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Ranking World Cup 2014 Football Matches by Data Envelopment Analysis Models with Common Weights

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Abstract

Football is one of the most popular and exciting sports fields throughout the world. Today, in addition to the result, the number of goals and points, attraction and quality of the played matches are important for club management staff, coaching staff, the players and especially the fans. Beside number of goals, there are different criteria such as successful passes, attacks, defenses, tackles and etc. can determine the quality of matches. Therefore, in this survey, researchers consider the quality of World Cup 2014 football matches. For this purpose, after the review on research literature, the quality criteria of football matches are determined. Afterward, related data of each criterion are extracted. Then, the DEA common weight analysis (DEA-CWA) is used in order to evaluate and rank the quality of competitions. Results show that the match between the national teams of Argentina and Nigeria was elected as the highest-quality match in Brazil's 2014 World Cup first round.

Keywords:
football
FIFA world cup
DEA

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INTRODUCTION

Football is a popular sport to spend leisure time (Karn et al., 2012). It is a competition between two teams, which there are eleven players in each team. The winner is the team has gained more points with the more number of goals (Boscá et al., 2009). After each match, the results are reviewed by specialists (Tiedemann et al., 2011). In international and important competitions, news media and mass media do attempt to rank teams based on color of the modals and the scores (de Mello et al., 2008). FIFA World Cup is one of the international tournaments, which can be accounted as an opportunity for participating teams to benefit from a major investment and leave a positive influence in international perspective. Hence, teams should be organized well and should try to gain acceptable scores, as the performance of teams is evaluated both general and specialized (Valerio & Angulo-Meza, 2013). A proper evaluation, considered players with their position and they don't deem the analysis which are published in mass media, sufficient (Tiedemann et al., 2011). In other words football has features that can be designated as a manufacturing activity, consequently the productivity and performance can be measured (Valerio & Angulo-Meza, 2013). In recent years, there are lots of scientific approaches which have been used to measure different aspects of sports. Although data envelopment analysis (DEA) is an approach which is introduced as a tool to assess and compare the productivity of decision making units (DMUs) (Arabzad et al., 2013) and it can be applied to evaluate and improve the efficiency of DMUs. Among suggested models, DEA-CWA can be mentioned. In this approach the conflicts of DEA models are discarded, and it is possible to rank DMUs in a special period of time (Kao, 2010). In reviewing the literature of research it is found that football is not only popular between fans and crowd of people, but also it has been popular between researches and scientists. Evaluating prestigious leagues, teams, players and the issues which are related to this sport are such topics that researchers engaged it in their studies thereby finding points of strengths and weaknesses case by case that can lead to improved performance and achieving better results in the championship field. On the side, the commercial aspect is an important issue for practitioners of this arena.

In this research, the quality of Brazil World Cup 2014 will be evaluated through using DEA-CWA. Thus, after reviewing the research literature, applicable criteria of football matches qualitative performance in international tournament of FIFA World Cup 2014, would be determined. Afterward the related data of specified criteria will be collected. In the next step, among all models of DEA-CWA, the proper models would be selected, and solved. Lastly, matches will be ranked based on quality criteria, and final results will be obtained.

LITERATURE REVIEW

There is a variety of surveys which were conducted about many sport fields, especially about soccer as a popular sport. Performance evaluation of teams, leagues and different tournaments are such subjects in this category. One of the studies which can be mentioned belongs to Tiedemann et al. (2011) which it has evaluated the performance of players of German football league (Bundesliga) with a non-parametric approach, meta-frontier (one of DEA models). For this purpose the players performance efficiency have been set according to the position they had played. Analysis results show that the efficiency score of players and team ranking in the league standing by the end of season are related. The other research in this field has been conducted by Kern et al. (2012). This study had a purpose to evaluate the performance of the football league in England, using two-stage DEA. The Survey aimed to prove the superiority of two-stage DEA in comparison with one stage DEA to calculate the efficiency of football clubs. The data which are considered were related to season which had held during 2006-8 and results were calculated using both one and two stage DEA and efficient and inefficient DMUs have been determined. At the end, the strategy to improve the efficiency of inefficient units has been provided. Another example of these studies was done to assess the allocation of funds and economic resources for Brazil Olympic Games by DEA. Valerio & Angulo-Meza (2013) have done this research. The inputs of the applied model were budget and the expected number of medals and the output was

the number of gained medals. The method used in this study to assess the financial allocation is ZSG-DEA. It can be understood from the results that those countries with adequate financial allocations, had better situation in number of gained medals. Arabzad et al. (2014) proposed a new hybrid method to seed determination in sport competitions. The issue of determining the teams which can participate in a tournament is very important because it has a direct impact to the way of champion determination. Two methods of DEA and TOPSIS were applied in this survey. To examine whether the model is functional, the European Football Championship 2012 has been analyzed. Arabzad et al. (2014) discussed using a machine learning approach, Artificial Neural Networks (ANNs), to predict the outcomes of football match results of Iran Pro League (IPL) 2013-2014 football. Table 1 is a review on research literature.

