

# Hierarchical multi-criteria analysis for the selection of a triathlon

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## ABSTRACT

Sports activities have an increasingly large impact in different fields: economy, tourism, environment, applied technology, social, culture, etc. This study analyses the most important criteria that triathletes take into account when choosing a triathlon event in Spain. The methodology used was *Analytic Hierarchy Process* (AHP), which quantifies the weighting of each criterion and sub-criterion in a survey. The survey was drawn up using 14 triathlete experts and was completed by 95 triathlon participants. The results show that the internal aspects associated with the development of the triathlon event, together with the proximity to the athlete's home, the layout and signage of the circuits and value for money, are the most important factors when choosing a triathlon event. **Key words:** SATISFACTION, CRITERIA, TRIATHLON, ANALYTIC HIERARCHY PROCESS (AHP), MULTI-CRITERIA ANALYSIS, R.

### Cite this article as:

Guaita, J.M., & Carracedo, P. (2018). Hierarchical multi-criteria analysis for the selection of a triathlon. *Journal of Human Sport and Exercise*, 13(2), 354-362. doi:<https://doi.org/10.14198/jhse.2018.132.20>



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Submitted for publication May 2018

Accepted for publication June 2018

Published June 2018

JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202

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doi:10.14198/jhse.2018.132.20

## INTRODUCTION

The increase of federation members participating in sports events in Spain, specifically in triathlon events in recent years, together with the number of clubs that has emerged from this increase in popularity of the triathlon, has awakened interest in finding out the criteria that motivate participants in these sports events to choose one or another of them throughout the season (García and Llopis, 2017; Tejero, 2015; Martín et al., 2015).

Between 2012 and 2016, there was a total increase in membership of federations in all types of sports, as shown in Table 1. Specifically in triathlon, this rose from 21,079 to 27,760 members. In terms of relative values, triathletes represent the majority of federated athletes, with their numbers rising from 0.6 to 0.8 of the total.

Table 1. Federated licenses (Source: MECD, CSD. Estadística de Deporte Federado).

	ABSOLUTE VALUES					PERCENTAGE VALUES				
	2012	2013	2014	2015	2016	2012	2013	2014	2015	2016
TOTAL	3,498,848	3,394,635	3,390,459	3,504,306	3,586,133	100	100	100	100	100
Triathlon	21,079	24,241	19,884	29,739	27,76	0.6	0.7	0.6	0.8	0.8

In addition, the data regarding federation membership by sex in the triathlon shows an increase from 16.9% (2015) to 17.7% (2016) for women. In 2016, the regions with the highest number of federation triathletes are the Community of Madrid (4,331), Andalucía (3,780) and the Comunitat Valenciana (3,723); at the back of the queue are Cantabria (485), Asturias (460) and La Rioja (159) (MECD, 2107).

In the field of international championships, the number of medals achieved by Spanish athletes in 2015 and 2016 in the triathlon stands out, with 29 and 20 medals respectively. During the University Championships in 2016, 129 participants took part in the triathlon event and participation was lower for women (37.2%) than men (62.8%).

The triathlon has been studied from the analysis of performance factors (Cejuela et al., 2007; Cabrero et al., 1996), the determinants of success (Ruiz, 2006), the social characteristics that surround the long-distance triathlon (García, 2016), segmentation through clusters (serious pursuits, sports lovers and socialisers) applied to triathlon participants as consumers (Wicker et al., 2012), as well as partial analysis of the different events (running, swimming and cycling) that make up the triathlon (Anta, 2005a; Anta, 2005b; Anta, 2006; Mon et al., 2006).

Over the last few years the number of triathlon events has been dynamically increasing, and it is known that the quality of sports events and participant satisfaction are closely related (Luczak, 2016). In Spain, there are more than 1,000 federated triathlon clubs with an average of 26.7 members per club (MECD, 2017). These clubs are having an economically and socially invigorating effect.

This increase in participants has led to the development of a new economic sector focused on sports events, sports equipment, related professions such as nutritionists, sports medicine, sports psychologists (Rodríguez et al, 2017), sports tourism (Naranjo, 2015) and sports marketing (Pereira et al., 2018), etc. The social demand for sports has been met by a business offer in all areas, with increasing levels of competition, and this encourages consumer analysis when choosing one or another sports event, a trend that requires

specialization in sports management (Pereira, 2016). Triathletes present a greater frequency of sports practice per week than runners, with a greater dependence on physical exercise (Latorre et al., 2016).

