC.

4. Managerial decisions: Formations and tactics

Formations are the technical and tactical structures of a football team. In football matches, deciding a formation and tactic is one of the most important ways a manager can influence sporting results. This is often seen as their direct contribution to their team (Dawson & Dobson, 2002). There are many types of formations, or tactics, to use against opponents in football. Among them is the classic *4-4-2* formation, which is a traditional approach referring to four defenders, four midfielders and two forwards (Narizuka & Yamazaki, 2019). This initial tactic has evolved over the years to give rise to more complex

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formations. Formations also depend on the characteristics of players and individual roles assigned to them by the Manager (Bangsbo & Peitersen, 2000). These formations are fundamental to demonstrating managers' strategies to achieve efficient attacking and defensive styles to ultimately win the match. For instance, deciding on a formation before the match may vary depending on the team fielded by the opponent. In addition, each formation determines the distribution of players in defending, midfield, and attacking positions on the pitch and specifies, as Naziruka and Yamazaki (2019) state, the distance and space among these players. These formations are also dynamic, which means that managers may constantly alter their initial tactics at any time during the game, depending on the match conditions (i.e., conceded goals, bookings, injuries, etc.).

Table 1. Formation decisions of the managers (in %)

Manager / Tactics	4 3 3	4 2 3 1	4 1 4 1	3 1 4 2	4 4 2	4 3 1 2	3 5 2	3 4 3	5 4 1	4 3 2 1	3 4 1 2	5 3 2	4 4 1 1
J. Klopp	51.6	20.9	15.9	0.5	6.6	0.5	0.5	0.0	0.0	2.7	0.0	0.0	0.5
P. Guardiola	62.3	13.2	16.7	4.4	0.9	0.0	2.6	0.0	0.0	0.0	0.0	0.0	0.0
U. Emery	2.0	43.1	2.0	9.8	7.8	15.7	2.0	3.9	5.9	0.0	5.9	2.0	0.0
A. Conte	0.0	0.0	0.0	68.0	0.0	0.0	26.3	0.0	2.6	0.0	0.0	2.6	0.0
M. Sarri	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
J. Mourinho[1]	23.1	46.2	3.8	3.8	3.8	0.0	3.8	0.0	11.5	0.0	0.0	0.0	3.8
O.G. Solskjær	28.6	19.0	0.0	0.0	9.5	33.3	4.8	0.0	0.0	0.0	0.0	4.8	0.0
M. Arteta	15.0	50.0	0.0	0.0	0.0	0.0	0.0	35.0	0.0	0.0	0.0	0.0	0.0
J. Mourinho	35.3	23.5	17.6	0.0	0.0	0.0	17.6	0.0	0.0	0.0	5.9	0.0	0.0
M. Pocchetino	8.3	25.0	0.0	0.0	16.7	41.7	0.0	0.0	8.3	0.0	0.0	0.0	0.0

Source: Authors' compilation

Table 1 represents the formation decisions of the managers individually. Accordingly, it can be said that among these managers of the six elite English Premier League teams, the most preferred formation style is *4-3-3*, in which the team is structured with four defenders, including wing-backs, with three midfielders without wingers and three forwards, including left/right attacking wingers. In contrast, the least preferred one is *4-4-1-1,* established by four defenders and four midfielders with wingers, one attacking midfielder and one forward. Our study observed that Maurizio Sarri, the Manager of Chelsea FC during the 2019-20 season, preferred using only the *4-3-3* formation (100%) during his managerial period. Pep Guardiola in Manchester City FC and Jürgen Klopp in Liverpool FC also used this tactic (62.3%) and (51.6%), respectively. In addition, Jürgen Klopp and Pep Guardiola, who have achieved the title with their teams in the English Premier League, avoided using formations such as *3-4-3*, *5-4-1*, *3-4-1-2* and *5-3-2* and mainly chose using tactics structured with four defenders. It can be stated that Maurizio Sarri with Chelsea FC has the highest stability rate on formations (100%) using only *4-3-3*. In contrast, Unai Emery used eleven different tactics during his managerial period at Arsenal FC.

[1] when José Mourinho was the manager of Tottenham (2019-20 season).