Table 1: Literature Review

Year	Title	Researcher	Explanation
2006	Assessment of the Soccer Teams in Brazil Using DEA	Caloba, EstellitaLins	Using the national and international competition results as data and comparison and ranking through using DEA.
2008	Comparative Analysis of Football Efficiency Among two Small European Countries: Portugal and Greece	Douvis, Barros	Performance evaluation of football clubs in Greece and Portugal in order to find the best teams based on their performance and their positive impact on football industry.
2008	Some Rankings for the Athens Olympic Games Using DEA Models with A Constant Input	Melo et al.	Some rankings for the Athens Olympic games using DEA models with a constant input and number of gold, silver and bronze medals as the output. Then to rank again based on weight summation and by using Athens Olympic games data.
2009	Increasing Offensive or Defensive Efficiency? An Analysis of Italian and Spanish Football	Bosca et al.	Assessment of technical efficiency in football of Italia and Spain using DEA. In Italy aggressive competition needs to improve while in Spain defensive games are in need of improvement.
2011	Assessing the Performance of German Bundesliga Football Players: A Non-Parametric Approach	Tiedman, Francksen	Determination of performance score using Meta Frontier and consideration of it is impact on the team position in the league table at the end of the season.
2011	Evaluating the Performance of Iranian Football Teams Utilizing Linear Programming	Soleimani- Damaneh et al.	Integrating effectual factors on input and output of the model using AHP Hierarchy and Performance evaluation of teams in Iran football league using a variable returns to scale and input-oriented DEA.
2012	Measuring the Efficiency of English Premier League Football A Two-Stage Data Envelopment Analysis Approach	Kern et al.	England Football League performance evaluation using one and two stage DEA and comparing the results and proposing solutions to improve the efficiency of the inefficient units.
2013	A Data Envelopment Analysis Evaluation and Financial Resource Reallocation for Brazilian Olympic Sports	Valerio, Angulo-Meza	Allocating resources and assessing ZSG-DEA model in which countries with better financial allocation, have gained better results to win medals.
2013	Ranking Players by DEA; The Case of English Premier League	Arabzad et al.	Choosing the best football players and rank them using DEA.
2014	Performance Evaluation of Tennis Players: Application of DEA	Chitnis, Viadya	Tennis players' performance evaluation using DEA with constant returns to scale, the output oriented model.
2014	A New Hybrid Method for Seed Determination in Sport Competitions; The Case of European Football Championship 2012	Arabzad et al.	Using TOPSIS and DEA to determine the parent and the layout model of sports teams, athletic and applying the model to European Football Championship 2012.

DATA ENVELOPMENT ANALYSIS(DEA)

DEA is a nonparametric approach for evaluating the productivity which is used to assess the efficiency of DMUs in comparison with other DMUs. In this method, DMUs have common inputs and outputs to calculate the weighted ratio of output to input thereby to calculate the productivity. The mathematical form of DEA model is shown in equations below.

$$\begin{aligned} &max \ {\sum_{r=1}^{s}(u_r * y_{rk})}\Big/{\sum_{i=1}^{m}(v_i * x_{ik})} \\ &\text{s.t.} \\ &max \ {\sum_{r=1}^{s}(u_r * y_{rj})}\Big/{\sum_{i=1}^{m}(v_i * x_{ij})} \le 1 \qquad j = 1, \dots, n \\ &u_r, v_i \ge 0 \qquad\qquad r = 1, \dots, s; \ \ i = 1, \dots, m \end{aligned} \tag{1}$$

In above equations x_{ij} refers to amount of *ith* input and y_{rj} refers to rth input of jth DMU. v_i and u_r are also refer to the weights of ith input and rth output (Charnes et al., 1978).

DEA is a non-parametric approach to calculate the efficiency of DMUs. In this model the rational efficiency of DMUs the ratio of weighted sum of outputs to weighted sum of inputs in the maximum form of it. In this way the factor of weight is a free variable in each model's run. Since DEA models should be implemented separately for each DMU, there would be a different set of weights for each DMU and each model's run. In this case the wide changing range of weights of each DMU is not acceptable. The Possible answer to this defection is common weight analysis (CWA) (Makuei et al., 2008). This approach assesses DMUs with common inputs and outputs. In order to calculate the efficiency, input and output weights are considered separately. The flexibility of choosing weights will contribute to increase the number of efficient units. Hence it can be said that this model is not able to evaluate DUM's efficiency separately and also it's not able to distinguish which unit is inefficient. On the other side, applying different weights for DUMs is resulted in decreasing the comparison ability and ranking DMUs based on a common scale (Wang et al., 2011). Therefore, Roll et al. (1991) have had a suggestion to use a common set of weights. The set of common weights for each DMU is used in different patterns by researchers. In this study, the first round of FIFA World Cup 2014 in Brazil would be ranked based on a set of quality indicators, using several models of DEA-CWA. In this part, the applied models are introduced.

