Journal of Sports Science 6 (2018) 118-128
doi: 10.17265/2332-7839/2018.02.007

Control and Management in Athletic Training of the Russian National Teams

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Abstract: The article presents wide experience in controlling athletic training aimed at preparation of the Russian national teams for major international competitions. Experimental part of the study has been carried out in the course of training camps and competitions since 2010. Forty Russian national teams in 15 winter and 3 summer Olympic sports participated in the research. Theoretical concepts set forth in the works of Anthony Stafford Beer made a basis of a system of control and management developed for the Russian national winter sports teams. In particular, a five-level system was applied to control athletic training. The authors point out that a system of control over athletic training in elite sport teams should take into account a few important issues: (1) each sport, team and athlete has distinctive features; (2) various aspects of athletic training and their interrelation must be aimed at raising effectiveness of training according to individual training plans; (3) coaches and sport managers must be provided with real-time information necessary for development of long-term and short-term training plans and their timely correction.

Key words: Control of training, management, elite athletes, training plans.

1. Introduction

Issues of control in athletic training have always attracted attention of Russian sport scientists [1-3]. In spite of wide experience in preparing top athletes for major international competitions, we clearly see insufficient use of scientific achievements in development of innovative methods in sport training and tracking of athletes' condition throughout the training process. Your goal is to simulate the usual appearance of papers in an IEEE conference proceeding.

A system approach to training of elite athletes is inseparable from continuous and complex control over various aspects of athletic preparedness and performance dynamics both in short-term and long-term perspectives.

Effectiveness of control largely depends on availability of objective and complete data collected with the help of standardized testing procedures on a regular basis.

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Standardization of data related to various aspects of the athlete's readiness for competitive performance permits to derive necessary information in the course of long-term training irrespective of a testing laboratory and compare it with test results of main competitors, including foreign athletes.

As any activity, preparation of the national sport team for major competitions must comply with general concepts and regulations of control and management in a complex structure.

In this respect, athletic training can be divided into three stages: (1) planning, (2) implementation of the plan, (3) control [4-6].

The essence of control and management in athletic training consists in creating conditions, under which an athlete can improve the state of his/her body systems in order to reach objectives, which were set for a given training stage. Therefore the system of control in athletic training consists of few separate control blocks: prognosis, planning, organization, control, and analysis. Being integral parts of a complex multi-level structure, these control blocks must be strictly arranged and coordinated.

To demonstrate key principles of interaction within this structure, we have developed its model.

The model consists of four main subjects: Athlete—Coach—sport scientific group—Chief Administrator. The main difficulty is that in the course of training an athlete is subjected to external influence in the form of training loads, but at the same time internal regulation of all functions takes place within his/her organism. External influence and internal regulatory processes must be well coordinated and conform to each other.

In this context, we define two types of objectives within the system of control and management in athletic training: "external objectives" and "internal objectives". Internal objectives are related to adaptation of the athlete's organism to training loads and/or development of a specified physical quality; while external objectives are related to completing training tasks and/or a preplanned sport result.

Review of relevant scientific literature showed that majority of studies were focused on methods and tools applied for gathering and primary processing of data related to athlete's actual condition and its dynamics. At the same time, researchers paid almost no attention to integration of data characterizing athlete's condition with parameters of training loads into a single system for real-time correction of training plans. The primary idea of the study: effective control and management in elite sport involves individual pedagogic control that should be strictly algorithmized and elaborated at each stage—from choosing control parameters to using relevant data for development and amendment of training plans. A training plan should be realized under appropriate legal and organizational conditions using all necessary facilities and equipment.

2. Materials and Methods

Experimental part of the study has been carried out in the course of training camps and competitions since 2010. Forty Russian national teams in 15 winter Olympic sports, more than 300 elite athletes and 36 chief national coaches participated in the research.

Algorithm of the system of control over athletic training in the Russian national teams included: means and methods of scientific support and sequence of their use, routine examinations, complex stage examinations, assessment of competitive performance, control over training and competitive loads. All information was used for development and correction of administrative and training plans and making management decisions at all levels of control and management system.

