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Optimization of Ticket Sales for Tehran Azadi stadium with the Approach of Simulating Queuing Systems and MCDM

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Abstract

The purpose of the present study was to optimize and improve the status of ticket sales at Tehran Azadi Stadium and reduce customer waiting times in queues using methods Simulation and Multi-criteria decision making (MCDM). First, using objective observation and time-out, the waiting time for spectators in the ranks of the ticket and presentation and physical examination calculations and then using the simulation software, The entire service process has been simulated from the moment the ticket is purchased until the moment they enter the stadium, and the average waiting time for spectators in the queue for the provision of services is calculated. And then we look at the problems with ticket sales. Also, using interviews with elite and expert people, there are some ways to reduce waiting times for customers in the queue. And each of these views was examined using the simulation software; then scenarios were developed to improve the status quo and then, using multi-criteria decision-making methods, we ranked the scenarios and selected the best scenario.

***Keywords**:* Ticket sale, Simulation, Azadi Stadium

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INTRODUCTION

Waiting in the queue, though unpleasant, is, unfortunately, part of the inevitable reality of life. In their daily lives, people are confronted with different types of queues that lead to the loss of their time, energy and capital. Time wasted in bus lines, dining and shopping and the like are tangible examples of this kind of waste in life. In today's societies, there are more important queues whose economic and social costs are far more than the simple examples above. These include urban traffic queues as well as queues at airports, ports, telecommunications establishments, and behind manufacturing processes. Overall, it can be argued that waiting in line is no longer an exception and has become a rule. But in today's competitive environment, organizations are successful in making efforts to improve their organization (Modiri & Anvari, 2013). Improving the quality of sports facilities is one of the issues that has always been of interest to the leading countries in the field of sports. In today's competitive world, customers and their satisfaction with the organization and its products are one of the important factors for the success and survival of organizations.

Organizations have realized that if they want to survive in the present world, they have to move towards customer-centric and customer satisfaction, and organizations that do not pay attention to customer needs are eliminated from the competition scene (Kordnaij & Delkhah, 2004). One of the important and effective factors in increasing customer satisfaction is improving the quality of service. Countries that host major sporting events, such as the Olympics and World Cups in various disciplines, should be of good quality to their venues and stadiums. The poor quality of these places is causing dissatisfaction among the athletes and fans who use these facilities. Successful service firms have found that while expectation is inevitable, it can still be sustained (Solomon, Bamossy, Askegaard & Hogg, 2002). Paying attention to the quality of the goods and sensitivity to the most desirable services are among the most important issues that the international community considers particularly relevant today, today is defining quality, customer demand, and perceiving customer expectations and expectations as the main determinant of quality (West, 2001; Sharma & Gadenne, 2001). In a competitive environment where organizations compete to attract customers, today more than ever, the issue of quality of service as an

important factor in the growth and success and sustainability of organizations and as a strategic, effective and pervasive issue is on the management agenda of organizations.

This is because organizations have found that the lack of sufficient information about customer expectations and feedback on customer service perceptions will cause problems (Beheshtirad, 2012). Due to the high popularity of the sport of football and the Football lovers around the world and the high capacity of the stadiums, the quality of service in this field is very important. In this regard, (Florez, Muniz & Portugal, 2014), in a study of spectators at the Maracana Stadium in Rio de Janeiro, Brazil, during the 2013 Confederations Cup, found that the characteristics and factors affecting the quality of service to on-foot spectators. Includes: accessibility, convenience, reliability, ease of use, security, security and socialization; Also, (Bakhtiari, Sajadi, Heidary & Emami, 2011) examined the satisfaction of Iranian Premier League audiences, stating that spectators who use stadium services are dissatisfied with the service and consider it poor. (Theodorakis, Alexandris, Rodrigues & Sarmento, 2004), in their study, found that the aspects of service delivery demanded by users of sports centers focused more on equipment, facilities, abilities, and attitudes of staff, on the cost of attending centers and Points to the planning and tabulation of services provided.