The first DEA-CWA model: Makuei et al. (2008)

The proposed model of Makuei et al. (2008) is a developed version of a multi objective model in linear programming which has been proposed by Kornbluth (1991). This model is a multi objective linear programming model to which is used to find common weights in DEA. The final DEA-CWA model is shown below.

$$\begin{aligned} &Min \ \ \sum_{j=1}^{n}(d_j^- + d_j^+) \\ &\text{s.t.} \\ &\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i \theta_j^* X_{ij} \le 0, \qquad j = 1, \dots, n \\ &\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i \theta_j^* X_{ij} + d_j^- - d_j^+ = 0, \qquad j = 1, \dots, n \\ &\sum_{r=1}^{s} U_r - \sum_{i=1}^{m} V_i = 1, \\ &d_j^-, d_j^+ \ge 0, \qquad j = 1, \dots, n \\ &U_r \ge \varepsilon, \qquad r = 1, \dots, s \\ &V_i \ge \varepsilon, \qquad i = 1, \dots, m \end{aligned} \tag{2}$$

In the above equations x_{ij} refers to amount of ith input and y_{rj} refers to rth input of jth DMU. v_i and u_r are also refer to the weights of ith input and rth output. θ_j^* is the optimal efficiency of of jth DMU. d_j^- and d_j^+ are salck and surplus variables of jth DMU.

The Second DEA-CWA model: Liu & Peng (2008)

Traditional models of DEA tried to maximize the efficiency score. However, the DMUs efficiency cannot increase upper than the "1", the common scale value. The proposed model by Liu & Peng (2008) has used this feature to explain the concept of common weights which is used for DMUs. Then a common weight model is provided in DEA and it can calculate the absolute efficiency of DMUs to rank them. Consequently DMUs are ranked based on common weights.

$$\begin{aligned} &\Delta^* = \min \sum_{j \in E} \Delta_j \\ &\text{s.t.} \\ &\sum_{r=1}^{s} Y_{rj} U_r - \sum_{i=1}^{m} X_{ij} V_i + \Delta_j = 0, \qquad j \in E, \\ &U_r \ge \varepsilon > 0, \qquad r = 1, \dots, s, \\ &V_i \ge \varepsilon > 0, \qquad i = 1, \dots, m, \\ &\Delta_j \ge 0, \qquad j \in E. \end{aligned} \tag{3}$$

In above equations x_{ij} refers to amount of ith input and y_{rj} refers to rth input of jth DMU. v_i and u_r are also refer to the weights of ith input and rth output. Δ_j is the slack variable and Δ^* is the optimal amount of slack variable.

The third DEA-CWA model: Jahanshahloo et al. (2005)

DMU's efficiency which has been measured with traditional model of DEA can be ranked in the next step. Nevertheless, is not possible to rank the efficient units with regular approaches. Jahanshahloo et al. (2005) have proposed an approach to measure the efficiency of DMUs with common weights and to rank them. The equations below, explain this model.

$$
\begin{aligned}
&Max \;\; z \\
&\text{s.t.} \\
&\sum_{r=1}^{s} U_r Y_{rj} + u_0 - z \sum_{i=1}^{m} V_i X_{ij} \geq 0, \qquad j \in A, \\
&\sum_{r=1}^{s} U_r Y_{rj} + u_0 - z \sum_{i=1}^{m} V_i X_{ij} \leq 0, \qquad j = 1, \dots, n, \;\; j \notin A, \\
&U_r \geq \varepsilon, \qquad r = 1, \dots, s \\
&V_i \geq \varepsilon, \qquad i = 1, \dots, m \\
&z \geq 0, \\
&u_0 \;\; free
\end{aligned}
\tag{4}
$$

In above equations x_{ij} refers to amount of ith input and y_{rj} refers to rth input of jth DMU. v_i and u_r are also refer to the weights of ith input and rth output. u_o is a free variable.

The forth DEA-CWA model: Hosseinzadeh Lotfi et al. (2000)

The model which is shown below is proposed by Hosseinzadeh Lotfi et al. (2000).

$$
\begin{aligned}
&Min \;\; \textstyle\sum_{j=1}^{n} z_j \\
&\text{s.t.} \\
&\sum_{r=1}^{s} U_r Y_{rj} + z_j \sum_{i=1}^{m} V_i X_{ij} - \sum_{i=1}^{m} V_i X_{ij} \leq 0, \qquad j = 1, \dots, n, \\
&\sum_{r=1}^{s} U_r Y_{rj} - \sum_{i=1}^{m} V_i X_{ij} \leq 0, \qquad j = 1, \dots, n, \\
&U_r \geq \varepsilon, \qquad r = 1, \dots, s \\
&V_i \geq \varepsilon, \qquad i = 1, \dots, m \\
&z \geq 0,
\end{aligned}
\tag{5}
$$

In above equations x_{ij} refers to amount of ith input and y_{rj} refers to rth input of jth DMU. v_i and u_r are also refer to the weights of ith input and rth output. z_j is a deviation variable, under the e condition that DMU_j would be a efficient unit, z_j does equal to zero.