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Table 2. Some features of the formations (on Average)

Formation	#	Win Ratio	Draw Ratio	Loss Ratio	Player Rating	Possession	Scored Goal Ratio*	Conceded Goal Ratio**
4-3-3	226	66.8%	18.1%	15.0%	7.0	63.3%	36.5%	27.8%
4-2-3-1	108	61.1%	20.4%	18.5%	6.9	59.0%	39.7%	27.8%
4-1-4-1	53	64.2%	22.6%	13.2%	7.1	64.5%	35.9%	33.9%
3-1-4-2	38	60.5%	15.8%	23.7%	6.9	59.6%	31.1%	27.1%
4-4-2	22	59.1%	9.1%	31.8%	6.9	57.4%	33.7%	31.0%
4-3-1-2	21	38.1%	42.9%	19.0%	6.9	58.2%	34.7%	31.7%
3-5-2	20	55.0%	25.0%	20.0%	6.9	56.7%	35.3%	35.7%
3-4-3	9	55.6%	11.1%	33.3%	6.7	50.2%	35.5%	15.1%
5-4-1	8	37.5%	25.0%	37.5%	6.8	61.2%	46.0%	34.2%
4-3-2-1	5	40.0%	60.0%	0.0%	7.0	55.5%	34.1%	26.2%
3-4-1-2	4	25.0%	50.0%	25.0%	6.8	56.1%	43.8%	31.5%
5-3-2	3	0.0%	0.0%	100.0%	6.3	41.6%	0.0%	28.4%
4-4-1-1	2	100.0%	0.0%	0.0%	7.2	43.5%	32.5%	12.5%

* Scored goal ratio is calculated by the division of scored goals on shots on target.
** Conceded goal ratio is calculated by the division of conceded goals on received shots on target.
Source: Authors' Compilation

Table 2 demonstrates some average features of the formations chosen by the managers of the six elite football clubs in the English Premier League. As shown in Table 2, managers who structured their team formation as *4-3-3* have the highest win ratio on average (66.8%), whilst the lowest win ratio on average is found with the *5-3-2* formation (0%) (used only three times by managers), at the same time the highest loss ratio (100%), comparing to the other formations. On the other hand, managers who set their team with *4-3-2-1* and *4-4-1-1* formations never concluded a match with a loss. Teams with a *5-4-1* (46%) formation are more productive in scoring goals, whereas the *3-5-2* (35.7%) formation conceded most goals. For the player ratings, it can be said that football players achieve a minimum of 7.0 rating on average with *4-4-1-1*, *4-1-4-1*, *4-3-3* and *4-3-2-1* formations. The average outcome of player ratings using formations with four defenders is higher. Also, for ball possession, it can be stated that teams with a *4-1-4-1* (64.5%) formation have the highest dominance on the pitch.

In this paper, we analyzed thirteen different formation types in 519 matches to measure the impact of managerial decisions on the performance efficiency of six EPL football clubs such as Arsenal FC, Chelsea FC, Liverpool FC, Manchester City FC, Manchester United FC and Tottenham FC.

5. Literature review

We have come across two types of research models used by researchers on managers' performance in football. Those who used parametric models and those who used nonparametric models. Studies with parametric models have focused on correlation and regression analysis (both linear and non-linear) to identify the relationship between the dependent – manager succession – and the explanatory variables (De Paola & Scoppa, 2007, Balduck & Buelens, 2007, Bruinshoofd & ter Weel, 2003, Flores *et al.*, 2012; de Dios Tena & Forrest, 2007). On the other hand, studies with nonparametric models have investigated the measurement of performance efficiency using a set of inputs and outputs that analyze the behaviour of each decision-making unit (DMU). However, these studies only focus on managerial efficiency regardless of their dismissals (Dawson & Dobson,

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2002; Kern & Süssmuth, 2005; Frick & Simmons, 2008; Tiedemann *et al.*, 2011; Jara *et al.*, 2015).