A study examined the relationship between service quality with customer satisfaction and loyalty of public and private indoor sports sites in Urmia; their findings indicated that there was a significant relationship between service quality and its subscales including "program quality, The quality of the facilities, the quality of the interaction "with customer satisfaction and loyalty (Seyed Ameri, Bahrami & Sayadi, 2013). One of the components of service at stadiums is the ticket section, where a large number of fans arrive at the stadium at the same time for a match at a specified time. So in the ticketing section of the stadiums we will have a huge crowd of passionate fans who want to use the ticketing service in person. Service delivery has a significant impact on customer satisfaction and in the meantime customers' waiting times in service queues affect their satisfaction with the service (Jones & Peppiatt, 1996).

Since in Iran there is still a high volume of ticket sales in person and on the site of the stadium, so doing so is particularly important. Investigating queuing systems and reducing the expected adverse effects

has always been one of the major topics in applied mathematics and research in operations. Almost all of us have experienced waiting in line. Investigating queuing systems and reducing the expected adverse effects has always been one of the major topics in applied mathematics and research in operations. Almost all of us have experienced waiting in line. Unfortunately, this phenomenon in our urban society, which is increasing in terms of population density and crowding, has caused customer dissatisfaction with these interpretations, which can be due to over-demand for inadequate service and other equipment. Due to lack of proper management and deployment of appropriate service systems.

Queuing theory began with the Danish engineer's research work in 1909.His study of the increase and decrease of demand in the telephone system (Kleinrock, 1975), where the inputs are more than the capacity of the system to respond to them, comes in the queue of the same people who provide Azadi Stadium football tickets are present; In other words, the queue occurs when the demand for services exceeds the service capacity (Panico, 1969); therefore, a model should be provided to improve the service, so that in a shorter time it can meet more clients and save on costs. Due to the waste of time and energy prevented. It also increased the rate of service delivery by customers and reduced the average waiting time for customers. Currently, the ticketing process at Azadi Stadium in Tehran has created numerous problems that can be attributed to the long queues, irregularities, and so on, which has left viewers dissatisfied, all due to the lack of a comprehensive and scientific ticketing program. It is for sale and for spectators. This research aims to present scenarios to improve the current situation by reducing the waiting time for Tehran Azadi Stadium spectators to enter the stadium and improve service by combining multidimensional simulation and decision making (MCDM) leading to a multi-dimensional review of the real model. And, by incorporating the factors that determine the optimal combination of service among the desirable scenarios, choose a scenario that best matches the capabilities and realities of the organization, while minimizing customer waiting time in the queue and system, minimizing customer dissatisfaction. To reach their level. Therefore, the main objective of this study is to optimize the ticket sales process of Azadi Stadium by simulating queue and MCDM systems in order to reduce the

waiting time of customers in the queue and to increase the efficiency of the clients and the number of outgoing customers.

METHOD

This article is applied in terms of information analysis. This research is a direct observation in terms of data collection methods. The research community also includes all the Premier League stadium matches in the Premier League in 1996-95 as well as the national team games in a total of 45 matches. The method of sampling in this study was Cochran's formula with 90% confidence level and 0.1 error level of which 16 matches were evaluated. For the purpose of this study, the data collected from the target stadiums include a set of data as follows:

- Distributing spectators' arrival time to the stadium
- Distribution of time between two arrivals
- Distribute the accountability of servants
- Pay rates for servants by miscellaneous jobs
- Number of servants

The method of collecting data is a type of direct observation by the researcher. To simulate the system the required parameters of the problem are determined by timer and timer recording by stopwatch. But in the simulation section it should be noted that simulation is an example of a real operating system using a computer that tries to have all the features and parameters. Using simulation science makes studying on real systems much easier and easier to understand. The purpose of this work is to summarize a real model on a computer to find out what the results will be if the actual model is repeated several times in the future and how to improve it. It may be very costly for real systems whose replication function to study to identify its removable points, but it can be simulated using the computer and simulating the data without realizing it. We got the system working. The simulation software defines a unique atom in the software for each ticketing system component. These atoms (as shown in Figure 1) schematically represent the various parts of the stadium ticket:

- Product atoms
- Source atoms
- Queue atoms
- Multi-server Atom

- Sink Atom (Model Output)

A proper statistical test is now needed to check the normality of the data explaining the data, which is a good test for this purpose (Kolmogorov-Smirnov test). The results and findings of the research are presented in full. Once the validity of the simulated model has been verified and verified, it is time to present scenarios to improve the actual system process. Improvement scenarios come from experts in the field, but what's important in defining scenarios is that the scenario being defined must be enforceable and not far from the facts.