SHANNON ENTROPY TECHNIQUE

The concept of Shannon Entropy (Shannon, 1948) has a dominant role in information theory. This concept has been developed to different scientific fields, such as physics, social sciences, and so on. We use this formula to obtain the degree of importance of alternatives in the following four steps (Soleimani-Damaneh et al., 2011):

• Step 1: Normalization

$$
P_{ij} = I_{ij} \Big/ \sum_{i=1}^{m} I_{ij} \quad i = 1, 2, \dots, m \;\; ; \;\; j = 1, 2, \dots, n \tag{6}
$$

Where *C1, C2,..., Cm* are the criteria and *A1, A2, ..., An* are alternatives and aij is the assigned rate for criteria *i* and alternatives *j*.

• Step 2: Compute entropy

$$
e_j = -e_0 \sum_{i=1}^{m} P_{ij} \ln P_{ij} \qquad j = 1, 2, \dots, n \tag{7}
$$

Where e_0 is the entropy constant and is considered equal to:

$$
e_0 = (\ln m)^{-1} \tag{8}
$$

• Step 3: Set of deviation degree

$$
d_j = 1 - e_0 j = 1, 2, \dots, n \tag{9}
$$

• Step 4: Calculation of relative weights of criteria

$$
W_j = d_j \Big/ \sum_{j=1}^{n} d_j \qquad j = 1, 2, \dots, n \tag{10}
$$

The importance degree of A_J would be determined through equation number 10.

FOOTBALL WORLD CUP (FIFA.com)

The FIFA World Cup, often simply called the World Cup, is an international association foot-

ball competition contested by the senior-men's national teams of the members of Fédération Internationale de Football Association (FIFA), the sport's global governing body. The championship has been awarded every four years since the inaugural tournament in 1930, except in 1942 and 1946 when it was not held because of the Second World War. The 19 World Cup tournaments have been won by eight different national teams. Brazil has won five times, and they are the only team to have played in every tournament. The other World Cup winners are Italy, with four titles; Germany, with three titles; Argentina and inaugural winners Uruguay, with two titles each; and England, France and Spain, with one title each. The current champions are Spain, who won the 2010 tournament in South Africa.

The current format of the competition involves a qualification phase, which currently takes place over the preceding three years, to determine which teams qualify for the tournament phase, which is often called the World Cup Finals. 32 teams, including the automatically qualifying host nation(s), compete in the tournament phase for the title at venues within the host nation(s) over a period of about a month. The 2014 World Cup is currently being contested in Brazil. The next two World Cups will be hosted by Russia in 2018 and Qatar in2022. Both choices have been criticized in the media; Russia given the 2014 Crimean crisis, and Qatar for allegations of vote-buying.

The current final tournament features 32 national teams competing over a month in the host nation(s). There are two stages: the group stage followed by the knockout stage. In the group stage, teams compete within eight groups of four teams each. Eight teams are seeded, including the hosts, with the other seeded teams selected using a formula based on the FIFA world Rankings and/or performances in recent World Cups, and drawn to separate groups. The other teams are assigned to different "pots", usually based on geographical criteria, and teams in each pot are drawn at random to the eight groups. Since 1998, constraints have been applied to the draw to ensure that no group contains more than two European teams or more than one team from any other confederation. The top two teams from each group advance to the knockout stage. Points are used to rank the teams within a group. Since 1994, three points have been awarded for a win, one for a draw and none for a loss (before, winners received two points).The knockout stage is a single-elimination tournament in which teams play each other in one-off matches, with extra time and penalty shootouts used to decide the winner if necessary. It begins with the round of 16 (or the second round) in which the winner of each group plays against the runner-up of another group. This is followed by the quarter-finals, the semi-finals, the third-place match (contested by the losing semi-finalists), and the final.

METHODOLOGY AND RESULTS

Today, football is not just a question of winning or losing. Attractive and high quality tournaments with the least mistakes of technical and tactical performance of players and teams are also a remarkable subject which is important in the perspective of both technical staff and audiences. Hence, in this research the quality of first round of the 2014 Brazil World Cup is studied and based on it, the matches are ranked using DEA-CWA models. In this case, after reviewing the literature and select appropriate criteria the quality of FIFA 2014 first round matches were evaluated and ranked. Fig. 1 shows the stages of research methodology.

• Step 1: Identifying quality criteria of football matches

In this step, appropriate criteria for evaluating FIFA 2014 first round matches regarding quality approach were collected from the brilliant reference of FIFA website. The qualified criteria were shown in Table 2.

• Step 2: Collecting data

In this step, data needed for each criterion were extracted from formal website of FIFA, special pages for Brazil 2014 tournament. The whole data were demonstrated in Table 3.