For the first group of studies mentioned above, it can be said that ample research has been made over the past three decades on the nature of the effects of managerial succession, with most studies arriving at the same conclusions. De Paola and Scoppa (2007), De Paola and Scoppa (2012), Balduck and Buelens (2007), Bruinshoofd and ter Weel (2003), Flores *et al.* (2012), de Dios Tena and Forrest (2007) and others all found no correlation between managerial succession and a change in sporting performance. More specifically, some studies assess managerial succession using parametric models. For example, Balduck and Buelens (2007) assessed 8392 football matches played in Belgium's football divisions to determine the effect of managerial succession on on-field performance. The research concluded that managerial succession in Belgian football was neither effective nor efficient in improving sporting performance in the short term. In addition, Flores *et al.* (2012) analyzed over 20 years of football match results in Argentina. They detected a tendency for managerial succession resulting in a deterioration of sporting performance. De Paola and Scoppa (2008) found no relationship between managerial succession and team performance in the Italian Serie A league. However, they found a correlation between managerial succession and the number of goals scored by the team.

In addition, Bruinshoofd and ter Weel (2003) found a slight improvement in on-field performance due to managerial succession. However, this improvement did not exceed the seasonal average of the fired managers, and they concluded that managerial succession is neither effective nor efficient in improving team performance. Furthermore, de Dios Tena and Forrest (2007) found no relationship between managerial succession and performance, except for games played in the club's home stadium. This theory supported the Ritual scapegoating theory and argued that appeasing fans can have on-field benefits, suggesting that home support may have a more significant effect on game performance than managerial succession.

Some researchers, such as Madum (2016), found an improvement exclusively for home matches following a managerial turnover, which suggested that home supporters played an essential role in the effectiveness of managerial succession. On the other hand, Audas et al. (2002) found that English soccer clubs that dismissed their coaches performed worse immediately after the turnover than those that retained their coaches. Koning (2003) was yet another study that found no links between managerial succession and team performance, arguing that board members likely take fan and media pressure as strong determinants of deciding if an underperforming manager should be kept or fired. Differently, substantial evidence is found by Hentschel *et al.* (2012) that managerial dismissals increase teams' performance in which teams have homogeneous characteristics. Nevertheless, it is also found that announcing to sack a manager affects the capital market, with rises and drops in the share prices of stock exchanges (Bell *et al.*, 2012).

Flint et al. (2014) investigated whether managerial change is logical for the team by analyzing matches from 2003 to 2004 and 2012 to 2013 seasons in the English Premier League. Although they found that managerial changes increase points gained per match, they concluded that success was not detected in the final league ranking teams. In another study, Van Ours and Van Tuijl (2016) analyzed 14 seasons of the Dutch Eredivise to understand the impact of in-season changes on the managers. Their findings reveal that no improvement is found in team performance after a manager replacement. In addition, Besters et al. (2016) investigated the effect of managerial changes in-season in the English Premier League for the seasons between 2000-01 and 2014-15. Similar to Van Ours and

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Van Tuijl (2016), they found that manager turnover does not improve team performance on average. On the other hand, Wilson *et al.* (2019) investigated the four main English Football Leagues for the seasons between 2000-01 and 2015-16 to demonstrate the impact of managerial changes on football teams' performances. Accordingly, their findings show that for clubs competing in the English Premier League, there have been significant improvements subject to managerial changes only for the ones in the bottom half of the league, whilst there was no evidence that this was the same for the other clubs (Hentschel *et al.*, 2012).

Moreover, González-Gómez *et al.* (2011) found that mid-season coaching changes in Spanish football clubs resulted in increased performance levels. However, the clubs continued to underperform compared to other teams that did not go through a period of managerial succession.

6. Methodology

We noted from the literature that research methodologies dealing with performance efficiency in football had been categorized and considered under two perspectives—the parametric and nonparametric methods. While parametric methods use the implementation of indicative correlation and regression analysis, nonparametric methods, on the other hand, deal with the overall measurement of the efficiency based on the analysis of production sets formed by selected inputs and outputs. The most common nonparametric method is Data Envelopment Analysis (DEA) (Kulikova & Goshunova, 2013).

Therefore, we considered the latter the most suitable method to carry out our study. It enabled us to establish a two-stage analysis, using a nonparametric model, output-oriented DEA, to measure the scale efficiency of football teams in the first stage and then test the efficiency scores with explanatory variables using a fractional regression model (FRM) to detect the impact of managerial decisions on teams' efficiency level.