After the improvement methods or the same scenarios are presented, the changes are applied to the simulated model and the model is executed with new changes N times. Average results of model implementation with new changes are compared with average results of model implementation with previous status to determine to what extent the ticketing system process is improved in terms of costs and waiting times to introduce a superior scenario. But the point to note is that each scenario has its own advantages and disadvantages, for example a scenario that is very good in terms of reducing customer waiting time in the queue for ticketing may not be appropriate and costly to the organization. Be costly. Multi-criteria Decision Making (MCDM) methods can be used to solve this problem. In this study, two methods Analytical Hierarchy Process (AHP) and (TOPSIS) are used. The AHP method can be used when the decision-making process has several competing options and decision criteria. The criteria can be quantitative and qualitative. The basis of this method of decision-making lies in pairwise comparisons. The decision maker begins by providing the hierarchy tree of decision. The decision hierarchy tree shows the comparative factors and competing options evaluated in the decision. Then a pair of comparisons is made. These comparisons determine the weight of each factor in terms of competitor options. Finally, the AHP logic combines matrices from pairwise comparisons to make the optimal decision.

The TOPSIS method is an applied method that compares alternatives based on their data values per criterion and weight of criteria (Chung, 2003) and, considering the comparative simulation performed by Zanakis, Solomon, Wishart & Dublish in 1998 among the eight methods of multi-criteria compensatory models, the TOPSIS method has the least flaw in ranking alternatives. This method was proposed by Hwang and

Yoon in 1981. This is one of the best multi-criteria decision making methods. In this method, in addition to considering the distance of an Ai option from the ideal point, it also considers the distance from the negative ideal point. This means that the chosen option should have the shortest distance from the ideal solution and at the same time have the shortest distance from the ideal negative solution.

RESULTS

Information on the data collected is from the average customer turnover time and average time served by ticket agents and law enforcement officers.

Table 1: Statistical Distribution of Information about the Games Ticket System

Statistical distribution	Parameter
11	The number of western door ticketing gates
14	The Number of Eastern door ticketing gates
12	Number of Western door ticket Curator
15	Number of Eastern door ticket Curator
24	Western door inspection personnel
35	Eastern door inspection personnel
Longnormal (0.05&0.2)	Viewer turnout rates
UNIFORM (4.1&3.9)	Ticket Service Rates
Negexp (9)	Ticket Service Rates
Negexp (10)	The rate of service of law
Negexp (4)	Service rates for electronic devices vary

Now, based on the information gathered, we will present a simulation model; at this stage the process of entering the spectators from both the western and eastern sides to the stadium and the steps they follow is simulated as shown in the following figure. They will pay for the ticket and then present their ticket to get access to the boarding school. The audiences will then be inspected and eventually some of the population will move to the first floor and some to the second floor.

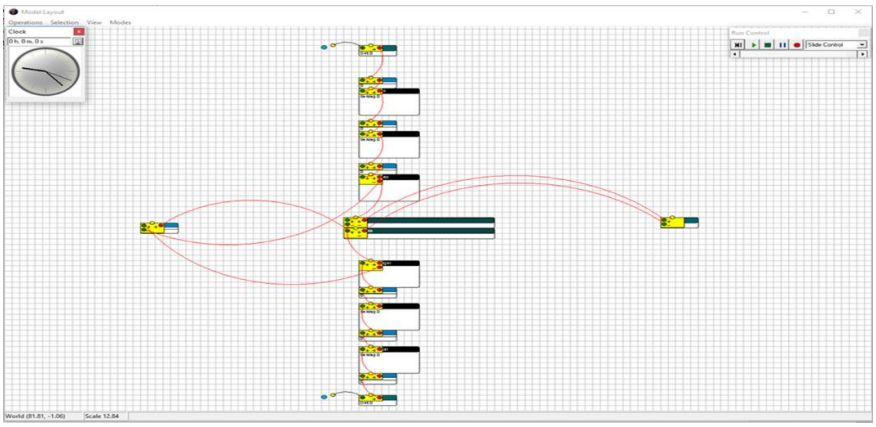


Figure 1: Simulated model of Azadi Stadium ticketing system in both east and west

We will now proceed to the validation of the simulation model, which at this stage aims to validate the model to ensure at one level that the output of the simulation model is equal to the output of the real world. That is, the real model is designed with the correct real world.