• Step 3: Selecting appropriate model for analyzing, evaluating and ranking

Among various DEA models, remarkable DEA-CWA models which pointed in section 3 were used. These models are comprised of Makuei et al. (2008), Liu & Peng (2008), Jahanshahloo et al. (2005) and Hosseinzadeh Lotfi et al. (2000). Due

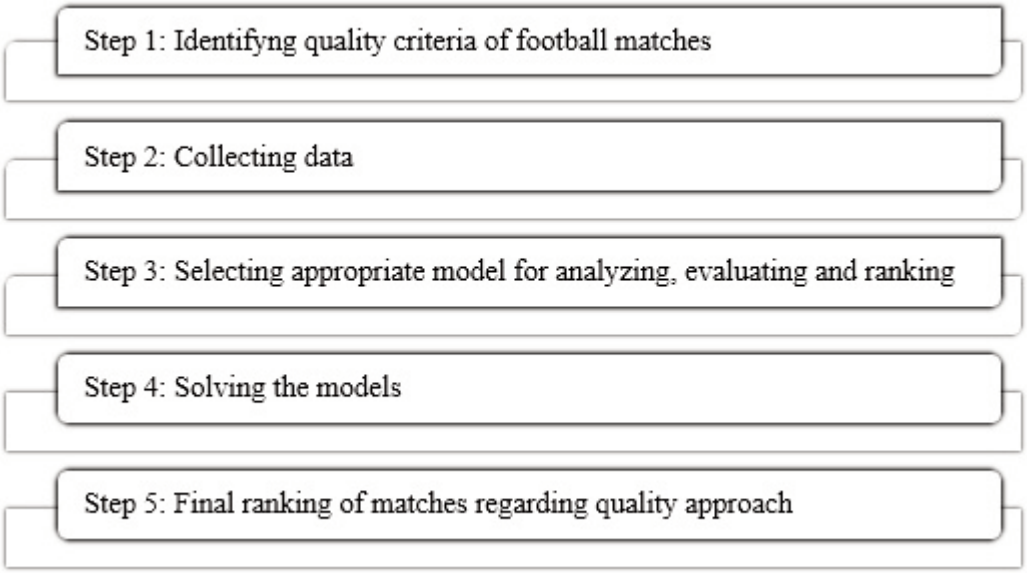

Fig. 1. The stages of research methodology

to obtaining different results that usually occur in different evaluation models, various DEA-CWA models were used to evaluate and rank the matches regarding quality approach.

• Step 4: Solving the models

After choosing appropriate evaluation models, 42 matches in the first round of FIFA 2014 as DMUs under evaluation of 14 quality criteria are analyzed and ranked. Table 4 shows the results of implementing various DEA-CWA models. It should be mentioned that LINGO13 software was used to solve the models.

• Step 5: Final ranking of the matches regarding quality approach

It is common in the process of ranking that ranking with various models consequence different results. Hence, a method is needed to integrate the different results and obtain a comprehensive ranking. In this paper, the well-known Entropy Shannon technique was used to integrate the results. In this technique, the task of identifying the importance weight of each model is being responded through this technique. The final ranking of matches is also shown in Table 4.

Table 2: The qualified criteria for evaluating quality of matches

	Criteria	Positive/ Negative
C_1	Pass Completed	Positive
C_2	Pass Completed %	Positive
C_3	Crosses Completed %	Positive
C_4	Throw-ins	Negative
C_5	Attacks	Positive
C_6	Sold Runs Into Area	Positive
C_7	Attempts On-target From Inside The Area	Positive
C_8	Attempts On-target From Inside The Area %	Positive
C_9	Cards	Negative
C_{10}	Fouls Committed	Negative
C_{11}	Goals	Positive
C_{12}	Clearances Completion Rate %	Positive
C_{13}	Saves	Positive
C_{14}	Tackles Won %	Positive

