

SUMMARY

Optimization of a Football Match as a Safety Sports Product

A football match is a unique type of sports product distinguished by its volatility, dynamics and unpredictability. It is a sociologically and marketing specific sporting event, which is the foundation of a wide range of sports products, conditioning its market success on the level of quality and value represented by a football match, which is subjectively assessed by its potential buyers.

The quality and value of a football match is primarily evidenced by the level of its safety, which is confirmed by the Polish Football Association (PZPN) safety philosophy, guidelines of international federations, legal regulations and basic marketing concepts which assume that a consumer will not be able to benefit from the consumed product if he or she does not consider it as a safe one.

Development of the sports market and the growing requirements for the sports products imply the search for new, unconventional, organizational, analytical and control solutions that will allow to design a fully valuable sports product - a safe football match.

Considering the complex nature of a sporting event (a football match) , it can be stated that the research conducted as part of this scientific work takes into account factors important for the organization of a safety, i.e. a safe football match, and the need to optimize the said product by determining the variables that shape the reduction and increase of the level of safety seem justified.

The main goal of this study was to optimize a football match as a valuable sports product with the use of mathematical modeling, in order to obtain a tool supporting its organization and helpful in identifying opinions on the level of safety, perceived by two extremely different groups of consumers - experts and fans.

The work was based on three main stages. The first one referred to the selection of the variables most strongly influencing the organization of a safe football match. The second stage concentrated on selecting the most effective optimization tool, that allowed proper analysis of the input data. The third stage, on the other hand, helped to identify the model with the highest fit indices. Selected model was used to determine the prediction of the organization of a valuable football match.

The aim of the research implied the formulation of the following research questions:

1. Which predictors of the organization of a football match significantly determine the safety of fans and the attractiveness of mass events in the opinion of organizers and experts?
2. Which predictors of football match organization significantly determine the safety of fans and the attractiveness of mass events in the opinion of fans?
3. Which predictors create the optimal regression model based on boosted decision trees, determining safety and attractiveness of a football match in the opinion of experts and fans (together)?

The operationalization of research issues allowed to formulate research hypotheses:

Hypothesis 1. The model predictors determining the safety of fans present in the sports arena during the organization of mass events, in the opinion of the organizers and experts, are: stadium infrastructure, application of applicable law, appropriate qualification of the competition as "increased risk", as well as the use of modern spectator identification systems which, in the opinion of the organizers and experts, allow the organization of a safe spectacle, i.e. a football match.

Hypothesis 2. The predictors of the model determining the safety of fans present in the sports arena during the organization of mass events are, in the opinion of fans, as follows: attendance; appropriate qualification of the competition as "increased risk", stadium infrastructure, functioning of an audio-video monitoring system, increasing and enforcing penalties for people breaking the law at a football match, professional service, as well as conducting educational activities among fans, which, in the opinion of the fans, that they feel safe participating in a football match.

Hypothesis 3. The predictors creating an optimal regression model based on the boosted decision trees, determining the safety and thus attractiveness of a football match are: cooperation of services responsible for the safety of football competitions (police, stewards, safety managers, etc.); use of the spectator identification system, stadium infrastructure, the presence of appropriate services.

With the aim of verifying the research hypotheses, a study was carried out on a representative group of experts and fans. The study used, with the consent of the author, a questionnaire developed by dr Szczepan Stempiński used in the scientific work „*Czynniki*

warunkujące bezpieczeństwo widowiska sportowego o podwyższonym poziomie ryzyka na przykładzie piłki nożnej” published in 2016.

The selection of the research sample was made on the basis of the mixed method. In case of fans, at the outset, a sample was chosen using random selection from Ekstraklasa football clubs, whose fans were to be tested using a questionnaire. The draw included all sixteen teams participating in the Ekstraklasa games in the 2018/19 season. The simple drawing tool available via the Google Assistant application, allowed the selection of 8 Ekstraklasa teams.

Fans of such teams as: Piast Gliwice, Jagiellonia Białystok, Cracovia, Wisła Kraków, Pogoń Szczecin, Śląsk Wrocław, Korona Kielce and Arka Gdynia were randomly selected for the study.

In order to narrow down the group of surveyed fans, a purposeful selection was made with the use of filtering questions, which allowed qualification of active fans aged 18 and over for the study. In addition, these people had to identify with the club colors for at least 5 years and participate in at least 5 away matches of their team. Survey forms in the group of fans were returned by a total of 251 people.

The study on a group of security experts was carried out during the 19th National Conference "Bezpieczny Stadion" organized by the Polish Football Association (PZPN). The conference was attended by about 400 representatives of football clubs and public entities responsible for the safety of mass events, who were qualified as experts characterized by high credibility of the opinions expressed, so it was decided not to narrow this research sample. In the group of experts, 108 people returned the questionnaire.

The most useful methods and tools of statistical analysis were used and verified to optimize the conclusions of the analyzes carried out. Regression models of boosted random decision trees and ANOVA analysis of variance were used. The homogeneity of the variance of the variables was tested using Levene's test. The distributions of normality were checked with the Shapiro-Wilk test.