Table 2: Comparison of outputs of the simulation model with the actual model over the remaining one hour until the start of the race

Simulated Model Output	Output of desired paths in the real world
20098	14345
17870	263451
23251	13354
15985	23454
17870	15345
19645	25354
15120	14693

But one of the main assumptions for most statistical tests is the normality of the observations distribution. The normality test is performed using the Kolmogorov-Smirnov test. Assuming $\alpha = 0.05$, the distribution of observations is normal if P-value> 0.05. Now, using the mini tab software, we will examine the assumption that data is normal:

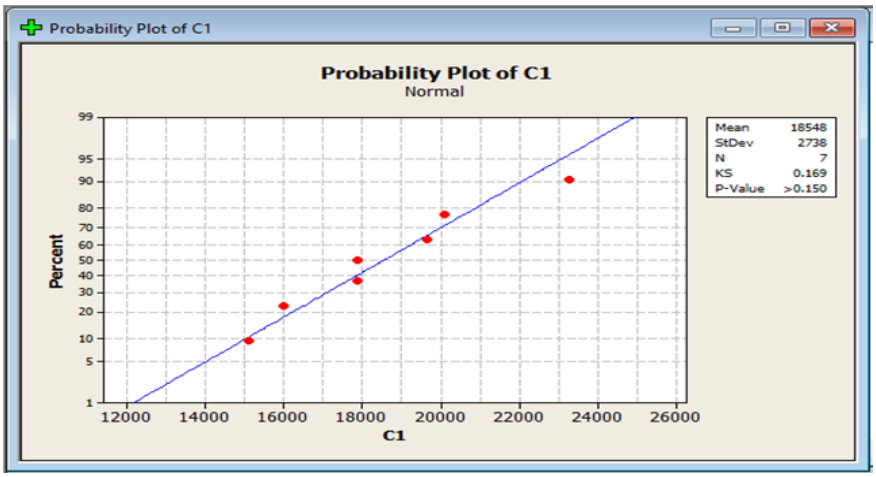


Figure 2: Distribution of data in the simulated model

Based on the output and the P-value, it can be concluded that the simulated model data follows the normal distribution.

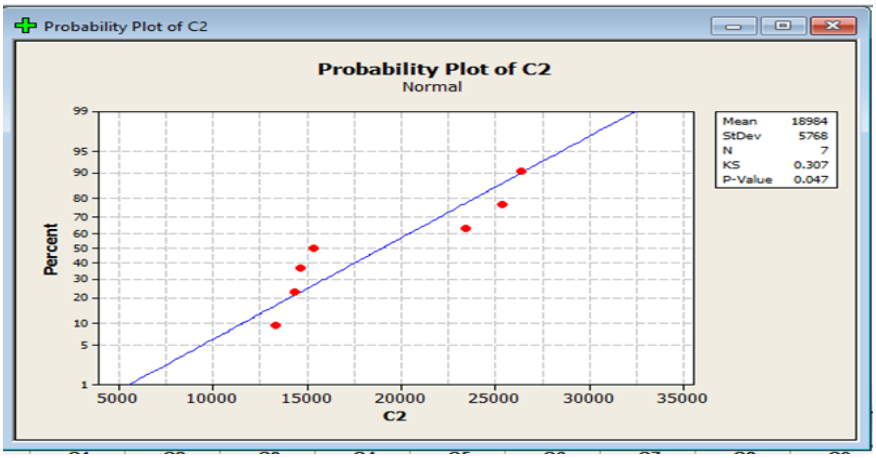
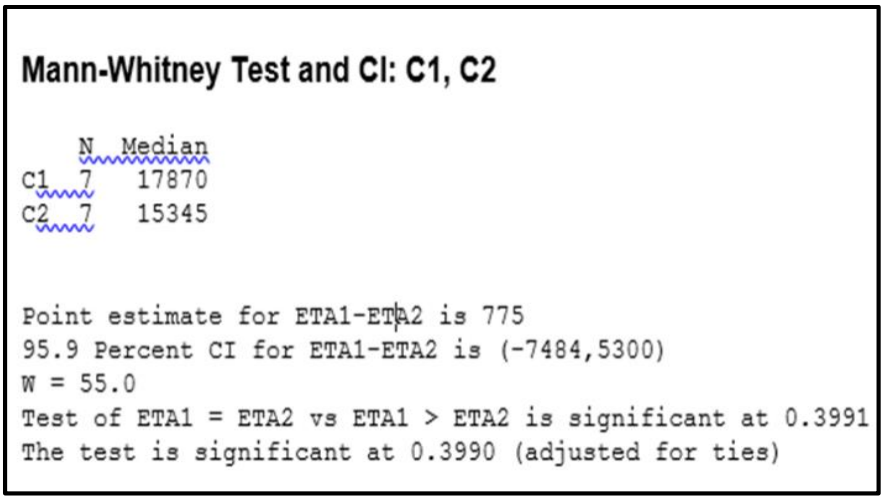