3. Results and Analysis

3.1 Scientific Support in Training of Elite Athletes

Scientific support is a key aspect in organization of training in all Russian national teams, because it permits to control implementation of training plans and to make necessary adjustments based on the results of complex testing procedures [1, 2, 7].

Complex testing procedures give comprehensive information related to the current condition of all national team members and the closest reserve. The analysis of testing results provides impartial information about functional condition of the athlete's organism, his/her specific physical and psychological preparedness, skills development and tactical mastery that helps coaches take timely measures and make necessary adjustments in training plans [2, 8, 9].

The system of scientific support in athletic training has developed over the years of work. Now we have a unified system of control over all components of training (including training loads) and condition of an athlete, which embraces: general quality of competitive performance, sport results, functional readiness of his/her body systems, estimates of physical, technical, tactical, and psychological preparedness.

Three forms of complex control are applied in Russian national sport teams [10]: (1) Assessment of Competitive Performance. It helps estimate main aspects of athlete's preparedness in competitive environment and makes essential adjustments in his/her training plan. (2) Complex Stage Examination.

It is carried out in the beginning or at the end of major training periods and includes anthropometrical examination and a set of specific tests performed under laboratory and/or field conditions. Testing results permit to assess the current condition of an athlete and cumulative effect of the previous training period, reveal his/her functional reserves, psychological status, determine limiting factors to further improvement of key physical qualities (endurance, strength, velocity, agility, movement coordination) and technique mastery. (3) Routine Examination. Routine is carried out daily during centralized team training sessions and permits to assess dynamics of the athlete's functional state, particular aspects of his/her physical condition and psychological status, techniques development and tactical skills. Daily monitoring of important physiological indices gives objective information related to immediate and cumulative training effects and reveals fatigue caused by excessive training loads.

Results of comprehensive examinations may help sport specialists detect specific features of each athlete and adjust individual training plans taking into account his/her strengths and weaknesses. However, there are objective reasons, which prevent coaches from receiving this important information on a regular basis. As a rule, coaches do not have enough time and skills to carry out a full complex of tests. Complex testing procedures require specific equipment and deep knowledge in testing methods appropriate for a concrete sport discipline. At present coaches mostly use pedagogical tests in order to obtain any information related to the athletes' condition. Pedagogical tests carried out without specific measuring equipment cannot provide sufficient and accurate data about functional state and preparedness of elite athletes. Such tests may serve only for general estimation of physical development, because they do not reveal shifts in separate specific parameters. We may state that till now we had a weak system of prognosis and control in training of elite athletes.

3.2 Planning

To develop and adjust a training plan, a coach must get sufficient information about the athlete's condition and analyze it thoroughly. Basic information for pedagogical planning includes functional characteristics of the athlete's body systems: muscular, cardiovascular, respiratory, immune, endocrine, and nervous systems. Important is that functional condition of an athlete always depends on the effect of training loads and competitions. Having received objective information about the athlete's functional state and knowing exactly the effect of particular training loads, a coach can make proper changes in the training plan.

A human organism is a hierarchical structure, in which every layer comprises several subsystems. In the course of sport training both external and internal factors exert influence on the athlete's organism. Depending on their nature, these factors may be controllable or uncontrollable.

Control and management in athletic training is a multistage process. Athletes get training tasks from their coaches, who are subordinate to the senior coach of the national team. General management in the national team is carried out by the national sport federation and the Ministry for Sports of the Russian Federation. Different layers of this control system are autonomous to a considerable degree, and very often the control is done without sufficient analysis.

To develop a training plan one should apply program-objective methods in planning and control, which call for orientation of all the activity at reaching the main goal. In sport, the main goal is to achieve the best athletic performance within a preset time period. Program-objective planning is based on a logical scheme "objectives—approaches—methods—means". First of all it is necessary to set objectives, then outline approaches to be used for reaching them, and at last select suitable means and methods.

