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Abstract of the doctoral thesis:

**IMPLICATIONS OF THE INTERNAL FACTORS OF PERFORMANCE
CAPACITY IN EXCEEDING THE BIOLOGICAL LIMITS UNDER
EXTREME COMPETITIVE CONDITIONS**

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Introduction

Red Bull X-Alps, a new competition with a particular status, catalogued as one of the toughest extreme races taking place at a global level, brings together several sports disciplines with a totally different competitive nature, namely: running, mountain race, climbing and paragliding.

Talking about a relatively new but constantly evolving extreme sport (such competitions gradually start multiplying), we should mention that the field experience, as regards the dosage and approach to this kind of effort, is almost inexistent.

Part of these disciplines, even they are autonomous, such as mountain race, climbing or paragliding, are still *insufficiently investigated*.

In our opinion, the research theme is topical and is even more interesting given that specialty literature provides very scarce sources containing information on the practice of this sport (by ordinary people or performance athletes).

Motivation for choosing the theme

The exceptional results achieved by the Romanian athlete Toma Coconeau in the *Red Bull X-Alps* world competition, concretized in his ranking on the second place at two editions of the race (2007 and 2011) and his experience gained by participating in all editions organized so far, were solid reasons for choosing him as a subject of this thesis.

We consider it appropriate and salutary to investigate an athlete with such qualities in our research.

Understanding the mechanisms and resources he can mobilize when performing the specific effort may lead to establishing some coordinates which, if generalized, can be used for preparation in various sports branches with similar effort zones and demands.

Also, the data already available to us represent a useful starting point, the direct collaboration with the athlete completing the substantiation of this work.

The thesis is structured in three parts as follows: theoretical background, preliminary research to establish the preparation content in the precompetitive stage relying on the analysis of previous competitive performances and functional explorations, and the research itself to establish the way of approaching the goal-oriented *Red Bull X-Alps 2013* competition.

Part I, Theoretical background of the thesis, includes 7 chapters:

Chapter 1: *Extreme sports, general issues*; **Chapter 2:** *Specific particularities of the RED BULL X-ALPS competition*; **Chapter 3:** *Forms of travel involved in practicing mountain race and paragliding sports*; **Chapter 4:** *Paragliding*; **Chapter 5:** *Psychosocial issues specific to extreme sports*; **Chapter 6:** *Diagnosis of sports performance*; **Chapter 7: Conclusions drawn from the first part:** Extreme sports are recent activities attracting more and more practitioners from all over the world, regardless of their social status, who, wishing to spend their leisure time as dynamically and extravagantly as possible, end up by initiating new sports branches.

Practicing extreme sports is a direct result of changes in people's lifestyle. In this context, we can state that the emergence and development of extreme sports are based on the following major elements:

- the increased living standard worldwide, due to advanced technology and automation, has led to expansion of free time, the need for new activities to occupy this time coming as its natural consequence;
- young generations express their age-specific nonconformity by cultural events, music, art, leisure activities and sports practiced under various forms, meant to increase their adrenalin level and need for everything is spectacular;
- sportswear manufacturers bring to market increasingly sophisticated equipment, as a result of using the highest production technologies;
- promoting on a large scale this type of sports activity through the media responds to an increasingly higher need "for adventure" of the population of all ages;
- the investors' interests in promoting these sports branches are commonly materialized in the financial profitability.

The rapid evolution of extreme sports has led to inclusion in the Winter Olympics of sports branches such as snowboard, freestyle skiing, cross-country skiing and short-track skating, as well as triathlon, BMX cycling and mountain biking, in the Summer Olympics.