6.1. Data collection

We focused directly on the EPL, which was ranked the world's best league in the 2020 edition of the Deloitte Football Money League Report. Specifically, our focus was on clubs with similar objectives and demanding similar sporting results (Deloitte Football Money League Report, 2020). We analyzed the top six performing clubs in the EPL based on the 2020 Deloitte Football Money League Report. These were Chelsea FC, Tottenham Hotspurs FC, Manchester City FC, Manchester United FC, Liverpool FC and Arsenal FC (Deloitte, 2020).

The top six clubs in the premier league were explicitly chosen to exclude any biases and extraneous factors from the study since they hold similar characteristics, such as levels of income, stadium sizes and general attendance (de Dios Tena & Forrest, 2007), levels of performance demands and pressure on their players and staff (Flores, 2012), and hold similar organizational objectives.

According to the Football Money League Reports conducted by Deloitte between 2014 and 2020, these six clubs have consistently been reported as the top six performing premier league clubs for the last seven years, which means no club included in the study ever faltered in being a top-six performer during the investigated period. This removes any potential limitations related to a difference in the clubs' organizational objectives. Hence,

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we analyzed the seasons 2015/2016, 2016/2017, 2017/2018, 2018/2019, and 2019/2020 football seasons in the EPL (Deloitte, 2020).

We feel that maintaining the study within certain boundaries of these six football clubs helped limit any differences and the factors that may be specific to certain clubs. This enabled us to achieve results void of the possible noise of any external factors and nuisance variables, enabling us to generalize our findings.

Table 3. Variable Definitions and Descriptive Statistics

Variable	Definition	Statistics				
Input		**N**	**Mean**	**SD**	**Min**	**Max**
Shotsot	Shots on target	519	5.75	2.80	0	17
Rshotsot	Received shots on target	519	3.43	2.40	0	13
Saves	Saves by goalkeeper	519	2.41	1.96	0	11
Possession	Ball possession (in %)	519	61	11	0	100
Touches	Touches (including all players)	519	789.86	130.98	457	1161
Successpass	Pass success (in %)	519	84	6	0	100
Aerialswon	Total aerial winnings	519	50.20	10.84	15	85
Tackles	Tackles (including all players)	519	16.24	5.39	3	36
Clearances	Clearances (including all players)	519	18.30	8.34	0	50
Interceptions	Interceptions (including all players)	519	10	3.95	2	32
Output						
Points	Points gained per game	519	2.05	1.24	0	3
Goalscored	Goals scored	519	2.06	1.46	0	8
Goalconceded	Goals conceded	519	1.02	1.04	0	6
Ratings	Ratings of players	519	6.94	0.38	6	9
Explanatory						
Stadium	HOME=1, AWAY=0	519	0.50	0.50	0	1
Formation	Team formation	519	-	-	-	-
Fchange	Change in formation (YES=1, NO=0)	519	0.50	0.50	0	1
Mchange	Manager change (YES=1, NO=0)	519	0.14	0.35	0	1
Efficiency	Efficiency scores (SE)	519	0.98	0.03	0.78	1

Note: Rshotsot and Goalconceded are derived by calculating the inverse function to measure efficiency. The formation is based on "3-1-4-2", "3-4-1-2", “3-4-3”, “3-5-2”, “4-1-4-1”, “4-2-3-1”, “4-3-1-2”, “4-3-2-1”, “4-3-3”, “4-4-1-1”, “4-4-2”, “5-3-2” and “5-4-1”.
Source: Authors' Compilation

The data above was collected from Transfermarkt GmbH & Co. KG (www.transfermarkt.com) and Whoscored.com (www.whoscored.com). The authors performed a two-stage analysis using the DEA technical efficiency parameters – inputs and outputs – and explanatory variables to assess the impact of managerial decisions on team performance. Table 3 shows the definitions and descriptive statistics of the variables. Unlike some studies that perform efficiency analysis using defensive and offensive (or attacking) approaches for the input variables (Garcia-Sánchez, 2007; Boscá *et al.*, 2009; Sala-Garrido *et al.*, 2009; Villa and Lozano, 2016; Rossi *et al.*, 2019), we combine input variables for both defensive and offensive approaches since this data includes attacking players with defensive contributions (i.e., tackles, interceptions, clearances, etc.) as well as defenders with offensive attempts (i.e., shots on target, etc.). For the first-stage analysis of the measurement of scale efficiency, we used the same input and output variables, similarly to authors such as Carmichael *et al.* (2001); Garcia-Sánchez (2007); Boscá *et al.*

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(2009); Sala-Garrido *et al.* (2009); Espitia-Escuer and Garcia-Cebrian, (2010); Tiedemann *et al.*, (2011); Villa and Lozano, (2016) and Rossi *et al.*, (2019).