Figure 3: Distribution of data in the real world

Based on the output and the P-Value, it can be seen that real-world data does not follow the normal distribution. As a result, we use nonparametric statistics and Mann-Whitney test to check the equality of the two populations based on the Chang diagram:



Mann-Whitney Test and CI: C1, C2

	N	Median
C1	7	17870
C2	7	15345

Point estimate for ETA1-ETA2 is 775
95.9 Percent CI for ETA1-ETA2 is (-7484,5300)
W = 55.0
Test of ETA1 = ETA2 vs ETA1 > ETA2 is significant at 0.3991
The test is significant at 0.3990 (adjusted for ties)

Given that the value of zero is in the range (-5300 and -7004), it can be concluded that the equality condition of the averages is confirmed and the model is well validated. Four benchmarks are now set to compare each of the management strategies to improve ticket status:

Table 3: Criteria and amounts of each of the two hours left to start the match to compare scenarios

Criterion		**Value**
Average number of spectators entered		46541
Average Percentage of Employees Employed		79%
Approximate cost of implementing the solution		68475000
Average people waiting in line	Buy tickets from the west door	2875
	The queue presents tickets from the west door	540
	Western door inspection queue	418
	Ticket queue from east door	2227
	The queue for tickets from the east door	261
	Oriental door inspection queue	208
	Lower input queue	84

After determining the quantities of each criterion, the best management strategy should be selected from the strategies defined in the study. To do this, the importance of each criterion must first be determined using the experts who are the personnel of the Azadi Sport Complex. To do this, using the Questionnaire (AHP), expert opinions on the importance of each of the four criteria are identified.

Table 4: AHP Matrix

	The number of spectators entered	**Percentage of employment of officials**	**The cost of implementing ideas**	**Number of people waiting in line**
The number of spectators entered	1	5.87	3.61	3.15
Percentage of employment of officials	0.17	1	0.63	0.49
The cost of implementing ideas	0.27	1.58	1	1.76
Number of people waiting in line	0.31	2.04	0.56	1

Table 5: The importance of each criterion in the cost of the method (AHP)

Criterion	**The number of spectators entered**	**Percentage of employees employed**	**Cost of implementing the solution**	**Number of people waiting in line**
Weight (importance)	0.35	0.14	0.29	0.22

We now present the following scenarios to improve processes where these scenarios can be defined and addressed in various dimensions and aspects. In order to rank the scenarios, we use (MCDM) methods and the purpose is to simulate the analysis of different scenarios and analyze them.

1- Increase the number of inspection forces
2- Adding unused capacity to ticket stadium services
3- Increase the number of ticket holders and law enforcement personnel
4- The process of buying tickets online
5- Creating electronic gates to enter the audience

Table 6: The results of each of the scenarios

Criterion		Current mode	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Average number of spectators entered		46541	50278	59585	52193	62871	65821
Average Percentage of Employees		79%	73%	68%	74%	77%	84%
Approximate cost of executing the scenario		68475 000	84675 000	88500 000	88875 000	54100 000	37900 00
Average people waiting in line	Tickets queue for Western door	2875	2949	2243	2889	0	0
	The queue presents the ticket from the west door	540	662	572	354	1474	706
	Western door inspection queue	418	163	244	253	617	582

	Ticket queue from east door	2227	2239	2403	2154	0	0
	The queue presents the ticket from the east door	261	219	368	166	798	564
	Eastern Door security line	208	43	118	83	349	312
	Downstairs entrance queue	84	217	167	105	111	116

Now, we will rank the proposed solutions by the TOPSIS method. First we draw the decision matrix consisting of criteria, weight of criteria and solutions, and then the decision matrix is normalized and then we rank the solutions according to the criteria we consider. Expert opinions are taken and applied.