When the principal goal is set, a coach has to develop a proper plan to reach it. A standard individual training plan includes: description of major

shortcomings in preparedness of an athlete, key objectives and tasks for the forthcoming training period, calculation of volume and intensity of training loads, facilities to be used, logistics, medical support, etc., training means and methods, organizational issues, methods of control, estimation of expected efficacy of the training plan (dynamics of key parameters of the athlete's condition).

Any plan should be based on the few principles: scientific character, efficacy of the suggested training program, balance of different training loads, consistency of short-term and long-term objectives.

Taking into account these principles, we may specify key rules of planning in athletic training: (1) Model of competitive performance. When elaborating an individual training plan, a coach must know exactly what qualities determine top results in a given sport discipline. The model must be described in biomechanical, physiological, and psychological terms (no pedagogical description only) and include measurable values (i.e. model characteristics). The main objective is to define determinants of athletic performance in competitions and reveal interconnection between them (i.e. interconnection between the elements of the model). (2) Prognosis for the dynamics of the athlete's condition. A coach must not confine himself to planning of training loads only (i.e. volume and intensity). A training plan should be based on the prognosis for changes in different components of the athlete's preparedness (CP), which will enable him/her to achieve the planned parameters of the model of competitive performance, i.e. those parameters of his/her condition, which determine performance in the main competition(s). (3) Analysis of the previous training period. A training plan for the forthcoming season is drawn up on the base of thorough analysis of changes in the components of the athlete's preparedness related to training loads executed by him/her in the previous training period. Therefore a coach must have a report about training loads executed during the previous training period and results of Complex Stage Examinations and Routine Examinations carried out during that period. Training loads and results of examinations should be presented in the form of charts and tables. (4) Concrete objectives. Concrete objectives related to measurable changes in key components of the athlete's preparedness must be set for every long-term or short-term stage of training. Besides that a coach must specify definite methods of control, which will permit to assess changes in key components of the athlete's preparedness. (5) Selection of the most effective training means and methods. A training plan must comprise only those means and methods and their combinations (within a single training session, a training microcycle or mesocycle), which produce desirable changes in the components of the athlete's preparedness. (6) A training plan must be readable and easy-to-interpret. It should reflect the logic of training aimed at changes in key components of the athlete's preparedness. The plan must include both numerical data and graphic illustrations.

3.3 Control

Control in athletic training is aimed at: (1) assessment of a training task set by a coach (prognosis based on the athlete's condition); (2) assessment of the athlete's condition after execution of the training plan developed by the coach (changes in the major body systems).

To develop a system of control and management in preparation of the Russian national team for the Winter Olympics, we used theoretical concepts set forth in the works of Anthony Stafford Beer [11]. We applied his five-level system for control and management in athletic training: (1) 1st control level—an athlete (who controls his body) and a coach (who controls the athlete); (2) 2nd control level—specialists, who carry out instrumental examination of an athlete and monitor training loads executed by him/her; (3) 3rd control level—experts in particular fields of knowledge; (4) 4th control level—analysts, who summarize and generalize the information; (5) 5th control

level—headquarters, who provide general guidance.

At the 1st level of control an athlete controls his body. This type of control is carried out by an autonomous system consisting of three levels. This system regulates condition of the organism by providing feedback to its different levels in order to smooth over fluctuations, caused by excess demands (training loads).

Each system of the athlete's organism plays its role in reaching the preset objective related to improvement of athletic performance. For example, one part of a subsystem A is crucial for reaching top athletic results, while its other part provides functioning of the subsystem B. Functions of the subsystems A and B are closely connected with the subsystem C, and so on. Let us assume that something goes wrong in the subsystem B. In this situation, a coach may try to change influence on the subsystem B. Most probably, local changes within a complex system will be impossible, because all the subsystems are interconnected. In this case, a training program for the subsystem B should be adjusted in order to exert correct influence on the subsystems A and C. Such adjustment will change the reaction of all three subsystems on the training load. It should be noted, that malfunctions within a complex system (a human organism) might be transferred from one subsystem to another (from subsystem A to subsystem F, from subsystem D to subsystem E, and so on).