Part II, Preliminary research to establish the preparation content in the precompetitive stage relying on the analysis of previous competitive performances and functional explorations, comprises 7 chapters:

Chapter 8: *Operational methodological framework of the preliminary research*;
Chapter 9: *Analysis of sports performances at the 2011 edition of RED BULL*

*X-ALPS - a premise for identifying a preparation and competition model; **Chapter 10:** A virtual design model for the racing route - implications in the preparation process; **Chapter 11:** Developing the preparation framework-system for participation in the RED BULL X-ALPS 2013 competition; **Chapter 12:** Ascertaining study on the assessment of biomechanical and functional parameters in order to establish the training values; **Chapter 13:** Training planning; **Chapter 14:** Preliminary research conclusions.*

The main purpose of the preliminary research was to collect information on the nature and dosage of the effort, the mechanisms enhancing such major efforts, the metabolic costs and mechanisms affecting the athlete during the race, which we aimed to value in organizing and conducting training in the next periods and stages of preparation, for optimizing the athlete's performance-related behavior.

Research type and objectives

1. Analyzing competitive effort in the X-ALPS race, correlated to the provisions of Regulations, environmental conditions, route planning etc.
2. Delimiting the main factors of performance capacity, which contribute to achieving remarkable results in competitions, in general, and highlighting them for the investigated athlete.
3. Emphasizing the factors that cause wrong decision-making, because of considerable physical and mental fatigue.
4. Analyzing the preparation plans, in correlation with the adaptive changes undergone by the athlete, for extracting those methods and means which can be successfully used to develop performance capacity in other sports branches based on excellent aerobic capacity.

Preliminary research tasks

1. Documentation and scientific foundation of the topic addressed, correlated to the general theoretical framework underpinning knowledge, understanding and approach to the proposed phenomenon.
2. Establishing the organizational stages of the preliminary research.
3. Establishing and performing the most appropriate measurements, trials and tests, in order to highlight the hypotheses of the proposed experiment.
4. Analyzing the preparation programmes designed for the investigated athlete, in a competitive year and a year without goal-oriented competitions.
5. Selecting the most efficient methods and means of preparation, in order to develop aerobic exercise capacity and formulate methodical indications regarding their implementation in other sports branches, where performance achievement is conditioned by the same factors.
6. Processing and interpreting the data collected from investigations during training and correlating them with the achieved performance.
7. Formulating conclusions and proposals.

Preliminary research hypotheses

- ➔ *Using simulated (virtual) training in a precompetitive year may facilitate higher valorization of the existing psychophysical potential.*
- ➔ *Monitoring the functional effects occurred in the body of the athlete subject to maximal and supramaximal demands will ensure more efficient preparation, due to the optimum ratio between energy resources and result.*

Preliminary research conclusions

Biomechanical motion analysis performed at “Dr. Alexandru Partheniu” Interdisciplinary Research Center within the National University of Physical Education and Sports, Bucharest, allowed us to detect in our athlete some biomechanical deficits that largely influence his competitive performances.

After interpreting the collected data, we could present *viable solutions to remedy or at least improve the existing deficits.*

The assessment of performance capacity provided us the information needed for planning and conducting the preparation content over the period left to the start.

After establishing the training parameters, we could contribute to increasing the athlete’s performance capacity, as confirmed by the data collected in the preparation periods.

Testing performed at the end of the preparatory period showed that the aerobic threshold was reached at a travel speed of 10 km/h, compared to 8.2 km/h in previous testing, the recorded heart rate having values of 144 beats per minute, compared to 126 beats per minute.

It is also worth noting that heart rate recorded a decreased resting value, from 55 beats per minute to 51 beats per minute. These decreased heart rate values for the same efforts as in the previous preparatory period, concomitantly with increased travel speed, are positive aspects, which have proved that the training planning on real bases was correctly done.

Thus, hypothesis number 2 of the preliminary research is confirmed.

Preparation carried out in the Alps, on the racing route, was beneficial and respected the initial purpose, namely simulating the competition under conditions very close to the real race.

It was also possible to improve and adapt the racing strategy to the concrete field-collected data.

Preliminary research conducted prior to the goal-oriented competition provided us the opportunity to collect actual and reliable data for a successful approach to the competition.