The structure of this study is as follows. Section 2 shows the most relevant aspects in the choice of a triathlon event. Section 3 defines the applied AHP methodology and the software used (R). Section 4 presents the results. Finally, Section 5 presents the main conclusions of the study, points out the limitations and offers suggestions for future research.

## METHOD

### Analytic Hierarchy Process (AHP)

The data was obtained from surveys constructed around the conduct of 14 triathlete experts (participants and triathlon club coaches) who contributed their experience in order to identify the most relevant explanatory variables to include in the design of the questionnaire.

Table 2. Criteria and sub-criteria analysed using the AHP method for triathlons.

CRITERIA	SUB-CRITERIA
<b>CR1 Aspects prior to the sports event</b>	CR1.1 Ease of registration through the web
	CR1.2 Clarity in information about the circuits, logistics of the event, supervision of material, services and regulations available on the web
	1
	CR1.4 Closeness to the triathlete's habitual residence
	CR1.5 Accessibility from the city: public transport and infrastructure
<b>CR2 External aspects associated with the development of the event</b>	CR2.1 Quality of logistics services
	CR2.2 Event environment
	CR2.3 Attention from the organization's personnel when handing out numbers, in the T1, in the T2.1 (bicycle collection), in the T2.2 (bag tents), and in the finishing zone
	CR2.4 Clarity of the information offered at the technical meeting
	CR2.5 Post-triathlon quality (massages, attention to the triathlete, medical service, time messages, classification, etc.)
<b>CR3 Internal aspects associated with the development of the event</b>	CR3.1 Quality and location of refreshments
	CR3.2 Professionalism, reliability and friendliness of the judges on the circuit
	CR3.3 Layout and signage of circuits
	CR3.4 Control of drafting
	CR3.5 Organization of swimming leg

<b>CR4 General aspects of the event</b>	CR4.1 Prestige of the event
	CR4.2 Value for money
	CR4.3 Event environment in the city
	CR4.4 Services for companions
	CR4.5 City's tourism and hotel offer

The questionnaire used is defined by four general criteria: aspects prior to the event, external and internal aspects associated with the development of the event and general aspects of the event. Within each criterion, 5 sub-criteria were incorporated, giving a result of 20 variables that are taken into account when performing the analysis, as shown in Table 2.

The sample studied was made up of 95 participants from different triathlon events, of which 80% were men (76) and 20% were women (19). 90% of the respondents were federation members belonging to triathlon clubs.

For triathletes it is essential to have a tool that allows them to efficiently select a triathlon event. The chosen tool was the method called Analytic Hierarchical Process (AHP), originally developed by Saaty (1978) which enables the analysis of complex problems, facilitating decision making under mathematical multi-criteria. It is a system that adds our experiences captured through science (Jiménez, 2002) and that consists of hierarchical ordering in levels weighted by importance (Saaty, 2004).

This methodology has been used in different sectors of the economy, from rural tourism (Ramiro et al., 2016) and infrastructure projects (Álvarez et al., 2006) to measuring the quality of life in cities (Martínez, 2016). But, until now, this technique has not been widely used in the sports field, and never in the field of triathlon. The statistical analysis was carried out using the R Core Team free software (2015), specifically the MCDA library (Meyer and Bigare, 2015). This library provides an AHP function that applies the multi-criteria decision analysis method.

## RESULTS

The AHP process comprises three steps: First, after comparing the criteria, experts with a consistency ratio over 5% in the 4x4 pair matrixes and 10% in 5x5 matrixes were discarded (Saaty, 2004). Secondly, the assessments of the experts were aggregated through the geometric mean. Finally, the relative weights for each assessment were obtained.

Table 3 suggests the following assessments:

Table 3. AHP results.