Let us examine an example of interrelation and interference between the cardiovascular system (subsystem A), the central nervous system (subsystem B), and the muscular system (subsystem C) in an athlete. The objective for a training session was to improve aerobic capacity in muscles. To achieve a desired effect, an athlete performed specific continuous training exercises, which involved both slow and fast oxidative muscle fibers. To control the intensity of training exercises, the athlete used the heart rate value (HR) related to the anaerobic threshold (AT) (4-6 millimole per liter in the blood), which was calculated earlier under laboratory conditions.

The aerobic training session was preceded by several workouts of different duration, which included high-intensity exercises and caused fatigue in the nervous centers of the brain, which regulated the heart work via vagus and sympathetic nerves. As a result, during aerobic training session relationship between HR and power of the workload became nonlinear and the athlete had to recruit glycolytic muscle fibers in order to maintain the target HR (the HR at the anaerobic threshold). Accumulation of lactate in the blood and muscle fibers turned aerobic training into the anaerobic one that could worsen aerobic qualities.

Let us assume that this training caused excessive tension in the body systems of the athlete. There are several ways to handle the situation and protect the athlete's organism from overtraining and failure in reaching the preset objective. The most effective among them are: (1) Adjustments, which are made before important deviations in the athlete's condition from the intended values occur. These adjustments are based on the results of Complex Stage Examinations and include alteration in volume, intensity and specific features of the training means. (2) Adjustments, which are based on the results of Routine Examinations and are aimed at keeping the parameters of the athlete's condition within the preset limits. (3) Strategic modification of the training plan based on changes in the training objectives resulting from undesirable deviations in the athlete's condition, if compared with the model parameters.

Indices of effectiveness, which determine the rate of improvement in the body systems, can exceed the upper limits of individual model parameters for a given training stage. Individual limits of model parameters are derived from results of Routine and Complex Stage Examinations. The athlete's condition at the level 1 is monitored by specialists of the control level 2 by means of biochemical, physiological, and biomechanical tests during Routine Examinations. First of all, specialists of the level 2 register parameters of short-term adaptation

of the athlete's organism to training loads and pass the data to experts of the control level 3 for thorough analysis. The experts in different fields of knowledge (biochemistry, biomechanics, physiology, etc.) analyze the data and provide coaches with recommendations on correction of the training plan in order to prevent overtraining and/or use of additional means, including pharmacological support. The main task for this autonomous system is to maintain internal stability of all processes in the athlete's organism during training according to the plan.

It may happen that an athlete is not fit enough for completing training loads included in the plan. In this case physiological mechanisms in the athlete's organism will prevent him/her from exceeding the limits of safe functioning of the body systems. Then the next level of control hierarchy (level 4) gets involved into the process of training. The analysts of the level 4 analyze the initial training plan (developed by the coach) and the information provided by the experts of the level 3 and suggests appropriate ways of modification of the initial training plan. They then report the results of their work to the control level 5—Headquarters.

At the level 5, Headquarters analyze all the information received from the lower control level and make their suggestions for further training. For instance, they may recommend to alter the target result for the forthcoming competition. Experts (the level 4) have to analyze the decision made by the Headquarters and its conformity with the athlete's physical condition and degree of risks. They revise the training plan and transfer the adjustments to the lower control levels (levels 3, 2, 1) in the form of numerical indices. The revised training plan will be executed by the athlete under the control of the coach and specialists of the levels 2 and 3. Until the training plan is executable for the athlete and his/her condition remains within physiological limits, the autonomous system will work under continuous control of the specialists. If the coach detects that the athlete cannot perform the suggested training loads, the control cycle will be repeated and new adjustments will be introduced into the training plan.

3.4 Analysis

Decision on changes in the training plan is made by analysts at the 4th level of control on the base of estimation of probable consequences of execution of the revised training plan by the athlete. From time to time information about condition of each athlete is passed to the 5th level (Headquarters).

Functioning of this 5-level control system in training top athletes has inherent contradictions between internal and external motivation. If internal motivation corresponds to functional capacity of an athlete and implementation of a training plan meets external requirements, the training process will be well balanced. In this context, two objectives become evident: (1) keep stability in internal condition; (2) achieve stability in interaction with external conditions.