Descriptive statistics methods with the use of count tables were used in the work, which allowed for the proper characterization of the research material, taking into account the difference in the size of the respondent groups. When making intergroup comparisons, a comparison of the percentage values from the total was selected in terms of the size of individual groups.

In order to obtain lack of differences between the values of individual studied intergroup variables and describing intergroup relationships, the Chi square analysis was used.

The reason for using the mentioned regression models based on the boosted random decision trees in this study was their structure. The introduction of randomness to the performed analyzes was aimed at securing against overfitting, so that the returned models were distinguished by an appropriate degree of generalization and good predictive accuracy.

This algorithm made it possible to fit the predicted values well with the observed values. The use of decision trees with the C&RT partitioning method exhausting the search for one-dimensional splits, made it possible to quantify the importance of variables. To evaluate the fit of each model a matching quality factor was used: coefficient of determination, - R^2 , assuming that the closer the R^2 value was to 1, the less the estimated values of the dependent variable differed from the empirical values.

Data sets used in the analysis were divided into two subsets according to the positive and negative impact of the indicator (indicators in terms of survey questions). As a result, six models were created - a model for each group of respondents (fans and experts) and one common model broken down into factors increasing and reducing safety during football match.

The results of the conducted research allowed to state that, in the opinion of experts, the most important indicators influencing the increase in safety were:

The results of the conducted research allowed to conclude that, in the opinion of experts, the most important indicators influencing the increase in security were: equipping the stadiums with a fence separating the spectators, if it is plexiglass or special glass and preventing the sectors from "overcrowding", applying the current legal regulations, eliminate most of the threats, and also force changes in the organization and infrastructure of sports clubs, qualifying the competition as "increased risk", because it signals that the organizer analyzes the threats and prepares for them properly, the use of a tunnel separating viewers from players, coaches, referees, because it isolates spectators from other participants of the competition, and also prevents incidents if the fans near the entrance to the field are overly aggressive, the use of a spectator identification system (ticket-place-person) because it allows to eliminate the anonymity of participants

In addition to the indicators increasing safety, the group of experts also indicated determinants that significantly reduce the safety of the organized football match, among which the following should be mentioned: the use of fences, wires on a sports facility, because they impede efficient evacuation, organizing matches, shows, lotteries, etc., if they are attended by drunk or drug-induced people, when their course "slips out of the script" or when their course provokes the opposing team's fans; the presence of the police, law enforcement and information services in the stadium area during the match, if the police or the organizer are not properly

prepared to act; the use of fences, wires in a sports facility because they impede efficient intervention and make the viewer feel like an "animal"; the use of spontaneous statements in the work of the announcer that increase negative behavior.

In the opinion of fans who assessed the impact of identical determinants on increasing safety as the surveyed experts, indicators significantly increasing safety during an organized football match include: high attendance because it creates a good atmosphere at the stadium to which fans are subjected; numbered seats, monitoring, division into smaller sectors; qualifying the competition as "higher risk" because it eliminates hooligans from stadiums, for example by enforcing stadium and club bans; easy entry and exit, seating and possible evacuation of fans, the use of a tunnel separating spectators from players, coaches, referees, because it isolates fans from other participants of the competition, and prevents incidents if fans near the entrance to the pitch are excessively aggressive; functioning of the audio-video monitoring system, because it allows the use of records for educational purposes; equipping the stadiums with a fence dividing the spectators, in the case of the presence of antagonized groups of fans; increasing penalties for breaking the law at a football match, if it is consistently implemented by everyone entitled to do so; the use of precise messages by the announcer in an emergency, as well as conducting educational activities by clubs for fans.

The fans, assessing the determinants having a negative impact on ensuring safety, pointed to a strong relationship between the reduction of safety and: the lack or insufficient number of law enforcement services; the functioning of the audio-video monitoring system at the stadium when there is no systematic analysis of the recording of this system, as well as when it is badly constructed and, what's more, hooligans know about it; the actions of the organizers if there is a lack of discipline and consistency in the operation of his services.

By comparing the opinions expressed by the surveyed experts and fans, it was possible to develop a common model evaluating the significance of determinants that reduce and increase safety, that presents areas in which the opinions of both surveyed groups indicated coherence of views.

Joint assessment of the determinants significantly influencing the increase in security emphasizes the importance of indicators such as: cooperation of services responsible for the security of football competitions (police, stewards' safety managers, etc.), because it allows for a precise division of tasks; use of the spectator identification system (ticket-place-person) because it gives access (to the organizer and the police) to the data of people buying the ticket equipping the stadiums with a fence dividing the spectators, in the case of the presence of

antagonized groups of fans; presence of the police, law enforcement and information services in the stadium during the match, if negative intentions are known.

Among the indicators reducing safety, the joint opinion of the surveyed groups allowed to distinguish such factors as: performing the duties of announcer by people without qualifications and experience, the conduct of the organizers if there is no discipline and consistency in the activities of the organizer's services; training people responsible for the safety of professions when there is no exchange of views, information and experiences.

The obtained results indicate the complexity of the process of organizing a safe football match and the multitude of areas which significantly determine the quality of this product. Both fans and experts, expressing their opinions, referred to the indicators strongly related to the stadium infrastructure, the preparation of the organizers, consistency in the actions taken or the appropriate legal qualification and educational activities.