This approach equally made the athlete feel more secure, because he received concrete information about the provided effort and correct dosage of his available resources, and he also had the opportunity to cover, in the precompetitive stage, over 80% of the official route, *confirming thus hypothesis number 1 of the preliminary research.*

Part III, Experimental research to establish the way of approaching the goal-oriented RED BULL X-APLS 2013 competition, is structured in 5 chapters:

Chapter 15: *Methodological framework of the experimental research;* **Chapter 16:** *Research results - analysis of the goal-oriented competition - edition 2013;* **Chapter 17:** *Experimental research conclusions;* **Chapter 18:** *Conclusions;* **Chapter 19:** *Elements of originality, practical valorization of the research and result dissemination.*

The primary purpose of the experimental research was to objectively assess the effects of training in the preparatory period and accurately establish the athlete's available resources at the starting moment.

We also aimed, by completing the three main research directions, namely virtual simulation of the competition route, physical preparation of the athlete and presentation of a minutely documented racing strategy, to make available to the athlete a viable alternative for approaching the competition.

Research objectives

1. Emphasizing the internal factors of performance capacity in the investigated athlete through relevant research methods appropriate to the type of provided effort, which can be used easily and with affordable costs.
2. Analyzing and limiting the variables that intervene when performing such a sports activity.
3. Observing the psychosomatic manifestations that occur as a result of providing extreme physical efforts over several consecutive days of competition.
4. Valorizing the athlete's experience and adaptive changes subsequent to covering the planned preparation stages, in order to generalize and use them in the preparation process of other disciplines with a similar competitive character.

Research tasks

1. Valorizing the field information collected during the preparatory period, mainly the data about the racing route, and using them to design the race itinerary.
2. Establishing the stages to be covered in the racing days, localizing the camping alternatives for the mandatory rest periods set in the Regulations.
3. Performing functional analyses in the week before the competition and establishing the physiological parameters to be approached during the race.
4. Establishing the effort medication, depending on the level of demands during the race.
5. Collecting, processing and interpreting the data collected during the goal-oriented competition.
6. Formulating the final research conclusions.

Research hypotheses

- ➔ *Establishing the racing values by a previous diagnosis of the athlete's exercise capacity leads to higher efficiency throughout the competition.*
- ➔ *An increased level of exercise capacity ensures the travel efficiency, due to optimal decision-making in applying the flight strategy.*
- ➔ *Virtual route designing ensures the racing economy, by diversifying the orientation possibilities and enabling the choice of the best tactical variants.*
- ➔ *The planned administration of nutrition supplements during the competition ensures successful completion of the race, in terms of performance and health condition of the athlete.*

Devices used in the experimental research: Panasonic Diagnostec EW3006 Wrist Blood Pressure Monitor; Polar 710i Pulse Tester; Accu-Chek Active Blood Glucose Meter; Roche Diagnostics, Accu-Chek Glucose Test Strips; Roche Diagnostics, AccuTrend Plus System Lactate Analyzer; Roche Diagnostics, AccuTrend BM Lactate; Roche Diagnostics, Dr. Lange LP120 Photometer; LKM 140 Lactate Cuvette Test. Testing was performed on the Kettler Track Performance Treadmill.

Experimental research conclusions

In our experiment, we started from the premise that a successful approach to goal-oriented competitions involves, in addition to appropriate physical preparation that ensures the athlete an increased performance level, several factors which, in our opinion, enable to better reveal the athlete's qualities.

These factors are primarily related to the effort dosage in competition, based on values established by testing the athlete's exercise capacity (performance diagnosis).

After analyzing the racing data and especially after comparing them with the previous competitive results, we can synthesize the following conclusions:

- Respecting the racing values set after performing the physiological tests, the athlete was able to considerably increase his travel efficiency, as proved by the much longer distance covered at the goal-oriented competition within a significantly shorter time. Thus, the athlete was able to cover 2456 km in 11 days and 11 minutes, with 749 km more than at the previous edition and in a shorter time by 1 day, 14 hours and 48 minutes.