CRITERIA	CRITERIA WEIGHT	SUB-CRITERIA	SUB-CRITERIA %	RELATIVE %
<b>CR1</b>	11.04%	CR1.1	2.92%	0.32%
		CR1.2	24,11%	2.66%
		CR1.3	6.53%	0.72%
		<b>CR1.4</b>	<b>54.89%</b>	6.06%
		CR1.5	11.56%	1.28%

<b>CR2</b>	4.10%	CR2.1	3.47%	0.14%
		CR2.2	7.35 %	0.30%
		CR2.3	21.13%	0.87%
		CR2.4	10.41%	0.43%
		<b>CR2.5</b>	<b>57.65%</b>	2.36%
<b>CR3</b>	<b>64.82%</b>	CR3.1	32.36%	20.97%
		CR3.2	4.24%	2.75%
		<b>CR3.3</b>	<b>48.39%</b>	31.37%
		CR3.4	9.06%	5.87%
		CR3.5	5.95%	3.86%
<b>CR4</b>	20.04%	CR4.1	4.02%	0.81%
		<b>CR4.2</b>	<b>57.93%</b>	11.61%
		CR4.3	18.44%	3.70%
		CR4.4	6.26%	1.25%
		CR4.5	13.35%	2.67%

*Note. See Table 2 for description of criteria.*

The most important criteria for triathletes are all those variables related to the internal aspects of the event (64.82%), followed by those related to general aspects of the event (20.04%).

Furthermore, within the pre-event aspects, the most important were sub-criterion Closeness to the triathlete's habitual residence (54.89%), followed by Clarity in information about the circuits, logistics of the event, supervision of material, services and regulations available on the web (24.11%).

Regarding criterion CR2, Post-triathlon quality is the most valued dimension (57.65%) followed by Attention from the organization's personnel (21.13%).

Regarding criterion CR3, sub-criteria Layout and signage of circuits (48.39%) and Quality and location of refreshments (32.36%) were the most highly valued.

Finally, in criterion CR4, Value for money (57.93%) stands well above the second sub-criterion, Event environment in the city (18.44%).

## DISCUSSION

The main objective of this study is to establish the criteria that are most important to triathletes when choosing a triathlon event in Spain using the Analytic Hierarchy Process (AHP) (Saaty, 1980). AHP is a process which was presented at the end of the seventies and whose method focuses on the design of decision making based on the opinion of experts in each area analysed. Since the eighties, AHP has been applied in most areas of knowledge: science, education, transport, engineering, social impact, environment, management, benchmarking, geography, etc. (Télez et al., 2017; Medina and García, 2016; Ramiro et al., 2016; Vaidya and Kumar, 2006; Wind and Saaty, 2004). In AHP, the weight of each different criterion or sub-criterion is quantified in terms of its contribution to the satisfaction of the participants in this activity.

Therefore, it is essential to perform analyses that provide users with sufficient criteria to assess the different events. There are more and more characteristics that surround a sporting event: from the city where it is celebrated to the post-event service, such as the attention the participant receives once the goal is reached.

Studies have been carried out which analyse specific triathlon events from the point of view of the participant in order to assess the quality perceived by the spectator (Sánchez et al., 2016; Galdós, 2016) and the sporting context surrounding triathletes (Leruite et al., 2016).

In this regard, it has been demonstrated that the client's perception of value is a precursor to their loyalty, a concept that supports some benefits and sacrifices for the client. There is a direct and causal relationship between perceived quality, perceived value, satisfaction and loyalty (García, 2014; Baena et al., 2016).

## CONCLUSIONS

The main conclusions that can be established are the following:

- The general criterion most highly valued by the triathletes is the criterion that includes all aspects internal to the event (refreshments, judges, circuits, control of drafting and the swimming leg).
- The sub-criterion that was most valued in the aspects prior to the event was that of Proximity to the habitual residence of the triathlete.
- The most important sub-criterion in the external aspects associated with the development of the event was that of Post-triathlon quality (massages, attention to the triathlete, medical service, etc.).
- The sub-criterion most highly valued in the internal aspects associated with the development of the event was that of Layout and signage of circuits.
- The most highly rated sub-criterion in the general aspects of the event was Value for money.
- Finally, the mostly highly rated criterion among all those assessed was that of Layout and signage of circuits, with 31.37%, and in second place came Quality and location of refreshments with 20.97%.

The added value of this research lies both in the application of AHP methodology to decision-making in sport, and the use made of the statistical software R, with this being an innovative study to date.

Triathlons are complex events to organize and prepare (Wu et al., 2014; Valenzuela and Mármol, 2016; Guillén et al., 2015), therefore the companies and clubs that organize them must focus on these points for improvement in order to have as many participants as possible. This study is an analytical tool that highlights the mostly highly valued variables from the point of view of participants, enabling the organization to better focus their efforts on points for improvement. A future extension of this work would be to compare the results between the female and male categories.

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