Table 7: Decision Matrix in TOPSIS Method

Criterion	0.35	0.14	0.29	0.22
	+	+	-	-
	The number of spectators entered	Percentage of employees employed	Cost of implementing the solution	Number of people waiting in line
Solution 1	50278	73	84675000	6492
Solution 2	59585	68	88500000	6115
Solution 3	52193	74	88875000	6004
Solution 4	62871	77	54100000	3349
Solution 5	65821	84	3790000	2280

The results of applying the TOPSIS method are as follows:

Table 8: Scenario ranking using TOPSIS method and criteria

The size of the gap	Positive	Negative
Solution 5	0	0.1291
Solution 4	0.0364	0.0933
Solution 2	0.1182	0.026
Solution 3	0.1214	0.0118
Solution 1	0.1236	0.0085

In the TOPSIS method, the options fall between two ideals, positive and negative. The best option is to have the least distance with the positive ideal and the maximum distance with the ideal negative. According to the results of the method shown in the table above, Solution 5 is the best solution because it has the least positive ideal distance and the highest negative ideal distance. Solution 1 also shows the least improvement in ticket sales.

DISCUSSION

The results of the Azadi Stadium ticketing system analysis showed that at 95% confidence, with 2 hours remaining on the start of important games that would draw a significant number of fans to the stadium, Capable of providing services to approximately 46500 people; But most spectators who come to the stadium for important games are not fully satisfied with the ticketing system because it takes approximately 17 minutes for each person to get the ticket, submit it, and pass the physical inspection stage.

The results of the Azadi Stadium ticketing system showed that at 95% confidence, with 2 hours remaining, starting with important games that would draw a significant number of fans to the stadium, Capable of providing services to approximately 46500 people; But most spectators who come to the stadium for important games are not fully satisfied with the ticketing system because it takes approximately 17 minutes for each person to get the ticket, submit it, and pass the physical inspection stage. By presenting each solution, it was observed that the average number of people waiting in line decreased from 6600 to 2200, which is much better than the current one. For each of the solutions presented in the present study, an estimated cost of implementation was provided for each race

as each solution presented should be economically viable. Overall, the results of this study showed that if the online stadium ticketing system became both financially more cost-effective and by using this approach, more and more audiences would enter the stadium during the two-hour review period. By adopting Scenario 5, that is, buying tickets online and passing through electronic gates, the process of reaching the audience from the current 17 minutes is reduced to 8 minutes.

Adopting this scenario will also make Liberty Stadium more national as a national stadium and increase the international reputation of our country. The findings of the present study also confirm the findings of (Florez, Muniz & Portugal, 2014). The present study, which focuses on the facilities of the Freedom Stadium, is in line with the results of (Florez, Muniz & Portugal, 2014) on accessibility, proximity, and convenience. They found that the features that do not bother walking the stadium are the stadium's location characteristics, its surroundings, and its social characteristics. The present study also emphasized the spatial characteristics of Azadi Stadium. The results of this study are also in line with the researches of (Faraji, Bashiri, Yavari & Khoshnevis, 2016; Fatahi & Kashef, 2016; Ramezanian, Faraji, Khoshnevis & Danesh Sani, 2013) which were related to the quality of services provided in stadiums and sports facilities. That the quality of service provided and the satisfaction of the spectators has a great impact on the attendance of the spectators in these venues, during the performance of sports competitions.

CONCLUSIONS

Finally, the present study applied a simulation method to the study of ticketing service system, which has been studied by optimization studies by (Mohammadi & Mohammadi, 2018; Pardo & Fuente, 2008; Silic, Jadric & Cukusic, 2010). They have tried to improve the performance of service systems through simulation, and have been able to provide solutions to improve the status of the system by applying this method. The overall conclusion of the present study showed that by updating the ticketing system of sports stadiums in the country we will see much better results than the current situation. Updating the process of entering the stadiums not only increases the satisfaction of the spectators with the attendance but it can also increase the number of spectators for each

match. Updating the ticketing system also raises the level of the country's soccer and improves the professionalism of international football.

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