The main task in training athletes is to coordinate these two objectives. Sometimes a coach has to sacrifice an increase in physical qualities (i.e. to use less effective training methods) in order to keep in a preset time schedule. Sometimes it is necessary to delay reaching peak functional condition in order to keep the athlete's organism in safe physiological limits. If we apply scientific achievements, we will see that the control level 3 is related to achieving desirable response of the athlete's organism on training loads within the limits of individual biological functions. Only qualified specialists in athletic training can assess the athlete's condition and determine the limits of his physical potential by integrating various aspects of his/her preparedness. This work requires application of modeling and prognosis methods.

We applied the 5-level system of control and management for preparation of the Russian National teams for last three Winter and Summer Olympic games.

At the 1st level (coach-athlete) the principle objective was to control functions and condition of biological systems of the athlete's organism after execution of training loads under the direction of the coach.

Specialists of the 2nd control level conducted series of examinations and gathered primary numerical data related to the condition of the athlete's organism and the effect of training loads on it. At this stage, recording of training loads and using standardized testing protocols is of great importance. Specialists of the 2nd control level interconnect the level 1 (coach) and the level 3 (experts).

Experts of the 3rd control level regularly analyzed the data received from the 2nd level and gave their recommendations concerning the internal stability of the athlete's organism. The main task at this stage of control and management was to prevent overtraining. At any time a coach may request additional data from the specialists of the 2nd level and ask the advice of the experts (3rd level).

Besides that, the experts sort the information before passing it to the upper levels (4th and 5th).

The experts of the 3rd level do not analyze information about external conditions (performance of principal competitors, environmental conditions, sport facilities, etc.). This information is gathered and analyzed by the analysts at the 4th level of control. Forecast of athletic performance for the forthcoming season is based on the dynamics of the athlete's results in the previous periods (for instance, his/her rating in the World cup series, where applicable) related to the dynamics of results demonstrated by prize winners at the previous Olympic games and the coefficient of the athlete's potential.

The Analysts of the 4th level report information related to training of top athletes to the higher control level and serve as an internal inspectorate, which constantly control and correct the process of training.

Important is that the Analysts integrate the information they receive from the lower control levels and prepare complex reports, which do not include all the data received from the level 2 and 3, but only the most valuable conclusions.

Analysts of the 4th level have to deal with enormous amounts of different indices. To organize their work, we created an "operations room" [11]—a control operation center equipped with various communication facilities, which permitted to get the most current information from coaches and specialists present at the competitions.

All meetings of the Headquarters (5th control level) were held in this control operation center in the form of Expert council and Methodological commission. The "operation room" has facilities for organizing video conferences with Coaches' staffs in the course of major competitions, as well as closed communication systems intended for personal data exchange (including medical data for each athlete).

The control levels 1-3 form a self-sufficient complex system, which can monitor and manage "homeostasis" of training process in sport. This system works correctly under normal conditions, but any irregular situation may lead to the loss of control. At this point, the analysts of the 4th level have to examine and assess all circumstances, reveal the origin of the problem and find optimal ways to solve it.

The Headquarters (the highest control level) receive information from the Analysts after processing, integration and generalization.

The Analysts process a lot of information related to the athlete's condition using specific filters to select the most significant parameters. They never simply generalize the data in order to pass it to the Headquarter in the simplest form. This system of control and management in athletic training has been developed as diagnostic and prognostic tool.

Management and control in athletic training must include assessment of both short-term and long-term adaptation of the athlete's organism to training loads. At present the main criterion of training efficacy is a result demonstrated by an athlete in a competition or

his/her rating within the system developed in his/her sport discipline (the rating is based on the athlete's performance in a series of competitions). This information is not sufficient for controlling the athlete's condition.