Table 3: Research data

DMU	Match		C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}	C_{11}	C_{12}	C_{13}	C_{14}
1	USA	GER	1088	85%	24%	55	70	1	10	59%	3	24	1	84%	5	72%
2	ENG	ITA	1073	88%	18%	48	91	5	13	43%	1	20	3	72%	5	65%
3	AUS	ESP	961	79%	8%	61	63	5	8	53%	3	23	3	96%	2	58%
4	USA	POR	941	83%	14%	54	80	6	19	54%	1	25	4	58%	6	68%
5	CHI	AUS	939	81%	33%	69	74	9	15	63%	4	27	4	96%	5	36%
6	ARG	BIH	928	82%	26%	61	83	5	16	59%	2	24	3	75%	8	64%
7	GER	GHA	919	79%	21%	58	78	12	16	52%	1	28	4	82%	7	91%
8	ESP	CHI	911	78%	32%	81	68	6	13	59%	3	29	2	90%	8	72%
9	ESP	NED	884	80%	44%	52	73	8	17	77%	4	23	6	73%	8	43%
10	FRA	HON	875	82%	26%	50	64	4	12	50%	10	27	3	82%	3	64%
11	GER	POR	874	81%	18%	54	78	8	18	67%	4	19	4	69%	6	39%
12	RUS	KOR	834	76%	23%	64	82	1	16	62%	4	22	2	77%	8	68%
13	ITA	CRC	826	81%	37%	42	64	5	12	60%	2	34	1	86%	8	59%
14	BIH	IRN	819	77%	25%	50	68	4	14	70%	2	37	4	88%	5	73%
15	SUI	FRA	804	79%	32%	58	72	6	24	62%	1	28	7	80%	11	68%
16	NGA	ARG	787	75%	29%	51	98	10	20	67%	2	23	5	95%	10	75%
17	CIV	JPN	780	76%	31%	58	67	6	13	50%	4	25	3	93%	6	24%
18	HON	SUI	778	79%	26%	55	72	8	19	66%	1	35	3	89%	10	59%
19	NGA	BIH	776	76%	21%	59	72	5	23	61%	2	16	1	72%	16	64%
20	ITA	URU	775	76%	19%	67	73	2	14	61%	7	39	1	64%	5	70%
21	MEX	CMR	768	78%	30%	69	77	4	9	47%	2	23	1	91%	4	67%
22	ALG	RUS	762	72%	20%	65	83	6	13	72%	5	29	2	80%	9	89%
23	AUS	NED	760	76%	19%	60	70	9	22	88%	2	43	5	78%	9	81%
24	BEL	ALG	753	75%	18%	59	56	3	11	58%	2	38	3	91%	6	25%
25	ECU	FRA	738	73%	25%	66	85	5	20	65%	4	23	0	95%	11	61%
26	CRC	ENG	737	72%	17%	59	47	2	6	50%	3	34	0	100%	3	73%
27	SUI	ECU	734	77%	20%	69	77	3	18	64%	2	24	3	88%	8	33%
28	GHA	USA	726	71%	35%	86	87	1	15	52%	2	24	3	100%	7	68%
29	BRA	CRO	717	73%	26%	80	86	6	13	54%	4	26	4	95%	6	46%
30	JPN	GRE	714	79%	17%	47	87	5	16	64%	7	41	0	71%	9	67%
31	COL	GRE	705	76%	32%	61	89	5	15	63%	3	33	3	90%	7	70%
32	POR	GHA	703	71%	28%	85	90	4	16	43%	4	37	3	92%	9	82%
33	URU	CRC	700	73%	19%	72	57	2	9	43%	6	38	3	78%	3	23%
34	CMR	BRA	694	76%	27%	59	69	5	24	77%	3	33	5	70%	6	68%
35	KOR	ALG	687	72%	33%	70	79	7	14	58%	3	29	6	96%	3	75%
36	BEL	RUS	684	71%	19%	73	87	10	13	54%	3	23	1	93%	4	82%
37	NED	CHI	676	73%	34%	71	60	5	9	45%	2	39	2	89%	4	73%
38	CRO	MEX	675	72%	32%	56	74	6	12	55%	6	30	4	100%	2	70%
39	COL	CIV	669	75%	18%	61	80	8	20	77%	2	25	3	93%	8	78%
40	IRN	NGA	656	72%	24%	65	68	6	9	53%	1	34	0	84%	5	47%
41	KOR	BEL	653	71%	24%	73	89	6	23	68%	5	27	1	100%	13	90%
42	BRA	MEX	651	74%	21%	53	71	2	11	41%	4	31	3	59%	8	74%
43	GRE	CIV	647	78%	8%	54	74	9	14	54%	3	36	3	73%	5	66%
44	ARG	IRN	646	74%	18%	72	107	4	13	48%	2	22	1	79%	7	68%
45	JPN	COL	645	70%	32%	58	78	9	22	61%	2	29	5	93%	6	76%
46	CMR	CRO	634	75%	26%	68	80	10	21	54%	4	20	4	92%	7	55%
47	HON	ECU	602	69%	19%	61	83	5	14	58%	5	32	3	92%	6	69%
48	URU	ENG	600	69%	20%	75	77	6	14	61%	2	29	3	81%	8	48%