6.2. The first-stage analysis – Scale efficiency with DEA

Farrell (1957) introduced the DEA as one of the most popular nonparametric methods in the literature (Delice and Gerçek, 2018). It is used to measure the efficiency of commensurable decision-making units (DMUs), and it can be arranged as value-orientated to minimize or maximize the inputs or outputs to calculate the efficiency frontier for a given set of DMUs. (De Benedetto et al., 2019). In literature, the DEA methodology has been implemented under two main contexts, namely Charnes, Cooper and Rhodes (CCR) model and the Banker, Chames and Cooper (BCC) model (Villa and Lozano, 2016; Işgın et al., 2020). The CCR model supports the assumption of the existence of constant return to scale (CRS) on the efficiency frontier to measure the overall technical efficiency (OTE), whilst the BCC model evaluates the pure technical efficiency (PTE) by assuming variable returns to scale (VRS) on the scale efficiency frontier (Haas, 2003). We used the scale efficiency (SE), which is an indicator to identify whether the observed DMUs are close to the most productive scale size or not, by calculating the division of CRS and VRS for establishing a smoothed bootstrap method to ensure the bias-corrected technical efficiency scores to be implemented for the second-stage analysis (Simar and Wilson, 1998).

Johnes (2004) illustrates the equation of the CRS model – also known as the CCR Model, shown below:

$$TE_k = \frac{\sum_{r=1}^{S} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \quad (1)$$

where TE_k is the technical efficiency of firm k using m inputs to produce s outputs; y_{rk} is the quantity of output r produced by firm k; x_{ik} is the quantity of input i consumed by firm k; u_r is the weight of output r; v_i is the weight of input i; n is the number of firms to be evaluated; s is the number of outputs, and m is the number of inputs.

Then, the following equation must be solved for each firm:

$$Maximise \ \frac{\sum_{r=1}^{S} u_r y_{rk}}{\sum_{i=1}^{m} v_i x_{ik}} \quad (2)$$

$$Subject\ to \ \frac{\sum_{r=1}^{S} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}} \leq 1 \qquad where\ j = 1, \dots n \quad (3)$$

$$u_r, v_i > 0 \qquad where \qquad \forall r = 1, \dots, s \ and \ i = 1, \dots, m \quad (4)$$

Alternatively, Banker *et al.* (1984) suggested the VRS model – also is known as CCR Model – as follows:

$$\sum_{j=1}^{n} \lambda_j = 1 \quad (5)$$

Furthermore finally, to calculate the scale efficiency (SE):

$$SE = \left(\frac{\sum_{i=1}^{N} Z_i^{CRS}}{\sum_{i=1}^{N} Z_i^{VRS}} \right) \quad (6)$$

where Z_i represents technical efficiency scores for the ith team.

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Accordingly, if scale efficiency (SE) is equal to 1, one may interpret that football teams performed each match at full efficiency. When it is 0, it means that football teams perform entirely inefficiently (Coelli et al., 2002).

6.3. The second-stage analysis – Fractional regression model

We apply a two-stage analysis to DEA for nonparametric models, evaluating the DMU's efficiency at the first stage and then regressing the DEA efficiency scores with given explanatory variables. It is important to consider the bias problem during the regression and demonstrate that the efficiency scores are not independent and identically distributed values. Therefore, a bootstrap-based correction of efficiency scores is required (Simar & Wilson, 2007). As it is summarised above, the scale efficiency (SE) establishes this required bootstrap technique to compare the technical efficiency scores driven by the CRS and VRS approaches distributed at the interval [0,1] (Simar & Wilson, 1998). Accordingly, some methods exist to perform a two-stage analysis of DEA efficiency scores (Simar & Wilson, 2007; Ramalho et al., 2010). In particular, Papke and Wooldridge (2008) developed the Fractional Regression Model (FRM), and it has been applied to the scope of efficiency analysis by Ramalho et al. (2010). The FRM functions as an econometrical tool for measuring the variables that take all possible values inside the unit interval.