To assess the athlete's preparedness and revise the training plan, experts and analysts must have information about his/her condition in numerical format—in the form of so called achievement indices. This approach permits to make an integral estimate of different functional systems and not to confine oneself to calculation of shifts in separate parameters. When we compare two different impacts on a system, it does not matter if they are similar or not. Important is the effect they produce. Two similar test results may be caused by completely different impacts, and two different states of the system may be characterized by similar test results. For this reason, it is important to use specific numerical indices, which permit to assess (or classify) the state of the organism as a measure of its development. In this case, estimation is based neither on the previous condition, nor on values of separate parameters. The key criterion is "the shape of an achievements curve" determined by an absolute value of a corresponding index and its balance with the indices of potential capacity and effectiveness.

In our work, we used several coefficients and indices, which were necessary for specialists of the control levels 4 and 5 to analyze the information coming from the lower control levels. Let us assume that: current preparedness of an athlete is his/her performance achieved at the current level of his/her physical qualities after completion of previous training programs; resource level of development is athletic performance that the athlete would be able to demonstrate at the current level of his/her physical, psychological and technical development, if such an objective was set; potential level of the athlete's development is athletic performance that could be achieved, if the athlete developed his/her qualities and eliminated restrictions while using available training means and methods.

To calculate numerical parameters for each of the levels, we used specific coefficients. Coefficient of Potential (CP) reflects capability of an athlete to achieve a particular rating in his/her sport discipline. It should be expressed either in absolute values, or in points earned in the World Cup events (in skiing, biathlon, etc.). Generally speaking, it is a mathematical function of a set of parameters, which are crucial for achieving top results in a particular sport discipline.

CP = ∫ (dynamics of performance, age, morphological features, aerobic and anaerobic qualities, strength, condition of muscles, effectiveness of movement technique, efficacy of competitive performance, movement coordination, general fitness, psychological status, use of dietary supplements).

Successful and long performance in top athletic competitions depends on many factors.

Input data for CP calculation are derived from the results of profound medical examinations and regular Stage Complex Examinations, which are unique for every sport discipline.

Coefficient of the Current State (CCS) reflects current condition of an athlete (his/her physical, technical, and tactical preparedness) on the base of data obtained in the course of Routine examinations, Complex Stage examinations, and Assessment of Competitive Performance.

Coefficient of Physical Fitness (CPF) reflects development of key physical and motor qualities, which are specific in a given sport discipline. CPF is calculated on the base of data recorded during Complex Stage Examinations and Routine Examinations.

For example, in skiing CPF = ∫ (morphological structure, condition of the cardiovascular system, aerobic capacity of arm and leg muscles, strength of arm and leg muscles, alactic capacity of arm and leg muscles, glycolytic capacity of arm and leg muscles, efficacy of physiological precesses).

Coefficient of Technique Effectiveness (CTE). In cyclic sports CTE characterizes mechanical and

metabolic efficacy (aerobic, lactic and alactic components of energy supply) of competitive performance.

CTE is calculated as the ration of competitive velocity to energy consumption (both metabolic and mechanical) energy):

$$CTE = V(m/s)/\sum W$$

Coefficient of Implementation Efficiency (CIE) demonstrates how effectively an athlete uses his/her motor, coordination, technical, and tactical capacities during competitions.

It is calculated as a ratio of the result (R) achieved in a sport season (or in a competition) to an integral index of the athlete's physical (CPF), technical (CTE), and coordination (CCP) preparedness.

$$CIE = R/\sum CPF,CTE,CCP,$$

where CCP—Coefficient of Coordination Preparedness.

Numerical data related to the current condition of an athlete, potential capacity of every system of the athlete's organism, and dynamic changes in his/her condition during the previous training period permit to develop an individual training plan for each athlete taking into account individual biological peculiarities. Routine planning is referred to as Tactical planning and is based on "current state" of the athlete's organism. Strategic planning is based on the current "resource level" of the athlete's condition, while Probabilistic planning is based on the ever possible "potential level" of the athlete's development.

A training plan is developed in the course of routine planning. It is aimed at solving particular tactical tasks of training for a given time period. Strategic planning permits to change time limits and modify training objectives. In the course of Probabilistic planning a goal of reaching the maximal athletic development is set. Probabilistic planning carries inherent risks—it may lead to a great success or considerable losses.