Table 4: Ranking football matches with various DEA-CWA models

DMU	Match		Makuei et al.		Lio & Peng		Hosseinzadeh Lotfi et al.		Jahanshahloo et al.		Final Ranking	
			Efficiency	Rank	Efficiency	Rank	Efficiency	Rank	Efficiency	Rank	Efficiency	Rank
1	USA	GER	0.88110	6	0.81598	5	0.69243	16	0.67829	23	0.74582	14
2	**ENG**	**ITA**	**1.00000**	**1**	**1.00000**	**1**	**0.88724**	**4**	0.82200	7	**0.90825**	**3**
3	AUS	ESP	0.79107	14	0.77240	7	0.64013	27	0.68950	22	0.70809	20
4	USA	POR	0.85697	9	0.74918	12	0.76304	11	0.75036	13	0.77417	11
5	CHI	AUS	0.75531	23	0.69908	23	0.68911	17	0.73191	14	0.71689	17
6	ARG	BIH	0.83102	12	0.76213	8	0.75978	12	0.72886	15	0.76382	13
7	GER	GHA	0.81053	13	0.72983	17	0.79090	8	0.76675	11	0.77588	9
8	ESP	CHI	0.64093	40	0.58818	39	0.59991	36	0.58378	37	0.60039	37
9	ESP	NED	**1.00000**	3	0.79368	6	**0.92055**	3	0.87815	4	0.89907	4
10	FRA	HON	0.83143	11	0.73242	16	0.63522	29	0.65520	26	0.69604	23
11	GER	POR	0.97023	4	**0.84803**	3	0.86700	5	**0.91783**	3	0.89904	5
12	RUS	KOR	0.78745	18	0.73946	15	0.69824	15	0.69130	21	0.72029	15
13	ITA	CRC	0.87851	7	0.72657	18	0.65871	23	0.65952	24	0.71258	19
14	BIH	IRN	0.78767	17	0.64641	31	0.60989	33	0.62879	29	0.65590	29
15	SUI	FRA	0.84555	10	0.70145	20	0.83433	6	0.81504	9	0.80625	8
16	**NGA**	**ARG**	**1.00000**	**2**	**0.92683**	**2**	**1.00000**	**1**	**1.00000**	**1**	**0.98673**	**1**
17	CIV	JPN	0.77573	21	0.74010	14	0.66804	20	0.71490	17	0.71616	18
18	HON	SUI	0.78794	16	0.66094	28	0.66978	18	0.71356	18	0.70423	21
19	**NGA**	**BIH**	0.93425	5	0.83149	4	**0.95269**	**2**	**0.97233**	**2**	**0.93346**	**2**
20	ITA	URU	0.59022	45	0.49965	47	0.43861	47	0.44777	46	0.48107	47
21	MEX	CMR	0.71115	31	0.72537	19	0.63130	31	0.60184	35	0.65405	32
22	ALG	RUS	0.73670	26	0.64212	33	0.64570	25	0.62624	30	0.65600	28
23	AUS	NED	0.72725	28	0.52950	45	0.60629	34	0.65086	27	0.62919	33
24	BEL	ALG	0.64552	38	0.56707	43	0.46837	44	0.52378	41	0.53708	42
25	ECU	FRA	0.78237	20	0.75361	10	0.72396	13	0.80466	10	0.76583	12
26	CRC	ENG	0.64195	39	0.59172	38	0.45264	46	0.49737	43	0.52758	44
27	SUI	ECU	0.74291	25	0.69989	22	0.65302	24	0.71673	16	0.69856	22
28	GHA	USA	0.61091	44	0.64676	30	0.61882	32	0.59308	36	0.61426	36
29	BRA	CRO	0.63206	41	0.64226	32	0.60387	35	0.60483	33	0.61643	35
30	JPN	GRE	0.72720	29	0.60922	35	0.51599	41	0.55129	40	0.58375	39
31	COL	GRE	0.73045	27	0.67045	27	0.63351	30	0.62340	31	0.65523	31
32	POR	GHA	0.51901	47	0.52993	44	0.50839	42	0.48392	44	0.50655	45
33	URU	CRC	0.51020	48	0.47748	48	0.37230	48	0.39629	48	0.42487	48
34	CMR	BRA	0.77153	22	0.58623	40	0.66134	22	0.70967	19	0.68371	25
35	KOR	ALG	0.69388	33	0.64740	29	0.66721	21	0.64655	28	0.66210	27
36	BEL	RUS	0.68851	34	0.70082	21	0.66904	19	0.69819	20	0.68768	24
37	NED	CHI	0.55614	46	0.50859	46	0.46762	45	0.44445	47	0.48436	46
38	CRO	MEX	0.74871	24	0.69855	24	0.63667	28	0.65864	25	0.67589	26
39	COL	CIV	0.86336	8	0.75028	11	0.78546	9	0.85751	6	0.81650	6
40	IRN	NGA	0.61475	43	0.57304	41	0.48266	43	0.50509	42	0.53096	43
41	KOR	BEL	0.71674	30	0.67222	26	0.70149	14	0.76067	12	0.71776	16
42	BRA	MEX	0.68095	36	0.60050	37	0.56113	39	0.46994	45	0.56195	41
43	GRE	CIV	0.70351	32	0.60302	36	0.55067	40	0.57991	38	0.59813	38
44	ARG	IRN	0.68051	37	0.74187	13	0.64250	26	0.60388	34	0.65545	30
45	JPN	COL	0.79051	15	0.69755	25	0.77023	10	0.81621	8	0.77540	10
46	CMR	CRO	0.78689	19	0.75600	9	0.81085	7	0.87281	5	0.81599	7
47	HON	ECU	0.68301	35	0.64171	34	0.57925	37	0.60635	32	0.61864	34
48	URU	ENG	0.61998	42	0.57262	42	0.56382	38	0.57262	39	0.57875	40

After evaluating the quality of each match in the first round of FIFA 2014 World Cup employing various DEA-CWA models, the well-known Shannon Entropy model was implemented to integrate the results and to final rank of matches. The method of assigning weights in the Shannon Entropy model is based on disorganized concept of the four models. Relative importance weight for Makui et al. (2008), Liu & Peng (2008), Jahanshahloo et al. (2005) and Hosseinzadeh Lotfi et al. (2000) models respectively are 0.1813, 0.1879, 0.3162, and 0.3146. As it can be seen, the maximum weights are for the two last.