This confirms hypothesis number 1 of the research, according to which establishing the racing values by a previous diagnosis of the athlete's exercise capacity and complying with these parameters lead to increased efficiency throughout the competition.

Due to a good general condition, physically and mentally, during the race, the athlete was able to significantly better apply the flight strategy, the final results showing that he managed to cover by flight 68.3% of the total distance traveled, compared to previous editions: 46% in 2011 and only 24% in 2007.

These results *confirm hypothesis number 2 of the research*, according to which an increased level of exercise capacity ensures the travel efficiency, due to optimal decision-making in applying the flight strategy.

- Prior knowledge of the route and the field orientation landmarks allowed visualization of the virtual itinerary, which led to substantial increase in the traveled distances during a competition day, respectively 213.5 km/day in 2013, compared to 138 km/day in 2011: it resulted thus a positive difference of 75.5 km/day, following the elimination of the time lost for orientation and the increased travel efficiency, due to non-fragmented effort (interval-type effort).

These results *confirm hypothesis number 3 of the research*, according to which virtual route designing ensures the racing economy, by diversifying the orientation possibilities and enabling the choice of the best tactical variants.

- Since the athlete finished the competition with a worthy result, running 111 km in the last stage, at a speed of 8 km/h over 14 hours, we can state that his energy resources were well dosed, the difference between consumption and recovery being correspondingly supported by proper diet, combined with the regular administration of nutrition supplements throughout the competition. The athlete completed the race losing 3.5 kg of his body weight of 71 kg at the start, which is a positive aspect, given that in 2011 he lost 6 kg, and in 2007, 12 kg, during the competition.

It is thus confirmed the last hypothesis of the research, according to which the planned administration of nutrition supplements during the competition ensures successful completion of the race, in terms of performance and health condition of the athlete.

Conclusions

After completing the study, we can draw the following conclusions:

- Preparation of athletes at all levels must be systematic and organized, given the real opportunities to improve the performance level of practitioners, whether they are performance or amateur athletes.
- Monitoring the physiological values and updating the training values at regular intervals are procedures that ensure better dosage of the travel effort.
- A successful competition directly depends on the practitioner's physical preparation level; the higher the athlete's performance capacity level, the lesser the effort to cover distances on the ground, the athlete having increased decision-making ability in applying the flight strategy, the flight technique improvement being an important objective of the preparation.
- Prior knowledge of the route substantially increases both the travel efficiency and the athlete's safety; we refer here to the climate change that may occur within short time intervals, bringing with it low visibility up to

a few tens of meters, and especially to the orientation difficulty on the mountain routes in the absence of appropriate signs.

- Given that these activities involve a very high caloric consumption, which may reach 7000 to 10 000 calories per day, in the case of competitions, it is mandatory for the athlete to recover at regular intervals the energy deficit created by the prolonged efforts.

Personal contributions

- Analysis of major competitions organized at a global level, structuring and systematizing the collected data in order to be used, as a database, by athletes, coaches and specialists in the field.
- Development of training plans for the preparation periods, precompetitive and competitive periods.
- Systematization of the training methods and means needed for preparing the athletes in this complex sports branch.
- Adaptation of the procedures to assess exercise capacity, in line with the requirements of specific effort.
- Design of the virtual racing route, providing the user the opportunity to virtually cover the route in the period prior to the competition, without being necessary to really cover it. At the same time, the athlete can design an unlimited number of variants in approaching the route, which can be used depending on the concrete circumstances or if the opponent's tactics requires choosing other routes than the previously planned ones.
- Development of a strategy for recovering energy resources of the athletes during the competition, by selecting the most efficient dietary supplements, with the best possible ratio between weight - caloric support - absorption level.