To analyze dynamics of training, we use a notion "current preparedness" that is defined as the ratio of athlete's current condition to his/her "resource level". Each athlete has "latent reserves" which are defined as the ratio of his/her "resource level" to his/her "potential level". General estimate of athletic preparedness is determined as the ratio of athlete's "current condition" (current achievements) to his/her "potential level" of development. "Potential level" of an athlete is always higher than his/her "resource level", and the "resource level" is always higher than his/her "current level" of preparedness. These characteristics are not constant. Individual limits may change (either increase, or decrease) under the effect of internal and external factors.

Initial data for calculation of all indices and coefficients are derived from test results. To make reliable estimates, the experts of the 3rd level of control must operate with data registered with the help of standard testing procedures (which are held by specialists of the 2nd level).

Current planning in athletic training consists in developing of an algorithm of application of training methods aimed at reaching attainable goals. At the same time Administers (the 5th control level) must develop resource (or long-term) plans aimed at raising athletic performance to the maximal possible level.

Experts at the 4th level of control must develop and use an integrated model of the training process. In our work, we used simulation models of the main body systems [12], models of human movement control based on artificial intelligence [13], a computational model of metabolic processes in a human organism [14], a model of risk assessment on the base of hierarchy analysis [15].

3.5 Prognosis

When training plans for the forthcoming season are approved by the administers of the 5th control level, they are passed to the experts of the 4th level, who must use specific methods to assess the related risks. As soon as the experts of the 4th level get information from the lower control levels, the system starts functioning, and the initial training plan is subjected to

appropriate modification aimed at reaching the long-term training goals. Our model clearly demonstrates that even a very good training plan will not provide for top sport results, if it is not modified regularly taking into account current condition of the athlete. As the main objective of sport training is to attain particular level of preparedness in a given time interval, the system must have a specific mechanism in the feedback chain that will correctly interpret error signals. This mechanism has been created and reflects the systematic character of training in a whole.

Information transferred by the experts of the 4th level to the administers (5th level) is related to: (1) analysis of the previous training period (training work executed by the athlete and his/her results); (2) development of long-term probabilistic plans for further training. The analysis of the previous training period permits to assess the training workload and estimate effectiveness of training means and methods used by coaches, examine reaction of the athlete's organism on training, reveal immediate, cumulative and delayed effects of particular training means at different stages of training.

Long-term probabilistic training plans help estimate attainability of training goals, assess risks and expected effects of training. Simulation modeling permits the experts to use actual information in abstract models and work at the new quality level.

4. Conclusion

To be effective, a system of control and management of athletic training aimed at preparation for major international competitions must take into account key issues listed below: (1) distinctive features of different sports, teams and athletes, which are crucial for elaboration of training plans, choice of appropriate training loads and methods, time and degree of the athlete's body response to training loads, control procedures and tools; (2) major principle that all components and their interrelation must be aimed at raising effectiveness of athletic training accomplished according to individual training plans; (3) providing coaches and sport managers with actual information necessary for development of long-term and short-term training plans and making well-reasoned decisions, as well as control over methodological validity of training plans and their amendment.

An effective system of control and management in athletic training must include a few interrelated components: methodological control over development of control and model characteristics for each athlete, procedures of their elaboration, processing, and release; data collection, processing, analysis and transfer to coaching staff for development of high-quality individual training plans; methodological control over planning on the base of individual features of athletes; registration of training loads performed by athletes; monitoring athletes' state and preparedness; control over real-time correction of training plans on the basis of unbiased factual information.

The program and algorithm of the control system in athletic training should employ information flows within a training macrocycle. This permits to solve predetermined tasks aimed at raising sport results at each training stage. The control system should be based on algorithmized and computer-managed technologies of gathering, processing, transfer, interpretation and storage of information.

Long-term practical use of this control system provided evidence that organizational structure of the control system in athletic training must include: (1) federal analytic center; (2) regional methodical centers and sport federations; (3) diagnostic laboratories for testing athletes under laboratory and field conditions; (4) purposive training of specialists involved in scientific support of the national sports teams.

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