The results show that the match between the Nigeria and Argentina national teams have been the most quality match in the first round of FIFA World Cup 2014. The rank of this match has been one or two among the whole DEA-CWA models. Also, the match Nigeria-Bosnia has selected as the second most quality matches where the rank of this match was 4 and 5 for the two first models and 2 for the two last models. The third high quality match is the match between England and Italy national teams. Although this match has ranked in the first pot in terms of the two first DEA-CWA models, it has ranked in 4 and 7 position regarding the last models. This match has finally ranked as the third high quality matches. Fig. 2 illustrate the relative ranking of top matches according to the four ranking models.

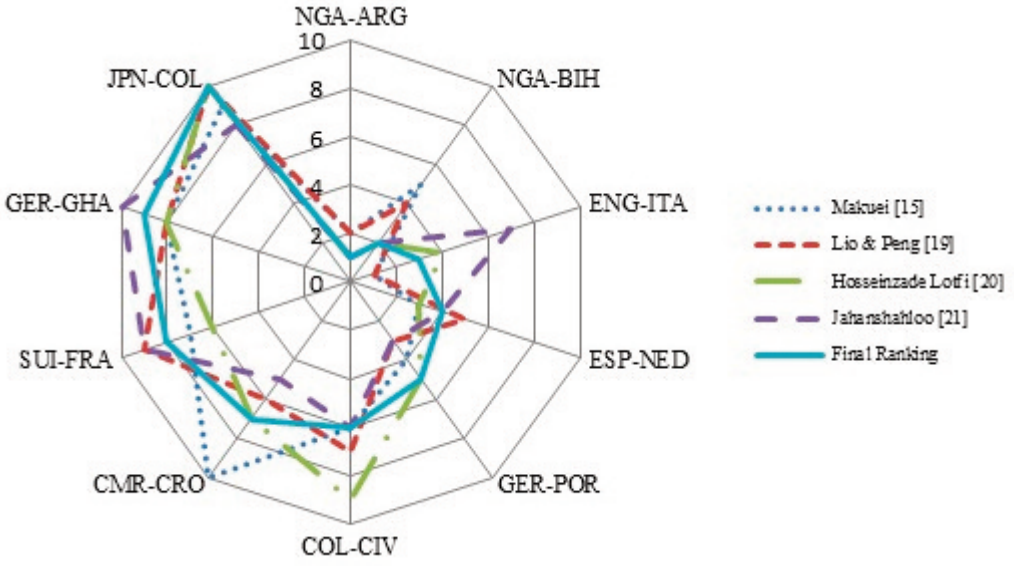

Fig. 2. The relative ranking of top matches according to the four ranking models

Among the top ten high quality matches in the first round of FIFA World Cup 2014 Brazil, there are just seventeen teams in which there quality of matches has regarded. Nigeria, Germany and Colombia with two appearances in the ten high quality matches are such kind of record. This means that the teams have had an important role in enhancing the quality of matches. Argentina, Bosnia, Britain, Italy, Spain, the Netherlands, Portugal, Cote d'Ivoire, Cameroon, Croatia, Switzerland, France, Ghana and Japan are also the other teams that their quality has once regarded in the top quality matches.

The results also show that among the top 10 matches, Groups 6 and 7 of tournament are identified as the best groups because of having two contributions. Group 8involvingRussia, South Korea, Algeria and Belgium is the only group that does not have any quota in the top matches. The best match of this group, Russia-South Korea, has ranked in the fifteenth position. Other groups comprised of the first five groups have one quota in the top matches. A remarkable point is the absence of Brazil as the honorable team of the tournament among the top high quality matches.

CONCLUSIONS

One of the most important issues discussed in football, and especially World Cups, is the quality of teams and matches. Performance evaluation in a system besides revealing the strengths

and weaknesses cause creating a competitive environment among decision-making units and have a positive impact on performance. In addition to technical and tactical positive points, a qualified match causes audience satisfaction. Moreover, the obtained result can be effective for football coaches and players to adopt appropriate future decisions. The aim of this study was to evaluate the quality of matches in the first round of FIFA World Cup 2014 Brazil. To this end, the DEA-CWA models were employed. In the first stage, evaluation criteria were determined. Then, the required data were collected from the formal website of the tournament. After that, some suitable evaluation models were chosen to rank the matches. At the end, the final ranking was done.

This study has some advantages which are mentioned below:

- In this research, football matches have been ranked based on quality factors, for the first time.
- To collect and introduce the quality factors of a football match.
- Proposing an approach to assess the quality and to rank the matches
- The capability of the provided procedures to applied at any other tournaments with related criteria.

There are some constraints in the way of doing this study as are mentioned in the following:

- This research has just deemed to introduce criteria by FIFA.
- The applied data are found in FIFA website statics. Therefore, the researchers have trust to accuracy of these data.
- The study has just considered the first round of competitions. Hence there it would be probable that in second round onwards, matches are performed with the higher quality. The only reason to consider just the first round is to compare all teams based on identical conditions.
- The authority to determine the weights in DEA models with the common weight is given to models.
- If the experts were available, researchers could also use methods of weight control.

Considering limitations of research, some suggestions are proposed for future studies to develop.

- To search and find other significant criteria for assessing the quality of football matches.
- To consider the experts idea related to criteria weight.
- To use other DEA models or generally other ranking approaches.

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