Theoretically, if y is bounded between zero and one, so the effect of any particular x_j It cannot be constant throughout the range of x (Ramalho *et al.*, 2010). To some extent, this problem can be overcome by augmenting a linear model with non-linear functions of x. Still, the predicted values from an OLS regression can never be guaranteed to be in the unit interval unless the robust standard error is considered. The drawbacks of linear models for fractional data are analogous to the weaknesses of the linear probability model for binary data. Our empirical analysis also provides estimates based on the fractional regression models since we fractionally calculated the scale efficiency of football teams within a range between [0,1]. Thus, the fractional regression model regresses the dependent variable with fractional values.

To sum up, we apply an output-oriented DEA model, selected through a search similar to that described above, using input and output variables to measure the scale efficiency scores of the elite six English Premier League teams such as Chelsea FC, Tottenham Hotspurs FC, Manchester City FC, Manchester United FC, Liverpool FC and Arsenal FC. Then, we implemented a fractional regression model (FRM) to detect the impact of managerial decisions on teams' efficiency in the manner of selected formations.

7. Findings

Table 4 presents the fractional regression model results of the team performance efficiency of the six EPLs, specifically Chelsea FC, Tottenham Hotspurs FC, Manchester City FC, Manchester United FC, Liverpool FC and Arsenal FC. We chose the 4-3-3 formation as a benchmark since it is the most used tactic. Hence, to eliminate the bias problem, we analyzed the impact of other formations on the performance efficiencies of football teams by comparing it to the 4-3-3 formation, respectfully.

As shown in Table 4, we can note that the 4-3-2-1, 4-4-1-1 and 5-3-2 formations have a strong significant and positive impact on teams' performance efficiency, whilst the 3-5-2, 3-1-4-2, 3-4-1-2, 4-2-3-1, 4-3-1-2, 5-4-1 show a lower performance when compared to the performance in the 4-3-3 formation. In other words, managers who decided to set their

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team with a 4-4-1-1, 4-2-3-1 and 5-3-2 line-up have better performance on match results than those with a 4-3-3 formation. Nevertheless, we did not find any significant impact using other formations (such as 4-1-4-1, 3-4-3 and 4-4-2) on teams' performance efficiency. Moreover, findings demonstrate that playing matches at the home stadium have a significant and positive impact on the teams' performance efficiency. Playing at home increases the performance efficiency more than playing away. In addition to these findings, as expected, we found that managerial change decreases the performance efficiency since it breaks the sustainability of football clubs in adapting to the Manager and his tactical decisions (i.e., stability of formations, tactics, positioning, etc.). Nevertheless, we did not find any significant effect of tactical changes of the managers on the performance efficiency of football teams.

Table 4. Fractional Regression Model Estimates

Scale Efficiency	Coefficient[2] (dy/dx)	St. Error	z	P > |z|	[95% conf. interval]	
3-1-4-2	**-.0107388**	**.0036635**	**-2.93**	**0.003****	-.0179191	-.0035584
3-4-1-2	**-.018227**	**.0042759**	**-4.26**	**0.000*****	-.0266075	-.0098464
3-4-3	.0049467	.0059161	0.84	0.403	-.0066487	.0165421
3-5-2	**-.0088299**	**.0045737**	**-1.93**	**0.054***	-.0177942	.0001345
4-1-4-1	-.0018423	.0065868	-0.28	0.780	-.0147523	.0011068
4-2-3-1	**-.0062769**	**.0030022**	**-2.09**	**0.037****	-.0121612	.0003927
4-3-1-2	**-.0083299**	**.0043123**	**-1.93**	**0.053***	-.0167819	.0001221
4-3-2-1	**.0915359**	**.0131717**	**6.95**	**0.000*****	.0657199	.1173519
4-4-1-1	**.0895194**	**.0137235**	**6.52**	**0.000*****	.0626219	.1164168
4-4-2	-.0032042	.004385	-0.73	0.465	-.0117986	.0053903
5-3-2	**.09333989**	**.0142268**	**6.57**	**0.000*****	.065515	.1212828
5-4-1	**-.0148403**	**.0043107**	**-3.44**	**0.001****	-.0232891	-.0063914
Home/away	**.0054072**	**.0023032**	**2.35**	**0.019****	.0008931	.0099214
Tactics change	-.0005377	.0022035	-0.24	0.807	-.0048565	.0037811
Manager change	**-.0056006**	**.0022626**	**-2.48**	**0.013****	-.0100352	.001166

*Significant at the 10% level. **Significant at the 5% level. ***Significant at the 1% level.
Source: Authors' Compilation

8. Limitations and significance

It is no longer just about points. As noted above, most research only focused on sporting results from the perspective of 'points achieved' (Wins/Draws/Losses). This research expands the definition of a sporting result by correlating decisions made by the Manager to overall tactical efficiency. However, in carrying out this research, we limited our study by considering the top six performing clubs in the EPL. Although this might seem restrictive, it ensures that we were comparing like with like, since their characteristics in terms of sports and finances are very similar. Also, we did not consider substitutions as another important managerial decision factor throughout the game. However, since there were three substitutions in 97.8% of the games, this variable did not carry any significant

[2] Margins of coefficients (dy/dx) are calculated.

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comparison to the model. Moreover, since we used secondary data, we could not detect any information regarding formation changes during the game (i.e., after conceding x amount of goals and restructuring a more defensive/offensive approach, or after a yellow or red card was shown).

9. Discussion and Conclusion

The findings of this study reveal that formations have a strong and significant impact on a team's sporting performance and overall efficiency and, in turn, the financials. They provide a clear, important step in outlining the capacity for a manager to influence sporting results by linking the decisions taken by that said Manager to the overall efficiency of the team itself. As noted above, several researchers in the field of managerial succession used final results as the main means by which one can measure the overall performance of a manager. However, due to the extraneous factors in play, this approach leaves several limitations that influence the study's final results and conclusions. Therefore, the link this study establishes between the decision-making of a football manager and the team's overall efficiency acts as an important, straightforward way in which one may assess the overall performance and capacity of a specific football manager, beyond simply tracking final sporting results.

This approach allows us to understand how effective a manager was in taking decisions and impacting the factors that are directly under their control. Interestingly enough, this research only builds a more compelling case for past studies, such as Balduck and Buelens (2007), Balduck, Buelens, and Philippaerts (2010), Madum (2016), De Poala and Scoppa (2008), (Tena & Forrest, 2007), Koning (2003) and Cannella and Rowe (1995), as it is clear that some managers who faced contract termination were indeed taking decisions which increased the performance of the club, and sacking that said the Manager did not lead to any improvement in neither the results nor the efficiency, of the team.

This result might suggest that Gamon and Scotch's 1963 managerial succession theory on Ritual Scapegoating best describes the decision making of board members in a football club when sacking a manager, which supports the claims made by Florres, Forrest and Tena (2011), Madum (2016), De Poala and Scoppa (2008) and others. Moreover, our results add further arguments in favour of the home away advantage enjoyed by clubs, with the correlation between home games and better performance being outlined both in this research and a multitude of studies that came before, including Cannella and Rowe (1995) and (Tena & Forrest, 2007).

The results obtained also point towards a potential decrease in efficiency due to multiple managerial successions due to the succession period disrupting the internal understandings and stability of the club, which can make it harder to develop well-understood tactics and formations. Researchers such as Bruinshoofd and ter Weel (2003) and Audas et al. (1997) came to the same conclusions. Interestingly enough, such results point towards Gamson and Scotch's (1963) 'Two Way Casualty theory' being more apt in identifying the nature of managerial succession in this regard, with Crossan's 1995 theory of Organisational Learning seeming like an equally adept theory in explaining the negative effects of repeated managerial successions.

In conclusion, it seems that repeat terminations in football to achieve quick, short-term results are neither an effective nor sound decision to take to maintain a football club's sporting success. It may be more beneficial for clubs to assess how that expenditure can be best used elsewhere instead of the millions of Euros spent carrying out the termination.

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